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IN THIS ISSUE: In 2017, the conference committee accepted 434 abstracts for presentation and rejected 30 abstracts. Authors of accepted abstracts were invited to submit a full paper. A total of 101 papers were received, 83 papers were selected for peer review. Finally, 25 papers were accepted for publication in this issue. Additionally, two (2) Theme Track papers have been added to this issue. The organization of this issue follows the standard conference tracks listed in the table of contents.
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Welcome to the sixth issue of *Landscape Research Record*, published by the Council of Educators in Landscape Architecture (CELA). In 2013, the CELA Board approved and adopted a procedure to become fully responsible for publishing peer-reviewed conference papers annually and named the publication *Landscape Research Record* (LRR). LRR is a post-conference publication and published online only.

This sixth issue of LRR is a collection of peer-reviewed papers presented at CELA 2017 conference hosted by Tsinghua University, Beijing Forestry University, and Peking University in Beijing, China. The 2017 annual conference focused on research, scholarship and creative activity that highlighted the theme of “Bridging” which emphasized the exchange of ideas within landscape architecture, across disciplines and cultures, and the sharing of knowledge and experience.

This issue contains 27 quality peer-reviewed papers resulting from the conference. We hope you find them to be a collection of provocative and insightful research that enriches CELA’s dialog of research and creative inquiry on the processes of debate and discussion.

Bo Yang, PhD, PLA, ASLA  
The University of Arizona  
Editor-in-Chief, *Landscape Research Record No. 6*  
CELA Vice President for Research & Creative Scholarship 2016-2018
REVIEWERS

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Lynne Manzo
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COMMUNICATION AND VISUALIZATION

Edited by Bambi L. Yost & Jon D. Hunt
IMPACTS OF IMMERSIVE VIRTUAL REALITY ON THREE-DIMENSIONAL DESIGN PROCESSES: OPPORTUNITIES AND CONSTRAINTS FOR LANDSCAPE ARCHITECTURE STUDIO PEDAGOGY

SLEIPNESS, OLE R.
Utah State University - ole.sleipness@usu.edu

GEORGE, BENJAMIN H.
Utah State University - Benjamin.george@usu.edu

1 ABSTRACT
This study evaluates the potential of immersive virtual reality (VR) to impact the design process of students engaged in a landscape architecture studio design setting. Immersive VR has potential to increase students’ understanding of three-dimensional spatial impacts while making design decisions, potentially improving their design capabilities but poses challenges as well, particularly for collaboration and larger-scale sites with significant topographic features. Following observation students’ engagement with a VR-based project, a survey, questionnaire, and focus group discussion solicited feedback from study participants. Participants self-reported improved awareness of the three-dimensional spatial relationships within their designs, and an improved ability to visualize these relationships. Results suggest VR may enhance development of initial design concepts and understanding of spatial relationships. Students also reported that VR’s immersive interactions significantly altered their approach to designing—and hindered their ability to communicate with others within collaborative design activities. As with many emerging technologies, VR will potentially impact landscape architecture’s creative processes and will change how the discipline is taught and practiced professionally. These potential transformative impacts will provide fodder for discussion as our discipline strives to maximize VR’s benefits while mitigating its challenges.

1.1 Keywords
Virtual Reality, Design Pedagogy, Technology
2  INTRODUCTION

2.1 Study Purpose

In this study we assess the use of immersive virtual reality (VR) as a mechanism for designing landscapes in a university landscape architecture design studio. VR has the potential to be a powerful tool to help facilitate design because it provides the designer with the ability to design a landscape in three-dimensions and digitally in-situ. This ability to design immersively may be particularly valuable to novice and less-experienced designers—many of whom find it cumbersome to visualize a design in 3-dimensions while laying out the design in 2-dimension, either on paper or on a computer screen. The advent of easily accessible 3-dimensional modeling software, such as Sketch Up, has provided designers with a more effective method for visualizing their designs in the 3-dimensions, but these programs still fail to provide a truly immersive site experience as the designer is designing the project from without the site and is constrained by the software interface. By utilizing immersive VR as a design mechanism, we theorize students may improve their design abilities and outcomes by situating them within their design site and increasing spatial awareness of their design decisions. However—within its current state of development—we also found VR impeded communication that landscape architects are accustomed to using during collaborative design activities, and its application to larger sites with significant topographical character is severely limited. Consequently, the discipline of landscape architecture must grapple with the potential ramifications of VR on the scale and collaborative character of design—within university-based design programs and beyond.

2.2 Background

Definitions of virtual reality (VR) vary; methods of both immersive and semi-immersive visualization both are commonly described using the term. In this research, we examine the use of immersive VR, which Castronovo, Nikolic, Liu & Messner (2013) describe as a computer environment that crafts a “convincing illusion and sensation of being inside an artificial world.” This illusion of reality can potentially make VR a powerful design tool, especially if designers can grapple with the complex physical realities of a site while simultaneously designing on the site as they are completely embedded in the virtual world, with the ability to interact visually, audibly, and physically (Slater and Usoh, 1993). Ability to meaningfully interact with the digital elements within virtual reality is a crucial element that provides the viewer with a rich and immersive experience (Grau, 2003). VR headsets, such as the HTC Vive and Oculus Rift, are an example of immersive virtual reality. By comparison, in semi-immersive VR the viewer is only partially enclosed by the virtual world in any number of sensory inputs (e.g. visual, audible, physical). Popular implementations of semi-immersive VR include CAVE VR systems or large wrap-around format screens on which imagery is projected. While semi-immersive VR has been proven as a powerful visualization tool, the sense of presence within the virtual world is significantly less compared to immersive VR (Hoffman, Richards, Coda, Richards, & Sharar, 2003; Stevens & Kincaid, 2015).

As an emerging technology, VR has begun to establish a track record in design education, with many examples of semi-immersive VR as an effective mechanism for visualizing landscapes. However, these uses of VR are passive and do not utilize VR’s spatial capabilities to facilitate design making in real-time. Portman, Natapov, and Fisher-Gewirtzman (2015) conducted a review of research on VR in the design fields and found that, especially in landscape architecture, VR has been primarily used as a visualization tool. Similarly, Freitas and Ruschel (2013), in evaluating the use of VR in architectural design, found that nearly all of the published research assessed VR as an evaluative visualization tool in the design process. Bullinger, Bauer, Wenzel, and Blach (2010) demonstrated that semi-immersive VR could positively impact the design process by evaluating a design through VR at different stages of design development. Similarly, Castronovo, et al. (2013) concluded that both immersive and semi-immersive VR are effective mechanisms for critiquing and evaluating designs due to viewer’s perceptions of immersion within the design. VR can also be utilized to facilitate collaboration and other social interactions. Gu, Kim, and Maher (2011) utilized semi-immersive VR to facilitate collaboration among individuals, and Dunston, Arns, and McGlothlin (2011) had users collaboratively interact with virtual design elements in an immersive setting.

VR’s ability to increase spatial-related factors has motivated the design disciplines to apply the technology. Castronovo et al. (2013) note that VR can present spatial information more accurately and in more quantity than conventional means, leading to improved spatial awareness among viewers. George
(2016) successfully utilized VR to conduct a remote site analysis and found students were able to accurately interpret spatial site qualities. However, Gill and Lange (2015) and Lange (2011) caution that VR separates users from the physical site and its sensory experiences, noting that individual users will apply different spatial and value perceptions to the site regardless of the level of detail used in the visualization. Moreover, designers within VR cannot smell the site’s aromas, feel its wind and weather, or experience all the serendipitous facets of the site such as the onset of changing weather, encounters with wildlife or strangers, or hear all of its ambient sounds. Portman, et al. (2015) noted that VR improves spatial conception when used to visualize a design. Bullinger, et al. (2010) have raised concerns that semi-immersive VR does not provide sufficient spatial immersion to assess design ideas. However, Rahimian and Ibrahimi’s (2011) study, which utilized non-immersive VR, found that VR encouraged students to more meaningfully consider the three-dimensional nature of their design work.

Except in the case of Rahimian and Ibrahimi (2011), the literature describes VR’s design application as interpretive—whether visualizing a site or design, the viewer’s experience is fundamentally defined as consuming rather than generating spatial information. Very little research has been conducted VR’s application in generating spatial information—how it can facilitate the actions of designing. While Chamberlain (2015) explored the use of VR to generate hypothetical cityscape scenarios but the scale and tools used would preclude the design of site-scale landscapes. The lack of exploration into design creation with VR may largely be attributed to technology. Prior to the release of Oculus’ VR headset in 2015, VR headsets were cumbersome and expensive; VR’s ability to input information from hand gestures became affordable when HTC released the Vive VR headset in 2016. Based on the ability of immersive-VR to provide immersion and improved spatial awareness, the possibility to utilize VR as a design input tool in addition to its visualization capabilities, provides abundant opportunities for research.

3 METHODS

This study describes VR’s impacts, opportunities, and constraints as a design tool. The study’s sample (n=29) was drawn from a junior-level recreation design studio course in an accredited landscape architecture program in the U.S. A total of 24 undergraduate students were enrolled in the course, comprised equally of males and females. An additional three female and two male graduate level MLA students also participated in the studio. First, students were asked to self-assess their proficiency and use of both digital and hand graphic representation techniques. Next, the study utilized a qualitative singular case study approach, conducted over two scheduled studio sessions totaling six hours, to evaluate students’ feedback on VR programs (Yin, 2008). Initially, students were divided into groups of five groups, each comprised of five or six students. Teams were provided a design problem statement. The problem statement—based on the concept of Park(ing) Day—instructed students to design a micro-scale park in VR that would replace a parking stall and include several common landscape features such as seating, vegetation, and site fixtures. Within their assigned teams, students used an HTC Vive, an immersive VR headset that features handheld “wands” that track the user’s physical movements and enable the user to input data and draw through gestures. The students used SculptrVR, a 3d modeling program in which to build their designs using a similar gestural process.

In their teams, each team of students occupied a designated studio space and took turns collaboratively designing a micro park. While one student worked in VR, the remaining students in the team observed what was created in VR by watching their VR colleague gesture within their designated physical space and the progress of their design a large monitor. The observing students provided feedback and suggestions to their colleague in VR. Despite receiving this feedback, the design exercise was largely individual in nature, due to the agency provided by the VR controls. During this activity, the researchers observed and documented the process through notes, photographs, and video. This observational data provided one set of data for analyzing the way in which they interacted with the medium and its impacts on their design process. At the conclusion of the project, the researchers held a focus group session with the students to discuss their experience with VR and allow the students to vocalize their observations on the affordances and constraints of the medium.

4 FINDINGS

According to students’ self evaluation, designing in VR significantly impacted student’s approach to design, particularly in their awareness of spatial considerations and improved freedom of expression. Students responded positively to VR’s ability to enable them to immediately understand the 3-dimensional
nature of their design and to consider their design decisions’ spatial impacts. Consequently students reported they were much more cognizant of their design decisions’ spatial impacts, than if they had designed the same project on paper or at a computer screen. Students also reported VR provided them with greater freedom of expression during the design, especially compared to designing on a computer screen. In particular, students felt the HTC Vive’s spatial tracking combined the benefits of both 3-D modeling and traditional drawing. Students were able to create 3-D models using SculptrVR by applying traditional drawing gestures, which they reported as a symbiotic creative relationship between digital and hand design production. Additionally, students were able to easily interact and move within their design, providing several serendipitous moments of discovery, during which they recognized ways to improve upon their design or add details.

Figure 1: A Student designs in VR while his colleagues provide verbal feedback.

However, the VR interface also presented challenges to design creativity and collaboration, and students reported frustration with some elements of designing in VR. While the learning curve for the VR headset was very short—students frequently commented on how natural it was to use—respondents felt SculptrVR’s software interface was not as intuitive or flexible as they would have preferred. Consequently, several students used only a few tools or colors in their models, because they found the process of adjusting the settings confusing or distracting. Additionally, because SculptrVR uses scalable cubes as the basic unit for modeling, students reported the modular cube geometry was distracting when attempting to create curved objects. Finally, although the exercise was designed as a collaborative activity, students found it awkward to collaborate with their colleague in VR. Students observing from outside of the VR could only provide vocal feedback to their colleague who was working within VR, which was both frustrating to both those within and outside of VR. Additionally, the images displayed on the monitor did not accurately convey
the design that was being created and experienced by the student in VR, leading some observing students to make comments that reflected differences in perception between those in VR and those outside VR. Consequently, though the exercise was first conceived as a collaborative design activity, instead it became primarily an individual design activity, albeit with rigorous peer observation and feedback.

Overwhelmingly, students responded favorably to using VR, reporting that VR helped facilitate their design work by improving their spatial awareness of their designs in real time. Their responses confirm VR’s spatial benefits—realized for decades as visualization tools—are equally applicable to designing within VR. They suggest VR has potential to greatly impact the pedagogy and practice of landscape architecture as the technology matures. Improved spatial awareness during the design process and its impact on development of their designs are among the technology’s positive impacts reported by the students. For instance, one student commented how VR helped her “better understand how important scale is, even in simple design tasks.” Another commented that it “was easier to get a feel for dimensions and the relationships” in the design. Another student described how he was “more aware of the space elements take and that every step of the design process affects actual space” impacted his design process. These comments demonstrate the immediate and beneficial impacts that VR can have on students learning to design. Many of the students felt that their experience with VR would directly benefit their design work outside of VR because they were now more aware of the need to think 3-dimensionally.

Despite students’ positive feedback, there are drawbacks to the use of VR to design. The drawback most immediately apparent to the students revolved around the cube-based geometry that SculptrVR uses, which hampers creation of curvilinear, naturalistic, or organic forms—or at best adds a geometric texture to organic forms. Consequently, resulting designs had a rough quality several students found frustrating. Students referred to their designs as “blocky” and found the visual aesthetic of the program to be distracting. A lack of high degree of fidelity limits students’ abilities to create detailed or refined design elements and forced them to instead focus on general concept development within their design. From a pedagogical perspective, this limitation can be interpreted either negatively or positively. Those attempting to use SculptrVR to develop refined and detailed design decisions may find the technology ill-suited for their purposes. However, just as design faculty often limit the palette of graphic tools available to their students to limit precision and instead produce broad, conceptual, and bold gestural designs, SculptrVR may be viewed as akin to a thick marker or soft charcoal pencil. Realistic awareness of the graphic limitations of VR will enable users to determine appropriate applications for employing the technology.

5 DISCUSSION
In its current level of development, SculptrVR’s ability to facilitate collaborative design was more limited than anticipated. Students found collaborating and discussing within VR to be difficult. Occasionally, students within the VR found it difficult to implement suggestions from viewers, because they had to rely on listening to verbal suggestions and subsequently try to implement those suggestions in a visual manner to the best of their understanding. Similarly, some viewers found clearly vocalizing their feedback challenging. This led the students to recognize how heavily we rely on visual language to communicate design ideas. This was complicated by the fact that the experience of the design from within VR is markedly different to the 2-D image displayed for the viewers on the monitor.
This led viewers to make suggestions that they may not have vocalized, had they been in the VR and immersed in the design. Likewise, students designing found receiving comments from those viewing their designs on the monitor confusing or not applicable, because the commenting observer had a false impression of the site based on their distorted view from outside VR. The differences in visual perceptions raises a concern with immersive-VR. In providing a fully immersed experience for the user, VR simultaneously cuts them off from the outside world. In this manner, their horizon of observation is severely
limited, making it more difficult for them to actively collaborate with others (Hutchins, 1995). Furthermore, this demonstrates the difference in collaboration effectiveness between semi-immersive and immersive-VR, as previous studies had found semi-immersive-VR were very conducive for collaboration (Gu, et al., 2011; Castronovo, et al. 2013). SculptrVR also supports multi-user design, in which multiple VR users can work on a design simultaneously over the internet. Future research should explore its ability to enhance the collaborative experience and its impacts on barriers to visual communication.

Additionally, scale and terrain—factors integral to designing within large sites—are currently limited within VR. SculptrVR allows the user to create large designs, and to rescale their designs once they have been created. However, this is only possible to a certain level—and it would be difficult for a designer to switch between significantly disparate scales without degrading the VR’s immersive spatial experience. For example, designs for a larger site, such as a twenty-acre park, would need to be created at a smaller scale that would not be immersive. Furthermore, the designer would be unable to “zoom in” on portions of the park to design at true scale, negating VR’s immersive benefits. Consequently, in its current level of development, the immersive value of VR is limited to smaller sites. Terrain also presents challenges within VR. While difficult, terrain models can be imported into SculptrVR; however the physical environment in which the designer occupies does not replicate the virtual world being shown to the user. As a result, it is not possible to physically climb a slope in VR in the same way that a person would physically engage a site, experiencing its full sensory and tactile characteristics. Instead, the VR user would walk through the geometry of the terrain.

This study suggests that in its current development, VR is best suited for smaller sites and during broad and conceptual phases of design. Students felt that VR increased their desire and ability to explore multiple design concepts, which suggests its suitability for early in the design process. Additionally, the lack of fidelity in the created model suggests VR is best employed in development of forms and spaces but prior to designing refined levels characterized by decisions on literal materiality. Similarly to a blank canvas, several students commented that they found it difficult to initiate a design in VR, and would rather have started their design exercise by first developing a set of very rough concepts on paper which they would then develop and explore in VR. Such a workflow would assist students in better visualizing their 2-dimensional designs as they rapidly iterate and shift back and forth between 2-dimensional sketching and VR.

Finally, using VR in a studio setting was not without technical challenges. Setting up and maintaining a VR system is relatively straightforward, but requires a level of technical expertise. The HTC Vive requires sufficient open space free of obstacles; approximately 25 square feet is needed. Additionally, because the Vive utilizes synched infrared base stations to track the position of the user in space, multiple VR systems cannot simultaneously occupy the same space where the infrared from the multiple base stations might interrupt the tracking of the individual VR units. Multiple VR systems must instead be set up in separate rooms, for simultaneous operation.

The students were overwhelmingly positive in their evaluation of the immersive experience and the intuitive nature of designing in VR. Students described the experience of being in VR as feeling akin to being situated on a site, and used terms as “in the design,” “in the site,” and “on site” to describe their experience. Students used these terms, despite the fact they clearly were not on site, and the digital workspace displayed by SculptrVR does not resemble a physical parking lot. Rather, students described the sensation of being present within their design concept, a sensation heightened by their ability to occupy, move throughout, their design through physically walking and by creating their design through physical gestures, in a similar manner to how a designer might walk across a site and use their hands to gesture or visualize the creation and placement of elements (Figure 1). As one student described her experience designing in VR: “It felt really different to be in the space. I didn’t have to think of how wide a space was. When I working with the VR, I was on site. I was going by what I felt on site.” Another was even more enthusiastic in describing her experience: “I absolutely love designing in 3-D! I felt so alive and connected to my design! I could literally experience whatever I imagined!” These comments—which reflect students’ excitement and positive reception of VR—also illuminate the need for caution. Within design, VR poses a double-edged sword. While its technological limitations may limit its scale and range of use, VR also possesses dazzling potential to deceive emerging designers into feeling they have experienced the reality and complexity of a site when they clearly have not. Designers’ ability to deeply know the limitations of their virtual world requires deep experiences the real one. Without protracted experiences within the real
landscape—and its manifold tactile qualities, sounds, smells, and physiological impacts—future generations of landscape architects will have no way of knowing what they are missing.

6 CONCLUSION

In this study we evaluated impacts of immersive VR on the design process of landscape architecture students. Based on researcher observations and participant feedback, the technology has the potential to enhance the visualization, spatial awareness and broad conceptual design abilities of landscape architecture students. However, in its current state of development, the technology also limits the scale, topographic character, and may limit the collaborative and sensory connections to that designers must cultivate to their colleagues and their physical site. Future research should explore whether VR—as the technology is refined—can be successfully applied in the design of larger-scale sites, especially those with significant topography. Additional explorations might also explore the application of immersive VR within the actual landscape of the site, to evaluate the impacts of ambient noise and other sensations on the design experience. And, additional studies might also compare the experience of designing in VR to similar analog three-dimensional design processes including physical construction of models using light-weight and moveable objects in true-to-life spaces. Comparative evaluation of designing three-dimensional spaces using VR vs. analog construction of mock-ups will provide additional clarity on their respective constraints, benefits, and impacts on collaborative design.

Throughout history, technological advances have transformed the habits and practices of cultures. Some may find VR’s current limitations outweigh its potential benefits. However, as VR continues to develop and its design capabilities evolve, landscape architecture should contemplate its potential impacts on our discipline’s habits, practices, and culture. Landscape architecture’s long-established culture of creativity and collaboration, enculturated in university design program studios, professional offices, and outreach activities will likely be impacted by VR, just as it has been by other once-emerging technologies. While some may presently regard VR as simply the latest novel design entertainment, its potential future indispensability as a design tool will have wide-ranging impacts on how we create, teach, and practice.

7 REFERENCES


DESIGN EDUCATION AND PEDAGOGY

Edited by Matthew Powers & Ashley Steffens
INTEGRATION OF LANDSCAPE PERFORMANCE INTO SITE ENGINEERING CURRICULUM

DIMOND, KIRK  
University of Arizona, Tucson, AZ, kirkd@email.arizona.edu

1 ABSTRACT
The breadth and depth of the profession of Landscape Architecture merits a comprehensive professional curriculum. With time intensive studio sequences and a myriad of supporting topics to introduce to students, typical landscape architecture curricula are tight. This challenge is expounded as pressures influence programs to consider changing from five years to four years, while most first professional graduate programs are already compressed to three years. Pedagogical goals and objectives need to be refined and synergies explored to continue to meet the core knowledge, skills, and applications of landscape architecture. As a recent addition to LAAB, Landscape Performance joins the list of topics under “Assessment and Evaluation” in the Professional Curriculum section of the 2016 Accreditation Standards, making it necessary to address how professional programs are including this important topic in their already tight curriculum. Through the Landscape Architecture Foundation’s Landscape Performance Education Grant, there are resources to aid in the incorporation of landscape performance into specific studios, seminars, and special topics courses, but this paper seeks to explore and describe the opportunities and challenges of integrating landscape performance into a core Site Engineering course while enhancing the learning experience in this technically challenging fundamental course. The format and objectives of Site Engineering at the University of Arizona were modified to include Design Decisions and Performance, with a focus of developing an understanding of design decision implications related to the four elements of Earth, Water, Fire, and Air with the means to measure and evaluate landscape performance in each. The success of the course was measured through use of student surveys, interview with the teaching assistant, use of an assessment rubric and an instructor reflection. Findings indicate that Site Engineering is a good fit for introducing landscape performance as required by LAAB Accreditation Standards. While challenges with time and progress in fulfilling other course objectives posed a challenge of prioritization, student understanding and awareness of measurable social and environmental aspects of the landscape helped enhance comprehension and meaning of typical site engineering course material.

1.1 Keywords  
Landscape Performance, Site Engineering, Pedagogy
2 INTRODUCTION

2.1 LAAB Standards and Landscape Performance

Landscape Architecture professional curriculum is tight. The diversity and complexity of landscape issues require extensive knowledge in many subject areas. A breadth of skills is also necessary to keep up with technologies and methods of analysis and communication. While professional development is a lifelong effort, landscape architecture students need a strong and diverse base to build on, to effectively serve the profession and communities for which they design.

In 2002, The American Society of Landscape Architecture (ASLA) crafted a Policy Statement that defined landscape architecture as:

“...Any service where landscape architectural education, training, experience and the application of mathematical, physical and social science principles are applied in consultation, evaluation, planning design (including, but not limited to, the preparation and filing of plans, drawings, specifications and other contract documents) and administration of contracts relative to projects principally directed at the functional and aesthetic use and preservation of land” (ASLA, 2002).

As indicated from the comprehensiveness and length of this and other definitions of landscape architecture, it is natural that professional curriculum of Landscape Architecture programs across the nation are challenged to give both educational breadth and depth in a variety of areas pertaining to the complexities of society and the built and natural environments. With tight frameworks of 4-5 years for undergraduate education (with many programs reducing from 5 years to 4), and 3 years for graduate education, it is challenging to provide a time intensive, studio-based education with a variety of emphases and priorities from one course to another. Efforts of instruction require extensive thought and planning to produce achievable educational goals and objectives that prepare students to enter this diverse profession.

To ensure a minimum level of student preparation based on the delivery of educational material, the Landscape Architectural Accreditation Board (LAAB) has been established to “evaluate, advocate for, and advance the quality of education in landscape architectural programs” (ASLA, 2017). To facilitate the evaluation process, the LAAB established seven standards for evaluation, including Standard 3: Professional Curriculum, which addresses the core knowledge, skills, and applications of landscape architecture that must be addressed in first-professional degree programs in the United States. Included in this standard are nine major themes followed by a varying number of sub-themes (LAAB, 2016). In the 2016 revision of the Accreditation Standards, “Landscape Performance” was added as a sub-theme under major theme of “Assessment and Evaluation” (Foundation, 2016; LAAB, 2016). This act requires all landscape architecture programs to demonstrate how this topic is addressed in their already-tight curriculum starting in the Fall of 2017. The thought of adding more educational requirements can seem daunting, however, as the profession evolves, the need for changes provides an opportunity for creative problem solving to address topics of such importance.

2.2 Landscape Performance

Since 2010, the Landscape Architecture Foundation (LAF) has been promoting Landscape Performance as “a measure of the effectiveness with which landscape solutions fulfill their intended purpose and contribute to sustainability” (Foundation, 2017a). Similar to Building Performance, popularized through the LEED rating system, landscape performance removes the focus on landscape elements and pushes the need for evidence-based design decisions that can be quantitatively assessed to demonstrate economic, environmental and social benefits (Wang, Yang, Li, & Binder, 2016; Yang, Li, & Binder, 2016). The increase of attention to this subject is timely with the launching of SITES v2 and the SITES AP designation. The LAAB’s decision to integrate Landscape Performance into the accreditation standards further emphasizes that many educators and practitioners agree – as LAF responded – that, “future landscape architects must be able to assess and communicate the environmental, social, and economic impacts of design solutions” (Foundation, 2016).

LAF provides both case studies (Foundation, 2017b) and resources for educators (Foundation, 2017c) to promote landscape performance. The ten existing examples from the resources for educators demonstrate integration of landscape performance into studios, lectures and seminars, but lacks examples of its application to core implementation courses. The effort described in this paper serves to fill that gap by integrating landscape performance into the core site engineering curriculum at the University of Arizona.
2.3 Site Engineering

Site Engineering is a typical course title that most commonly refers to the teaching of grading and drainage for landscape architecture students. This course, in its variations, serves as an important core part of the curriculum in accredited landscape architecture programs by directly addressing the major theme of “Implementation,” along with supporting many of the sub-themes required for LAAB accreditation.

As described in one of the common textbooks for the course, the focus of site engineering courses is to provide the “technical ability to transform design ideas into reality” (Strom, Nathan, Woland, & Lamm, 2009). As evidenced by the pleadings in this textbook and others (Sharky, 2014), often the perception of design and its connection to this course becomes muddled by the math heavy calculations and technical communication. Delivery of this content contrasts sharply with early design studios, where the “why” (Sinek, 2009) behind design work is emphasized with design principles and philosophical concepts as the foundation that leads to “how” and “what” of the design and communication. Site engineering often focuses on the “what” and “how” in a technical way first and primarily, with less engaging reasons behind the actions to explain the “why.” Few efforts to address this course have been recorded in pedagogical research publications. Among the few, Calkins (2002) recommended a strengthening of instruction to add green building in the construction/engineering course sequence, due to the lack at that time, based on survey results. She also recommended an additional course to “address green building from concept to implementation,” and to “tie everything together to strengthen a comprehensive understanding of green building in landscape architecture” (p. 93). Also relating to sustainability, Phillips (2009) proposes an integrated sustainable design curriculum model that includes discussion topics for construction/engineering courses among other core courses. She claims the model results in the integration of principles of sustainable design without largely changing the established course sequence. Most recently, Yglesias (2014) reports on efforts to reduce the emphasis on the “how to” of teaching materials in landscape architecture by using a comprehensive approach that includes history and theory to “cultivate [student’s] instincts” (p. 17).

The intent of this study is to explore and describe the opportunities and challenges of incorporating landscape performance with site engineering curriculum, which similarly strengthens comprehensive understanding of the subject areas without requiring a shift in the established course sequence. The hypothesis is that Landscape Performance can be the “why” for site engineering to provide students with a more robust and comprehensive knowledge of their design actions. By reformating the site engineering course to emphasize landscape performance, the necessary technical skills can be deeply engrained on a foundation of evidence-based design. The increase in understanding of the “why” of this technical work will reinforce creative problem solving processes with defined metrics for success and change the generally negative student perception of this course to be more positive and engaging. Linking creativity and technical skills in this way changes the traditional pedagogy of this course. This shift to a more holistic and engaging approach might better prepare students for professional practice where creative abilities are linked with technical knowledge and the evaluative tools provided by application of landscape performance.

3 METHODS

With support from a 2016 Landscape Architecture Performance Education Grant, LAR 554 – Site Engineering at the University of Arizona was modified from its standard course format as taught in the Fall of 2015 to a new format in the Fall of 2016, which integrated Landscape Performance. The course objectives were enhanced from the previous year, with attempts to expand upon the course and not diminish any existing objectives (see Table 1).

<table>
<thead>
<tr>
<th>Table 1. Site engineering course objectives comparison.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall 2015</strong></td>
</tr>
<tr>
<td>Be able to graphically communicate your work using appropriate symbols and notation using both hand drafting and AutoCAD.</td>
</tr>
</tbody>
</table>
**Design Decisions and Performance**

Develop an understanding of design decision implications related to the four elements of Earth, Water, Fire and Air with the means to measure and evaluate landscape performance in those areas.

**Comprehension and Skills**

Develop a thorough working knowledge of the conceptual approaches to grading and drainage through understanding the trade-offs and synergies for social and environmental welfare related to:

- Human safety, comfort and universal accessibility
- Surface water management
- Aesthetic and spatial perception
- Environmental health and stewardship

Demonstrated the ability to professionally complete grading for relatively simple sites that include both hard and soft surfaces.

Have developed a thorough working knowledge of the conceptual approaches to grading and drainage. By doing so you should be able to transfer this knowledge to a variety of similar situations.

Be able to review site grading and drainage plans and note deficiencies and areas of special consideration.

Know the appropriate uses of simple survey instruments and how to skillfully use equipment in various situations to obtain desired information.

Interpolated contours based on a grid using various techniques.

Four tools were used to observe and record the opportunities and challenges of integrating landscape performance into the site engineering curriculum, and measure the success of the course in meeting the learning objectives resulting from the incorporation of landscape performance. Student Surveys, a Key Informant Interview, an Assessment Rubric, and an Instructor Reflection were each analyzed to evaluate the course both in comparison to the success of the course in the previous semester and as a stand-alone evaluation.

Landscape Performance Introductory Surveys were distributed to the students enrolled in the course at the beginning of the semester to evaluate pre-knowledge related to landscape performance. 17 out of the 17 enrolled students completed the voluntary survey during a lull in class time. The same questions were distributed in form of a survey to the students after the semester ended and resulted in 6 out of 17 respondents. The teaching assistant (TA) for the course was interviewed after the semester had ended as a key informant in evaluating the success of the course. The TA took the course as a student in the previous year with the same instructor, and was asked to reflect on and critically compare the similarities and differences of the course between the Fall of 2015, without the integration of landscape performance, and the Fall of 2016 with the integration of landscape performance. An assessment rubric was also created based on the objectives of the original course and used to assess the level of fulfillment as demonstrated in the student’s final comprehensive project in both the Fall of 2015 course without landscape performance, and the Fall of 2016 course with landscape performance. Finally, an instructor reflection was crafted promptly at the end of the 2016 class as a response to the Landscape Architecture Foundation requirement for the Landscape Performance Education Grant. This reflection was written before reading the student survey results and before the key informant interview was conducted.

Most weight in this study is put on the student survey responses and the key informant interview to minimize bias. The assessment rubric and teacher reflection, both produced by the author before reviewing...
the surveys and interview, are used objectively to demonstrate agreement or disagreement to the survey and interview.

4 COURSE DESCRIPTION AND RESULTS

4.1 Course Description

LAR 554 – Site Engineering is a four credit hour course intended for first professional graduate students in the LAAB accredited Master of Landscape Architecture program at the University of Arizona. The course is recommended to be taken in semester one of six along with a heavy load of other courses, including Design Studio I, Plant Materials, Landscape Analysis, and Contemporary Landscape Architecture, totaling 19 credit hours. Being in the first semester of the first professional degree program, students are not expected to have prerequisite knowledge of site engineering or landscape performance. In addition to site engineering topics, primarily grading and drainage, the course also serves as the program’s primary introduction to drafting software.

In the Fall semester of 2015, the course was structured after the traditional way it had been previously taught (see Table 2). The sequence of material started with simple problems that progressively grew to be more complex, loosely following the associated textbooks. This approach introduced key forms and elements with defined parameters to be communicated with contour lines in plan view by using the slope formula and interpolation. Principles and calculations related to stormwater management were later introduced and a final project tested the student’s ability to provide and communicate positive drainage and detention for a simple site with a building slab, parking lot, path, and street with few grading constraints.

Table 2. Site engineering course material sequence and comparison.

<table>
<thead>
<tr>
<th>Contours and communication</th>
<th>Earth:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpolation and Slopes</td>
<td>Contours and communication</td>
</tr>
<tr>
<td>Surveying Tools</td>
<td>Interpolation and Slopes</td>
</tr>
<tr>
<td>Swales</td>
<td>Streets and Swales</td>
</tr>
<tr>
<td>Slabs</td>
<td>Accessability (Start of Landscape Performance)</td>
</tr>
<tr>
<td>Roads, Curbs, and Shoulders</td>
<td>Slabs</td>
</tr>
<tr>
<td>Intersections</td>
<td>Cut and Fill</td>
</tr>
<tr>
<td>Stormwater Management</td>
<td>Water:</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Stormwater Management</td>
</tr>
<tr>
<td></td>
<td>Permeability</td>
</tr>
<tr>
<td></td>
<td>Quantity and Quality Measures</td>
</tr>
<tr>
<td></td>
<td>Rainwater Harvesting</td>
</tr>
<tr>
<td></td>
<td>Fire and Air:</td>
</tr>
<tr>
<td></td>
<td>Soil Compaction</td>
</tr>
<tr>
<td></td>
<td>Safety and Visual Access</td>
</tr>
<tr>
<td></td>
<td>Thermal Comfort</td>
</tr>
<tr>
<td></td>
<td>Synthesis and Reflection</td>
</tr>
</tbody>
</table>

In the Fall semester of 2016 site engineering course, the order and delivery of material was restructured to facilitate the integration of landscape performance. The course was refocused into modules centered on the four elements of Earth, Water, Fire and Air, which served as an organizational strategy that broadly encapsulates the various forces involved in site engineering. Each module involved weekly lectures and individual assignments that covered many of the principles from the previous version of the course, but consolidated and ordered them to facilitate relevant discussions related to landscape performance. Performance topics discussed were focused on (1) Human safety, comfort, and universal accessibility, (2)
Surface water management, (3) Aesthetic and spatial perception, (4) Environmental health and stewardship, each pertaining to one or more of the four modules. Class field exercises associated with each module were also used to more tangibly reinforce the classroom conversation and to give examples of measuring performance on the campus landscape. Rather than building on complexity, lectures and assignments naturally transitioned to the following subjects, and the final project allowed for comprehensive synthesis of the information, including diagramming and reflection relating to social and environmental landscape performance as a supplement to the grading plan construction document.

AutoCAD tutorials were concurrently introduced in the beginning four weeks of both versions of the course as the primary introduction to this tool for the MLA program curriculum. Early exercises were hand drafted to fill the gap for the software learning curve and focus on landscape performance began at the end of the AutoCAD orientation with a kickoff webinar provided by LAF. The first four weeks allowed for introductory concepts, language, and communication for the course to be introduced as a foundation to the later conversations about landscape performance.

4.2 Student Surveys
The student surveys asked enrolled students to reflect on six questions before covering the subject early in the semester (pre-survey), and after the semester concluded (post-survey). Both surveys were identical, asking: 1) What is Landscape Performance?; 2) How does Landscape Performance affect people?; 3) What measures are available to measure landscape performance?; 4) What are some landscape elements or strategies that may affect landscape performance?; 5) How would you rank your overall understanding of Landscape Performance (circle one) with 1-5 indicating Low Understanding, Moderate Understanding, and High Understanding; 6) What thoughts or questions do you have about Landscape Performance?

The most quantifiable question was number five, which showed a self-assessed increase in student understanding of Landscape Performance from an average level of 2 (Range 1-3) to 3 (Range 2-4) by the end of the course. Question one suggests a confirmation of this increase in understanding with 1 out of 17 pre-surveys using the term “measure” in their definition of what is Landscape Performance, compared to 4 out of 6 post-surveys using the same term in their response. Question six also indicates that the majority of responses in the pre-survey questions were merely a guess, as many repeated question one here as their response. In the post-survey question six indicated a curiosity to learn more, asking about other resources, databases, and studies related to landscape performance.

While most of the questions demonstrated a more informed response to the post-survey compared to the pre-survey, the response to question four remained consistent between the two surveys. The question asked for elements or strategies that affect landscape performance, which had many students responding with elements such as water, drainage, sun/shade, air quality, transportation, culture, vegetation, materials, and strategies such as green infrastructure, constructed wetlands, passive and active water harvesting, accessibility and way finding, maintenance, shade, and filtration. Most of the wording and descriptions seemed to indicate site scaled responses to landscape performance, with exception of two of the post-survey responses addressing contextual location and climate.

4.3 Key Informant Interview
The Key Informant Interview with the Teaching Assistant (TA) of the course was important to establish some of the differences between the course in the Fall of 2015 and the Fall of 2016. The TA originally took the course in the Fall of 2015 as a student, and was in attendance for the delivery of all of the 2016 changes. He was asked to 1) explain how the courses differed, 2) address how the conversation and activities of landscape performance factored into the new course, 3) assess the preparation of the students, 4) describe the clarity of information presented in relation landscape performance, and 5) give other observations and feedback.

When asked about his previous experience taking the course, the TA confirmed some of the connotations associated with the class, saying that he and his classmates referred to it, as “the class where we have to learn grading.” He described the content and delivery as a “progressive linear ramp up of complexity” and confirmed the focus on the “how” and “what” with his summary of the approach being, “here are some tasks that you’ll be expected to do in professional practice… we will teach you how to do those things.” He positively described the new organization as “Segments of a broader idea that get packed together and synthesized at the end of class.”
The TA explained that the value of adding landscape performance to the class in 2016 created a stronger connection between the engineering side and design side of landscape architecture, and that the engineering was “more digestible” in that frame of reference. He felt that students engaged in this material would be better-informed designers in their approach even at a conceptual level compared to student gain from the prior delivery that merely provided a simple understanding about “direction of water and what slope is for purposes of site analysis.” Regarding technical skills, he felt that students are “equally prepared or better” in the 2016 course, but suggested that much of that may be due to the restructuring of the course. As a parting comment, he expressed that it is important, but also a challenge, to continue the conversation of landscape performance outside of class.

4.4 Assessment Rubric

To further compare the difference in the site engineering classes between the Fall of 2015 and 2016, an assessment rubric (see table 3) was adapted from the University of Arizona MLA Learning Assessment Rubric to be based on the learning objectives of the original course. This rubric was used by the investigator to assess the level of fulfillment related to communication, content, and comprehension as demonstrated in the student’s final comprehensive project for both the Fall 2015 and 2016 versions of the course and compared between the classes (see table 4). The scale used is as follows: 1 – Unsatisfactory, 2 – Meets Requirements, and 3 – Exceeds Requirements.

Table 3. Final project assessment for site engineering.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Communication</th>
<th>Content</th>
<th>Comprehension (Synthesis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3- Exceeds Requirements</td>
<td>The student presents clear and concise technical communication. Drafting is precise and demonstrates clear hierarchy of information with appropriate use of symbols and notation.</td>
<td>The student demonstrates a high level of response to the project prompt and other resources provided in class demonstrating in-depth detail. The student is able to go beyond the focus of the content by demonstrating how the plan fits into a wider context of theory and practice.</td>
<td>The student’s design demonstrates technical accuracy and innovation. The student is able to synthesis diverse aspects of site engineering including grading, drainage, vegetation, layout, and earthworks into a comprehensive and complex plan.</td>
</tr>
<tr>
<td>2- Meets Requirements</td>
<td>The student presents work clearly but layout, precision and hierarchy could be more comprehensive.</td>
<td>The student demonstrates understanding of the content and mostly responded to the project instructions, but may have omitted some necessary information.</td>
<td>The student’s site engineering plan is primarily technically accurate and understandable to reviewers. Most of design variables are coordinated into a cohesive plan. The construction techniques are feasible, but in some cases, may need to make minor adjustments to their approaches</td>
</tr>
<tr>
<td>1- Unsatisfactory</td>
<td>The student fails to communicate a clear grading plan. Organization is unclear and appears incomplete.</td>
<td>The student demonstrates only a minimal knowledge of the information needed to communicate his/her ideas and fails to respond</td>
<td>The student’s design implementation concepts are not well developed and methods and techniques would fail if</td>
</tr>
</tbody>
</table>
completely to the project prompt.
implemented in the built environment.

<table>
<thead>
<tr>
<th>Score (circle)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Final project assessment scoring.

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>LAR 554 Fall 2015 (n=14)</th>
<th>LAR 554 Fall 2016 (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>2.00</td>
<td>2.13</td>
</tr>
<tr>
<td>Content</td>
<td>2.14</td>
<td>2.00</td>
</tr>
<tr>
<td>Comprehension</td>
<td>1.86</td>
<td>2.06</td>
</tr>
<tr>
<td>Overall</td>
<td>2.00</td>
<td>2.06</td>
</tr>
</tbody>
</table>

While the overall improvement from the Fall of 2015 to the Fall of 2016 is modest, it is noteworthy that the level of comprehension increased, suggesting a greater ability to synthesize the diverse course material into a comprehensive and cohesive plan. The decrease in “Content” involves the level of responsiveness to the project requirements and in class instruction, while the increase in “Communication” indicates improvements in graphic representation and precision.

The average score for individual projects from the assessment of the Fall 2015 version of the course creates a more normal distribution of scores (see figure 1), however the Fall 2016 assessment indicates more of a bimodal distribution with a greater divide between the upper and lower scores from the assessment (see figure 2). This may be indicative that the course changes helped improve the performance of some students within a middle group, while further inhibiting improvement among the lower scoring students.

Figure 1. LAR 554 Fall 2015 assessment histogram.
4.5 Instructor Reflection

The instructor reflection explained immediate observations of the opportunities and challenges that arose with the changes to the course in incorporating landscape performance. The reflection indicates that while students were required to think deeper about their work, some did get lost in more trivial material beyond the focus of the course. The interpretation of the student reflections also indicated an “emerging understanding” of landscape performance, which pertains to the mention of the opportune timing of the course being in the first semester of the three-year program. This allows students to further explore more on the subject through a variety of future courses and projects.

There is positive mention of the thoughts on Landscape Performance spurring the restructuring of the course content, but that much more time and planning would be required to develop additional resources and more fully integrate the field exercises into the regular lecture. Overall the reflection is positive with the desire for further refinement of incorporating landscape performance into site engineering.

5 ANALYSIS

5.1 Site Engineering as an introduction to Landscape Performance

The results from the student surveys, interview with the TA, Final Project Assessment and Instructor Reflection all suggest that integrating landscape performance into site engineering is positive as an introduction, but should not be a stand-alone course in addressing the LAAB requirement. This works well in this case with the course being taught as a first-semester course of a three-year graduate MLA program. In the student surveys, the ranking of overall understanding of Landscape Performance in the student surveys improved from an average of 2 at the beginning of the course to an average of 3 at the end of the course, with the free responses indicating a more confident and accurate definition of what is landscape performance. The average of 2 at the beginning of the class may be seen as an over confidence in their guess of what is landscape performance and their average of 3 at the end of the course is a more true assessment of their familiarity with the subject, but acknowledgement of the potential breadth of possibilities. This serves well to demonstrate that the students did gain with the integration of landscape performance into site engineering, but would further benefit with it seen as an introduction that may be reinforced and enhanced in personal study or follow-up courses. It should be noted however, that the response rate for the follow-up survey was low and is used as descriptive evidence and may not be reflective of the entire class.

Also evidenced in the pre-surveys, students indicate knowledge about techniques and elements that provide landscape benefits, and have an interest there, but seem to lack familiarity with the term landscape performance. The small step in reformatting the class to emphasize and reinforce language and communication for the awareness of landscape performance, without sacrificing the original learning
objectives of the course, indicates that the content is a good fit. However, limiting landscape performance to just site engineering perhaps gives a narrowed view regarding scale, and students would benefit from its application in other courses, especially those that may take a larger scale approach. Additionally, as indicated by the key informant interview, it is hard to keep the conversation continuing outside of class when it’s a solitary course discussing the subject. It may be beneficial to carry the subject into its follow-up course of site construction, as well as concurrent or proceeding studio and seminar courses.

5.2 Enhancing the learning experience

Overall the learning experience seemed to be improved from the course offering in the Fall of 2015 to the Fall of 2016. The results from the Key Informant Interview, Final Project Assessments, and the Instructor Reflection all suggest that the addition of content and conversation regarding landscape performance produced the “why” behind the “how” in site engineering. The TA spoke clearly about this advantage providing a strong connection between design and engineering, and the enhanced comprehension is further evident in the final project assessment.

While the interview with the TA along with the assessments and instructor reflection indicate a positive shift in learning, some issues are apparent. Even though the assessment average increased from one year to the next, there was a larger gap in the distribution of individual assessment scores, suggesting that not all students benefitted from the changes of the course and content. As indicated by the instructor reflection, some students had a tendency to get stuck on trivial matters when required to think more freely about the content. This may also relate to the course deemphasizing the “how to” approach, which may also explain why the assessment shows an overall decrease in the “content” score, which was based primarily on following instructions. As indicated, time was also a limiting factor potentially resulting in less individual instruction and feedback.

Also emerging from the key informant interview and instructor reflection is the question of the role the course restructuring plays in the outcomes of the two classes. While it is difficult to know what was the greater benefit, reformating the class, or incorporating landscape performance, the action of incorporating landscape performance forced the reformating of the course and provided more clarity to the content. The TA suggested that the advantage of technical competency in the students of the second class was likely due to the restructuring, whereas the instructor reflection indicated that time was a constraint in creating more cohesion between field exercises and classroom activities. The reflection also mentioned the need for further refinement for more full integration.

6 CONCLUSION

The purpose of this paper was to explore the integration of landscape performance into a core Site Engineering course to meet the new LAAB requirement and enhance the learning experience in this technically challenging fundamental course. It was hypothesized that Landscape Performance would give enhanced meaning to the site engineering material to provide students with a more robust and comprehensive knowledge of their design actions. The success of the course was described through use of student surveys, key informant interview, an assessment rubric, and an instructor reflection. Findings indicate that Site Engineering is a good fit for incorporating landscape performance, but as an introduction to the theme. Ideally the subject of landscape performance would be reinforced in follow-up courses to challenge students to more fully create defensible design solutions with a higher level of social and environmental sensitivity. It was also found that, generally, student understanding and awareness of measurable social and environmental aspects of the landscape helped enhance comprehension and meaning of typical site engineering course material without sacrificing necessary skill development.

7 REFERENCES

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SHAKING HANDS WITH THE LANDSCAPE: INTEGRATING PERCEPTUALIST THEORY INTO A LANDSCAPE ARCHITECTURE STUDIO CURRICULUM

SMITH, CARL
University of Arkansas, Fayetteville, AR, cas002@uark.edu

ERDMAN, KIMBALL
University of Arkansas, Fayetteville, AR, kerdman@uark.edu

BILLIG, NOAH
University of Arkansas, Fayetteville, AR, nsbillig@uark.edu

1 ABSTRACT
The paper introduces and provides a rationale for an interpretation of perceptualist, drawing-intensive methods of site engagement for a landscape architecture studio, and recounts some of the successes and the challenges of our approach. The studio drew on perceptualist theory as the means for understanding patterns, perceptions and processes on the Mt. Kessler Preserve in Fayetteville, Arkansas, a newly conserved 400 acre public resource. According to perceptualist theory, subsequent qualitative and quantitative data and knowledge enrich and frame phenomenological impressions. As is becoming more commonly recognized in landscape education, when a ‘checklist’ approach to site inventory and analysis is adopted there may be little thought to the sensorial responses a site elicits. However, the discrete elements that make up a checklist inventory are, in fact, overlays, interactions, or reinforcements that combine with aesthetic perceptions to define landscape character. This studio emphasized the importance of personal perceptions and reflections on what is ‘special’ about a landscape, with the objectives of developing a deeper understanding and demonstrating that objective knowledge will enrich and frame our perceptions. Since landscape architects are often solely responsible for communicating the aesthetic value of a landscape, the students were instructed in various methods of communicating poetics of place including site-sketching, temporary land-art installations, painting, composite analog/digital graphics, and character mapping. While the studio work itself was well-received by both art galleries and local land conservation organizations, and has catalyzed some important curricula changes within our unit, the approach was not without its challenges. The paper reports on some of the benefits and challenges of the shift in approach, while also suggesting possible areas for further modifications to practice to better incorporate perceptualism into landscape studios.

1.1 Keywords
perceptualist drawing, reflective interpretation, landscape architecture studio, phenomenology
INTRODUCTION

This paper presents work from a vertical landscape architecture studio conducted in fall 2014 at the Fay Jones School of Architecture and Design, University of Arkansas. The paper introduces and provides a rationale for our interpretation of a perceptualist method of site engagement and recounts some of the successes and challenges of adopting this phenomenological and drawing-intensive approach. The paper recounts no less than a sea-change in the approach and sensibility of a landscape faculty and reinforces the importance of, not only engagement with literature, but also with colleagues and peers in order to inform and develop design pedagogical practice. In a meta-sense, the paper—and the volume of which it is a part—makes a case for the importance of scholarly design communities, conferences and proceedings.

We were tasked with creating a pedagogy that could accommodate a range of design experience across three year levels of landscape architecture studios. The course needed to be accessible to the junior students but at the same time avoid redundancy and introduce hitherto unexplored skill-sets and sensibilities to their senior classmates. We alighted on the idea that we should task the students with a chiefly phenomenological exercise that utilized a common ability—the ability to experience your surroundings through the senses. Perception (use of the senses) as well as comprehension (understanding) has been posited as the key foundations for allowing a full aesthetic experience of a landscape (Bell, 2012). Perhaps the first, and most obvious benefit of taking a perceptual approach to site understanding, is that it utilizes, and is heavily grounded in, the sensory faculties common to most of us, rather than a rational comprehension that may require a good deal of technical expertise. The studio site was the Mount Kessler reserve some three miles from the campus and 1,500 acres in size. It is a rich, complex site; a mosaic of natural and cultural systems and phenomena, loaded with significance, meaning and memory—and potentially bewildering for students. How does one grapple with the complexity of a site like this? How does a student gain a toe-hold in understanding what this place is about; what makes it special; and what should the priorities for action be? Before moving on, it is worth pointing out that, as we move through the theoretical underpinnings of the work, sites that are local and easily accessible to a studio (either through proximity to the campus or through residential programs) may be the best candidates for this type of perceptual engagement. This is not a trivial matter, when considering the pressures for studios to address exotic, remote sites for high-profile, speculative competition exercises or similar.

2.1 Landscape architecture’s relationship with the perceptual

In Thomas Riedelsheimer’s 2001 documentary Rivers and Tides, Andy Goldsworthy Working with Time, the artist’s method is introduced—in his own words—as shaking hands with a landscape. That is, free of any a priori understanding of the natural or cultural processes at work, Goldsworthy responds to the patterns and perceptions he experiences that are then made manifest in his work: grounded in the nuances and specifics of that place. Often the sensory inputs that gives form to the works subsequently leads to a curiosity about what processes—be they hydrological, ecological, climatological or anthropomorphic—give rise to these patterns. The land-artists’ interest in grounding proposals in the poetics or drama of place has, at different times, been shared with the profession of landscape architecture. The garden designers of the 18th-century English Landscape School are often considered in this light, as they daringly turned their back on the established, formal tastes of the day that relied heavily on imposed geometries and axial relationships. Of course, the beautiful, picturesque and sublime landscapes of the English School were, in themselves, carefully staged scenes of artifice. For example William Kent’s landscapes drew on a background in set design to create evocative painterly scenes, but they were built off of the visual possibilities of the pre-existing landscape. Later, Humphrey Repton’s “Red Books” of water-colored scenes demonstrated the before and after design conditions for client approval. Like Kent and Lancelot Brown’s great garden estates, Repton’s plans were at least cognizant of the aesthetic potential of the landscape as it was found by the designer, what Brown called its inherent ‘capability’, a term he used so often it became his sobriquet.

By the close of the 20th century, landscape architecture’s interest in the visual romance of the land, its poetry and sensory appeal, has been often supplanted by a more codified approach. In his 1969 book Design With Nature, Ian McHarg posited that landscape interventions have to be founded in a full understanding of the myriad and layered but quantifiable characteristics of the land, beginning with the fundamentals of geology and working up to cultural patterns such as economics and land-use—though not the more nuanced facets of the social sciences (Farr, 2008). Furthermore, for all the careful construction of these layers, and despite the calls of contemporaries such as Aldo Leopold (1949) and Rachel Carson (1962)
to consider the wonder and romance of the environment, and others to understand place (for example, see Hiss, 1990), there is little room in this McHargian model for aesthetics. This more rational mode of site understanding has proved pernicious to other approaches to the reading and subsequent shaping of the landscape and a more holistic ecological literacy (Orr, 1992; see also Steiner, 2008). As suggested by James Corner (1991):

“It is not unfair to say that contemporary theory and practice [of landscape architecture] have all but lost their metaphysical and mythopoetic dimensions, promoting a landscape architecture of primarily prosaic and technical construction.”

This inventorial or checklist approach to comprehending a landscape aligns with the ‘integrationist’ or ‘cognitive’ school of aesthetic thought: that the scientific and historical underpinnings of a landscape must be understood in order for the viewer to appreciate natural and cultural landscapes and form an aesthetic response (Bell, 2012; Carlson, 2002; Rose, 1976; and Willard, 1980). This view contrasts with ‘perceptualist’ aesthetic persuasion, which holds that one’s initial aesthetic response to a landscape, either positive or negative, is not reliant upon an intellectual understanding, but that subsequently accumulated knowledge of site’s history, ecology, or other factors may alter or enrich the initial aesthetic perception (Bell, 2012). As instructors preparing for this studio we made the self-realization that we had all been trained in a more McHargian, integrationist approach to understanding of site analysis, with initial aesthetic perceptions minimalized, at best, or even not permitted to form due to being immediately immersed into a site’s inner workings and program suitability at the beginning of a project. We also realized that we, in turn, had been placing a similar emphasis in our own studios, and that while we had found this method valuable in its ability to gather and sort large data sets, we also observed that a primary focus on the quantifiable led to joyless studios with little emotional resonance between the students and the place; and the dreaded “analysis paralysis,” that left students with little inspiration from which to transition from the large amount of information they had collected about a site into a design. At the same time, we were aware of the increasingly poetic and perceptual approaches being adopted elsewhere as reported by Meyer (2005), and through our first-hand attendance at conferences and guest lecturing at other landscape architecture and design institutions. We were especially influenced by the writings on the four trace elements of landscape architecture (Girot 1999), and on creating knowledge as expounded by Seggeren et al. (2008) who suggest that:

“The ‘essence’, the character of a space must initially be approximated [by students] through intuitive analysis providing access to its complexity and a first overall expression”

As an educational experiment, we decided our vertical studio should emphasize the value of initial, uniformed aesthetic perceptions. We also wished to leverage and deepen our existing faculty expertise and interest in site-drawing which we recognized as a hugely important tool for cementing and communicating initial and developing understanding of place. Before moving on to a more detailed re-telling of our studio approach, it is worth summarizing the importance of site drawing, in particular its relationship with the understanding of place.

2.2 Place and place drawing

The traditional cartographic or spatial map—a typical product of the aforementioned McHargian approach to site evaluation and understanding—provides a great deal of objective and spatial (space) information. Understanding of place however, is quite different (Relph 1976). Christian Norberg-Schulz (1980) describes place as an amalgam of physical space, experienced phenomena and a perceived ‘spirit of place’. In describing the character of a landscape, Norberg-Schulz suggests a litmus test of language: can the landscape be described through nouns, prepositions and rich adjectives? If not, one is unlikely to have gained a full understanding of the landscape. In this context, McHargian layers of data and maps may be an inadequate starting point for site understanding, and Elizabeth Meyer (2005) notes a shift among environmental designers toward site readings and first-hand interpretations of place as a primary source for design inspiration. In particular, drawing in-situ allows the site reader to better commit what is being sensed and observed to memory, and access tacit emotions (Crowe & Laseau 1984; Graves 2012). When created
on-site, especially during the initial exposure to a place, drawings have the potential to capture an evocative spirit of place replete with deeply personal information on the spatial and characterful qualities of the land. In accordance with perceptualist theory, initial forays into a landscape can provoke uniquely insightful and impactful impressions on the reader, and this period can be especially powerful in stirring the reader's sense of creativity (Von Seggern et al. 2008) and curiosity (Bell 2012) in much the same way as reported in Riedelsheimer's aforementioned documentary on Andy Goldsworthy. In service to encouraging spontaneous recording of impressions and feelings, and privileging observation and presence, rather than craft and accuracy, site drawings can (should) be impressionistic and abstract, rather than literal and representational (Graves 2012). Still, they are very much grounded in a direct, personal understanding of place based on the senses and being present in the landscape.

3 STUDIO APPROACH

Our studio used a series of scaffolded projects, introducing skills that built on each other through the semester. This included four projects focused on Mt. Kessler: 1) an initial perceptualist reading of the landscape, including a land art installation; 2) a project integrating perceptualist character readings with cultural, historical and natural features; 3) a group character mapping of the entire site; and 4) site designs for various areas of Mt. Kessler. Each of these projects integrated skills and helped build dispositions in students that embodied the value of their aesthetic readings of the landscape, including how these perceptual understandings ultimately strengthened their site design.

For the 2014 vertical studio we attempted to break from the more traditional, inventorial method of site inventory and analysis and instead charged our students with adopting an initial visceral, immersive approach to understanding the landscape. We reassured them that there is no shame in documenting one’s own impressions and feelings in a site; to shake hands with a landscape and recognize its inherent patterns of light, texture, color and mood as an entry to identifying which underlying processes might be paramount in shaping the place, and which need to be considered through design and management. For this reason, information about the project site was withheld from the students from the onset of the studio until the initial site visit was made; the aim was to help students focus purely on their personal perceptions and aesthetic responses to the Mt. Kessler landscape, free of possible biases created by a priori knowledge of the site’s ecology and history, or even the intentions of the studio with regard to program and outcomes. During the initial visit students hiked up the mountain and the first project was introduced. After camping that night on the mountain, students explored the following morning on their own, tasked with filling a 24” x 240” paper roll with drawings on site, causing them to have to literally sketch on the land, imbuing their work with the qualities of their subject (see Figure 1). They were asked to communicate the patterns and moods they perceived, cognizant of what they sensed and imagined around them.
Figure 1. Students were tasked to communicate initial perceptions of patterns on Mt. Kessler through loose, abstract sketches on a large roll (left). Verbal explanation of these observations was then shared back in the classroom (right) (2014). Photos by authors.

The following week students returned repeatedly to the mountain as they sought suitable locations to create an ephemeral art installation, a la Goldsworthy, from found objects (see Figure 2). Rather than integrationist or cognitive, this approach again aligned with perceptualist aesthetic theory, which posits that a true and authentic initial appreciation of a landscape requires an exposure to ‘free beauty’ and an absence of ‘will’; and that a more prosaic understanding compromises our abilities to ‘lose ourselves’ and fully appreciate our surroundings (Bell, 2012). These initial forays onto site has been operationalized by French landscape architect and academic Christophe Girot as the acts of “landing and grounding”; arrival at a place and the formation of intuitive impressions, followed by discovery and understanding through study, immersion, orientation and rootedness (Girot, 1999).

Figure 2. Observed patterns were made explicit through temporary art installations on the mountain (2014). Photos by authors.

Following this initial reading, we immersed our students in more traditional site inventorial procedures, deeply studying the landscape character that is a result of cultural, historical and natural features, patterns, and phenomena that shaped the site (Hough, 1990). Efforts included class and on-site
meetings with residents, scientists, historians, advocacy groups, officials, and designers, coupled with data-gathering exercises that included additional site visits and topical reviews of literature and other available forms of documentation. For the subsequent project students were asked to identifying areas of distinct character on the mountain, based on their personal aesthetic perception, and then learn all they could about the influences that contributed to that character. The primary product of this assignment was again an artwork; a painting on a 24" x 36" canvas that communicated the chosen character and its influences in an abstract way (see Figure 3). The goal of this painting (and the students’ accompanying sketches, writings and verbal presentations) was to convey the essence of the site’s character, which was a convergence of their perceptual/aesthetic, natural, and historical/cultural observations, determining which aspects contribute most strongly to its unique sense of place or genius loci (Norberg-Schulz 1980).

Figure 3. Site character was conveyed through abstract painting, such as the reverence of a grove (left), the expanse of a vista (center), and the fragility of a shale barren (right) (2014). Paintings by Hillary Ramsay, Hannah Moll and Cameron Bayles.

The layering of site knowledge with emotional response increased with the subsequent project, when the class was divided into groups and asked to create landscape character maps of the entire mountain, supplemented by mixed analog/digital artworks and a supporting report that explained the cultural and natural features that contributed to the character of zones (see Figure 4). We discussed with students how aesthetic character understanding varies from person to person, and how this variation has caused consternation in landscape architecture with regard to whether an aesthetically derived understanding of the landscape is as valuable and robust as the understanding offered through disciplines from the natural and social sciences. We argued that we, as landscape architects, can and should reclaim that territory and that our aesthetic sense is vitally important for understanding the character of the landscape. However, as this project continued to demonstrate, it is equally important to broaden these emotive readings with a deep knowledge of the natural processes and cultural history of a site. In order to gain such a comprehensive understanding of character, students literally went deep into the site. They hiked far off trail, spending many hours over multiple days trying to extract an aesthetic reading of character and a distinct sense of place for each zone. These earnest efforts resulted in a layered representations and mapping of Mt. Kessler’s character that had previously been unexplored and/or undocumented.
Finally, in the concluding Mt. Kessler project, we asked each student to explore a design intervention—in the form of trail heads, new trail alignments and nodal destination points—that would facilitate user needs without compromising site character or the physical and cultural conditions that contributed to it. In keeping with the pedagogical trajectory, both the design solutions and the analog and digital graphics used to convey them were expected to communicate the perceptual characteristics of the site (see Figure 5).
4 FINDINGS

4.1 Landscape representation: from static scenery to emotional reading and palimpsest

The aforementioned disciplinary earnestness that has seen the rise of the inventorial approach to site understanding—the fear of being seen as, at best imprecise, and worst whimsical—might be said to have a corollary in the preciousness of hand-drawing used to record place: photo-real, literal, static and finite; digestible at a single glance. These drawings can require great craft and patience, but minimal reflection on what is being drawn and why and risks the over-emphasis of visual composition. In effect these drawings—especially if created off-site and from photographs—represent a compromised aesthetic reading of the landscape, where comprehension of space is privileged over perceptual engagement and communication. These types of drawings had, hereto, been commonly used by students within the unit, along with photography to communicate studio project sites’ character.

With regard to photography, Rhode & Kendle (1994) have warned of its use of photography in the recording of aesthetic reactions; the over-reliance—and potential bias—of apparent visual composition as selected, cropped and framed by the photographer in lieu of a fuller perceptual or sensorial reading. In the intervening quarter of a century, the literature on landscape and site representation has broadened the understood potential of site-photography, to include more nuanced and reflective modes (see, for example Lickwar & Crawford, 2014 and Werner, 2008). Hand-drawing too, can evolve to be looser and more personal and, crucially, undertaken on site while immersed in the landscape and cognizant of non-visual patterns and perceptions. In the ‘Mt. Kessler Studio’ the drawings produced by our students were simply a means to an end, an artifact of reflection, contemplation and observation, an aide-memoir. As suggested by Carr (2016) and Graves (2012), some of the principal benefits of hand (as opposed to digital) drawing is the consolidation of memories of the where, the why and the how of the drawing, and access to tacit knowledge, experience and emotion. By charging our students with the task of producing drawings while immersed in the landscape, and especially while observant and cognizant of their internal moods and perceptions, the emotional and memorial qualities of their drawings were amplified still further.

What was being drawn by our students was so inherently complex and difficult to understand—a landscape formed over eons and an individual’s sensorial response to it—that it is fitting that the drawings were usually incomprehensible on first reading, and it is telling that they only became clear once accompanied by a verbal explanation; these are deeply personal drawings; messy, abstract, open-ended, layered (see Figure 1). Often-times the students mixed site materials—rain, grass, mud, and so on—into their drawings, rightly recognizing that nothing represents the physicality of the landscape better than the landscape itself. That is not to say that these initial impressions—conveyed by the in-situ drawings—was all that was required of the students. According to perceptualist theory, “our perception stops at the perceptual surface and this defines the limits of the initial aesthetic judgement” (Bell, 2012, p 68). What the students gained through their initial efforts however, was a curiosity—much like that demonstrated by the film on Andy Goldsworthy—that then fired their investigations into non-perceptual factors: ecology, history, etc., and then deepened their appreciation of the landscape. We encouraged the students to maintain the mode of communication through drawing, painting and flat-work, layering information about geology, ecology and culture with aesthetic impressions to create pieces that were highly evocative of the site (see Figure 3). These paintings act as metaphor for the landscape itself—a palimpsest rather than scenery.

The deeply personal nature of these works imbued them with a soulfulness and, inevitably, their evocative and poetic nature was appreciated not just by the instructors, but through exhibitions and display. The work particularly resonated with users of Mt. Kessler who found their personal experiences of the place better reflected in the abstract form. Additionally, the students’ deep character readings and mapping became a contribution to the study of Mt. Kessler not seen heretofore. The validity of our approach was also reinforced by the depth of understanding gained by the students. In their endeavor to recognize the complexity and layering of natural, cultural and perceptual patterns on the mountain, as a basis for subsequent design proposals, the class created robust character maps of sufficient quality to be adopted as advisory documentation by the National Park Service, who was assisting the city of Fayetteville and advocacy groups in planning efforts for the new Mt. Kessler Reserve (see Figure 4).

The final design proposals for the mountain were uncommonly sensitive and informed, with material and form choices imbued with a sense of place, ephemerality and even whimsy. One student was drawn to
a clearing at the top of the mountain, initially attracted by its perceived functions as a welcome gathering spot for hikers who had reached their destination and as a node for the network of trails that converged at the summit. The student's aesthetic perceptions of the site were deepened and altered upon learning that the clearing was a naturally formed shale barren, an extremely fragile and rare ecosystem in the Ozark Mountains. His proposed design intervention was a large wooden platform that was suspended above the forested edge of shale barren, permitting the area to continue to function as a node and gathering space while reducing damaging foot-traffic. Another student proposed a new trailhead and visitor center embedded in a limestone bluff overlooking the new regional sports park that was being constructed at the base of the mountain, creating a new public gateway to Mt. Kessler. The principal inspiration for the physical form of the design was the flowing pattern created by the wild grape vines, an aesthetic that had captured the student's interest during the early semester projects (see Figure 5). Although some of the upperclassmen, who were already inculcated into traditional modes of site investigation, were skeptical of the value of perceptual exercises and resistant to the newly adopted approach, the majority of student responses were favorable, especially with regards to scope for more personal investment and direction, and the balance of art with technology:

“[This approach] challenges and enhances the traditional methods of landscape architecture. Our drawings evoked a spirit of place that was then woven through our final designs. Without the foundational experimentation of charcoal sketching, the project would lose the roots from which the design arose. I truly believe that this training has helped me become a more sensitive designer.”

“[This was] Landscape Architecture, over and above the standard held in today’s technology driven era.”

“[This approach] re-grounded me in my passion for design, but first-and-foremost in my passion for art in nature...It reminded me that incorporating the ephemeral and mysterious qualities of art and nature into the realm of the design is possible.”

In turn, the studio products were very well received by interested stakeholders, particularly people with intimate knowledge of, affection for and experience with Mount Kessler. Since this initial studio in 2014 we have integrated a perceptualist approach to design and graphics in subsequent studios. Though difficult to definitively prove, we feel that the recent increase in our award-winning student work is due at least in part to this new emphasis. Students employing a perceptualist approach since 2014 have been recognized with numerous awards from the state chapter of the ASLA and the ASLA Central States consortium—fora in which the department had previously seen little success. With regard to the types of perceptual drawings delivered through the studio approach outlined here, Professor Catherine Seavitt Nordenson, Associate Professor of Landscape Architecture at City College of New York and faculty editor of the award-winning landscape architecture journal PLOT writes:

“The integration of conceptual yet analytic artistic impressions of the landscape as a method of site investigation is evident in the work of [the] students. I am thrilled to include the beautiful in our Spring 2016 issue. The drawings are astonishingly breathtaking, and this submission was unanimously supported by our full student editorial board. It is the first time in five years we have published the work of undergraduate landscape architecture students, and we are thrilled to have discovered this Arkansas talent.”

Importantly, as instructors who were able to contextualize the work with efforts from previous years in Arkansas, self-reflection on the studio process and product deemed it to be highly successful: it added a significant skillset to the students’ repertoire, and recognition of what constitutes a useful and truthful understanding of landscape. For example, the same group of students in a subsequent studio (also led by one of the authors) relished transforming maps created in ArcGIS into an ESRI Story Map, with text and images redolent of the place. This subsequent studio—a collaboration with Biological Engineering—saw the landscape students become unselfconscious, eloquent and informed supporters for poetic, place
4.2 Challenges of the approach and further work

As we continue to pursue this approach to creating knowledge in our students, there are a number of immediate, clear but exciting challenges. Firstly, we must overcome an ingrained presumption of what it means to successfully ‘draw a landscape.’ As students join our department there is a great deal of self-consciousness around drawing; that their hand is not sophisticated enough. The high technique often required in first year design curricula is indeed intimidating. Although our perceptualist model trades this mode of drawing for a looser, less literal approach it is, itself, fraught with challenges related to lack of confidence and maturation. These drawings are personal, subjective and exploratory, but nascent design students often define the limits of their efforts very tightly and strictly to the parameters of what the teacher wants—and that this needs to be unambiguous, prescriptive and what will win them a high grade. It is important that we dismantle students’ presumptions of what is successful in terms of drawing the landscape. What a landscape drawing is for, and how it contributes to the landscape architectural design process. We believe that this challenge can be overcome through investment and encouragement in each and every student, and at the very earliest stages of the landscape architecture curriculum. As discussed above, a parallel evolution in the potential of site-photography (a technique not explored on the Mount Kessler project) suggests scope to mix media, with photography and site-drawing combining to record a phenomenological reading of place, rather than neutrally document spatial information. In-house faculty expertise in photography and hybrid media suggests the department is well-placed to explore this next step.

Irrespective of media used, these more abstract modes of site communication inevitably place a good deal of emphasis on confident and articulate verbal or written presentation. As a key component of place understanding is perception which is, by its very nature, highly personal, the student is required to robustly explain their aesthetic experience. We have found that this can be more challenging for students than the presentation of more tangible information related to a site’s inventory. Again, this places responsibility on the shoulders of instructors to encourage and nurture students, and clearly articulate the value of the students’ instincts. As reported by Smith & Boyer (2015), traditional architectural studios and specifically the mode of instructor feedback, has been oft-criticized for undermining rather than encouraging student confidence and creativity. The authors would suggest that a successful perceptualist approach to landscape studio pedagogy must require an attendant shift in studio praxis to one which looks to nurture and encourage confidence and creativity. This can include modes of verbal feedback (Smith & Boyer 2015); management of collaborative and co-working among students; conceptualization of the design process itself; and even the physical arrangement of studio and critique spaces (Crawford et al. 2013, 2014). Again—there is much that can be learnt from peers in design instruction, as we seek to become better instructors overseeing more creative and joyful studios.

Finally, we must come to terms with an unforeseen but, in hindsight, inevitable and unhelpful side-effect of the perceptualist approach. Most of our students come to us from small rural towns or the suburbs of large cities. There is a tendency for our profession to be perceived (from within and without) as the provider of a ‘nature band-aid’ to salve the sometime imagined wounds of the urbanized landscape. Students often enter the major with a sensibility that manifests as an ‘anti-urban’ or ‘pro-nature’ disposition, with neither the experience nor the knowledge to understand that urban fabric and places can be culturally and environmentally rich, and that ‘green’ places can be antithetical to ecological capacity and positive human experience. The anti-urban, nature-romantic position of many of our students provides fertile ground for biased landscape readings. This raises an important challenge to the instructor: to guide the student to a fuller appreciation of the landscape without denigrating their personal and individual readings of a landscape.

5 CONCLUSION

This studio marked the beginning in an ongoing shift in our approach to design process and studio pedagogy. By foregrounding a perceptual appreciation of site, as communicated through abstract drawings, we believe we are helping students to bridge the significant leap between analysis and design, by offering a gateway into understanding the site and formulating priorities for action. Our approach has been aided through engagement with local, accessible sites that encompass a significant amount of objective scientific
and cultural information made available to the students. The drawings our students have produced since 2014 have provided evocative artifacts that have been exhibited and published, and have formed the basis of award-winning design work. Undoubtedly, such beautiful work can be a vehicle for increased departmental profile. As representations of landscapes, these drawings are a fuller and more honest way of communicating the milieu in which landscape architects work; ambiguous, open ending, changing, but comprehensible with time and investment. More importantly, our students have increasingly embraced their role as advocates for a place-based understanding of landscape, bringing a crucial skill-set and sensibility to partnerships with other disciplines and stakeholders. This transition in studio approach has reinforced the importance of reflective design instruction, both through exposure to literature and to peer approaches and technique. In this regard design pedagogy conferences and other community venues remain a crucial resource. As a community of design scholars and instructors, it is important to remain engaged and open to change and the authors are committed to improving our studio experiences still further, particularly with regard to use of other media, studio structure and modes of feedback and student interaction.

6 REFERENCES


THE DESK CRITIQUE: ASSESSING THE ROLE OF TEACHING STYLES IN THE COGNITIVE DEVELOPMENT OF STUDENTS

KLONDIKE, TRAVIS
North Carolina State University, tmklondi@ncsu.edu

1 ABSTRACT
Desk critiques, the term that refers to the ongoing conversations between teachers and students in design studios, has been the lifeblood of design education for centuries. In a typical five-year design-based degree, it can be expected that a student will partake in well over 300 desk critiques, often lasting 15-30 minutes each. However, despite the significant role that desk critiques play in the education of design students, instructors often enter academia without any training as to how their own style of teaching can promote or hinder the cognitive development that is necessary for a student to progress as a designer.
This study takes a mixed-methods approach that aims to better understand the influence of teaching styles on the cognitive development of students, as they were observed in a semester-long graduate-level landscape architecture studio. Modeled after various studies conducted by Professor William Perry, analysis of pre- and post-test interviews determined the cognitive state of each student in relation to a nine-point positional framework (Perry, 1970). Throughout the duration of the semester, desk critiques were audio-recorded and subjected to a content analysis through a categorical coding scheme of the verbalizations (Goldschmidt, Hochman & Dafni, 2009). In doing so, this study was able to identify teaching styles of the faculty, and then overlay this information with the pre- and post-semester cognitive evaluations of each student. Results point to trends that link typologies of teaching styles in desk critiques with observed changes in the students’ cognitive state over the course of the semester.

1.1 Keywords
desk critique; design studio; cognitive development; pedagogy; teaching style
2 **INTRODUCTION**

It can be said that for nearly two centuries the pedagogical approach to design education has remained relatively stagnant. Launched at the Ecole des Beaux Arts in France in the early 1800s, the studio-based learning model is recognized as the first formal architectural education framework. Although this was in many ways only a slight pivot from the medieval apprenticeship method, the Beaux Arts move to a studio system nonetheless laid the foundation for the design curricula of today (Salama, 1995). Since that time, there have been a number of pedagogical movements that have altered the content and dynamic of the studio environment, but the inherent makeup of the framework has remained the same.

Fast-forward to today’s studio, and one would observe a workspace comprised of students that work toward a series of both individually-led and group projects over the course of one semester. Typically meeting two or three times a week for a number of hours each, studio sessions are centrally focused around students engaging in discussions with teachers and other students about the current state of their designs (Goldschmidt, Hochman & Dafni, 2009). These discussions are of particular interest for this study.

Formally called “desk critiques,” these describe, in the academic sense, the process by which a person of higher authority (i.e. teacher) and a person of lower authority (i.e. student) take part in the repeated proposition and critique of constantly evolving, never complete, design solutions (Brocato, 2009). When engaged in these conversations, the teacher must strike a delicate balance between providing instruction and enabling a student’s free will – with each individual, often for 15-30 minutes at a time – in order for them to be effective.

The sheer time commitment and one-on-one nature of desk critiques allows for a unique bond to form between the student and teacher. In a typical five-year design-based degree, it can be expected that a student will partake in well over 300 desk critiques. However, despite the significant role that desk critiques play in the education of design students, instructors often enter the teaching realm without any training in education or learning theory (Hargrove, 2007), and the published work specifically relating to the studio setting and desk critiques is painfully limited (Goldschmidt, Hochman & Dafni, 2009). Responding to these shortcomings, it seems that there is not only a need to better analyze desk critiques, but also to establish a way of evaluating the effectiveness of them for the student.

3 **THEORETICAL FRAMEWORK**

3.1 **Perry Developmental Scheme**

In the 1950s, William Perry – then professor at Harvard – began exploring the causal roots of cognitive and moral development in college students. Through a series of open-ended interviews, Perry immersed himself in a longitudinal study that asked hundreds of students to describe their college experiences at the end of each academic year. Expecting to observe a variety of personality traits, Perry conducted a pilot study with students from Harvard and Radcliffe. However, it quickly became apparent that instead of digging up different personalities, Perry was actually unearthing a rather consistent outline of the students’ educational journey (Perry, 1970).

After nearly a decade of interviews, Perry and his colleagues generated a model that reflected their findings – a nine-point positional framework that mirrored the ever-evolving perspective of a college student – describing a succession that moves from early expressions of dualism (simple, dichotomous views of knowledge, Knefelkamp and Slepitza, 1976), to gradual adoption of multiplicity and relativism (acceptance of a vast community of different possibilities, Knefelkamp and Slepitza, 1976), to positions of commitment (affirmation of one’s self or identity, Moore, 2001).

While the Perry scheme has drawn some scrutiny for gender and cultural differences that the study failed to taken into account, it is still widely recognized for its ability to connect students’ philosophical outlooks with their attitudes toward the educational environment (Moore, 2001) – in the case of this study, the way in which students cognitively develop within the studio environment.

3.2 **Self-Determination Theory**

In some psychologists Edward Deci and Richard Ryan. In 1985 the duo developed a meta-concept for the study of human motivation which they coined “self-determination theory” (SDT). Their proposed model stipulates that there are varying degrees of motivational drivers for any given situation. Deci and Ryan were on the front-end of those proposing that motivation is not a unitary construct (Deci & Ryan, 1985). Rather than depicting motivation as either ‘you have lots of it, or none of it,’ they were of the belief that a spectrum model was more fitting - ranging from highly external factors (deadlines, salaries, grades) to highly internal factors
(engaging in an activity because it is found to be fundamentally interesting). This model has been widely tested, and while some slight variations to the initial proposal exist, one of the most significant concepts that the model holds at its core is the idea that all motivation comes from three sources: competence (levels of confidence associated with goals and knowledge, Ryan & Deci, 2000), relatedness (desire to feel connected within a larger community, Baumeister & Leary, 1995), and autonomy (to align behavior in accordance with one's sense of self, deCharms, 1968).

When dealing with desk critiques, it is the prerogative of the teacher to find just the right balance of these three elements - competence, relatedness, and autonomy - to best promote students' learning. Furthermore, prescribing these motivational pillars in such a way that promotes the cognitive development of each individual student should be embedded within the modus operandi of all design educators. Despite the frameworks for SDT and Perry's scheme being constructed independent from one another, the areas of overlap as they relate to design pedagogy are unmistakably present. It is the goal of this study to find the relationship between these two theories as they manifest themselves through the desk critique.

4 PRECEDENT RESEARCH

While there is a wide body of work that has looked separately at the factions of SDT and Perry’s scheme, there isn’t much work explicitly detailing how the two can work in concert with one another - and research delving into how these concern the effectiveness of a desk critique is all but absent. There is most certainly a need for this type of research, as it is more or less just the next logical step in a building chain of pedagogical philosophies.


After observing architecture studio courses conducted at four different universities in the U.S., Dinham made particular notice of the “teacher-student exchanges” known as desk critiques. Dinham notes that desk critiques could be condensed into eight categories of teaching: philosophies / views manifest in teaching, ideas about teaching and learning, student preparation, time, teachers’ response to students, two-way communication, student talk, and teacher guidance based on student work. Dinham provides greater specificity by noting that further interpretation is needed from the “theoretical perspectives of cognitive psychology and adult cognitive development” in order to grasp a better understanding of the collective variables relating to desk critiques.


Adding another layer of detail, Salama and Wilkinson articulate the necessity to address “cognitive styles” in studio pedagogy – stating that design instructors need to “find ways in which knowledge and its applications are integrated in a learning setting that match students’ abilities.” Said in terms of this study, it becomes evident that teachers need to possess the ability to customize their teaching styles and motivational cues used during desk critiques, in order to promote the cognitive development of each individual student. However, up to this point, a way in which to appropriately measure and analyze this had not yet been conceived.

4.3 Goldschmidt, Hochman & Dafni (2009): The Design Studio “Crit”: Teacher-Student Communication

That is, until Goldschmidt, Hochman & Dafni entered the arena. Placing the genetic makeup of desk critiques under a microscope, this trio conducted a study that aimed to investigate teachers’ performance in the studio environment. Specifically, they looked into instructors’: teaching profile, management of critiques, priorities, and responsiveness to students’ concerns - through a series of observed desk critiques. While this was not the first case of examining these teacher-student exchanges, it was however, the first to introduce a quantitative measure into the analysis of them. After reviewing the collected data, Goldschmidt and her colleagues were able to formulate an eight-category coding scheme for the teachers’ language structure used during desk critiques. Categories consisting of: 1. Report / review / analysis of the state of the design, 2. Clarification questions, 3. Proposals for change / improvement, 4. Reference to design precedents / examples, 5. Explication of design issues, theories / principles / norms / conventions, 6. Statements regarding design methodology / presentation, 7. Praise, expression of satisfaction, encouragement, and 8. Questioning, pointing out mistakes / shortcomings, expressions of dissatisfaction, were all used to code the teachers’ side
of desk critiques. This was a monumental step forward in creating a better understanding of the teaching styles present in the studio environment – and it is from here, where this study takes flight.

5 RESEARCH QUESTIONS

While the work of Goldschmidt and her colleagues created a way to analyze different teaching styles present during desk critiques, it did not evaluate them in terms of a students’ cognitive development – which, in much of the precedent work, seems to be an integral piece to the equation. By overlaying the coding scheme presented by Goldschmidt and her colleagues with broader theories of SDT, and then adding a form of cognitive assessment (similar to the methods used in the original Perry study), it then becomes possible to shed light on the following questions:

1. Can the cognitive positioning of design students enrolled in the same studio course change over the course of one semester?

2. Are there other influencers, aside from desk critiques, that can affect the cognitive development of design students?

3. Do teachers express tendencies in teaching styles relative to the motivational pillars of SDT (competence, relatedness, autonomy)?

4. If tendencies in teaching styles exist, how do these styles correlate with the cognitive development of all students, cohorts of students at particular cognitive positions, or none of the students?

6 METHODOLOGY

6.1 Framework

In recognizing these research questions, this study used a diagnostic approach to better understand the breadth of influence that desk critiques have on a design students’ cognitive development. Rather than precisely measuring and controlling for the vast number of potential variables that can affect a students’ cognitive development, this study took a more holistic view that attempted to offer insight into the structure and dynamics of a specific element in a design students’ educational experience: the desk critique. In order to achieve this, the data collection for this study was concerned with pre- and post-test cognitive assessments of students, as well as motivational techniques used in teaching styles coded from the language used by teachers during desk critiques.

A graduate-level introductory landscape architecture design studio housed within the College of Design at North Carolina State University served as the study sample due to its studio-based education system and willingness to participate for one semester. The students enrolled in this course came from a variety of educational backgrounds, and for many was their first exposure to a landscape architecture specific studio. Eighteen students were enrolled in this course, and there were two teachers that co-taught the class. In order to collect a useful data pool, this study utilized a mixed methods approach broken into four parts:

1. Pre-Test Questionnaire: On the first class of the semester, students were provided with the Learning Environment Preferences (LEP) questionnaire. This is an objective, recognition-task instrument developed by researchers at the Center for the Study of Intellectual Development (CSID) and is directly drawn from the Perry position rating criteria. The questionnaire consists of 65 Likert-scale type questions that ask students to rate and rank their ideal learning environment (Moore, 1987). Students were provided with this questionnaire so that they could engage in self-reflection of their own learning preferences, and also become familiar with some of the terminology prior to the pre-test interview.

2. Pre-Test Interview: During the first week of the semester, students were asked to participate in a one-on-one focused interview, each of which lasted approximately 15-20 minutes. These video-recorded sessions allowed students to further elaborate on their responses to the LEP. Initial questions posed by the interviewer derived from the five primary categories of questions found in the LEP, and the interviewer probed when necessary in order to elucidate more material from the respondent. The initial questions were asked in the following order:
“In your ideal learning environment…”

a) “what type of course content would you prefer to be covered?”
b) “what would be the role of the teacher?”
c) “what would be the role of other students?”
d) “what type of classroom atmosphere would you prefer?”
e) “what type of evaluation process would you prefer?”

3. Audio-Recorded Desk Critiques: After all pre-test interviews were complete, audio recordings of desk critiques were able to begin. Teachers were asked to record all desk critiques, for all students, throughout the entire semester using an audio-recording device that the teacher placed on each students’ desk at the time of the critique. At the end of each studio session, the teachers handed over the audio-recording devices to the researcher in order to transfer the data.

4. Post-Test Interview: During the last week of the semester, students participated in a second one-on-one focused interview, each of which lasted approximately 15-20 minutes. These video-recorded sessions asked students the same initial questions as posed in the first interview, and follow-up questions asked student to reflect on their perceived changes or reaffirmation of beliefs from the start of the semester.

6.2 Strategies for Analysis

While all students in the class were asked to participate, the analysis phase of this study excluded four of the eighteen students for two reasons: lack of participation in either the pre- or post-test interview, or clear inability to articulate beliefs due to language barriers. Inclusion of such students would create potential scenarios where incomplete data would have been used, or where where the diction used by the students in describing their cognitive state may generate a rating not reflective of their actual cognitive state – thus skewing the validity of the results.

After the completion of the pre-test questionnaire and pre-test interview phases, video recordings of the interviews were given to a panel of two judges for further examination. The judges were then asked to consider the presented material for each student, and then agree on a consensus 1-9 score that is representative of each students’ current position in the Perry scheme. Prior to viewing the videos, both judges were familiar with the Perry scheme and individually reviewed the model in detail. A condensed summation of each position in the Perry scheme was also provided to the judges to serve as a rubric during examination of the video content.

Although the judges assigned pre-test scores to each student during the same semester the study took place, neither the studio teachers, nor the students were informed of the scores, and neither were aware that a cohort of four students had been excluded from the study. In order to control for bias and classroom rifts, everyone enrolled in the course was of the assumption that all data would be used.

Using the coding scheme developed by Goldschmidt and colleagues (2009), the desk critiques from the cohort of the fourteen selected students were categorized accordingly. However, a necessary modification to this system was added for the purpose of this study: the eight categories used for coding the desk critiques were allocated into groups under the umbrella of SDT, based on the motivational tendencies of each. Using the premise that all comments from teachers occurring during desk critiques are some form of motivation, the three pillars of SDT encompassed the eight categories of the Goldschmidt coding scheme within them:

1. Competence: Report / review / analysis of the state of the design, Clarification questions, Reference to design precedents / examples, and Explication of design issues, theories / principles / norms / conventions

2. Relatedness: Praise, expression of satisfaction, encouragement, and Questioning, pointing out mistakes / shortcomings, expressions of dissatisfaction

3. Autonomy: Proposals for change / improvement, and Statements regarding design methodology / presentation

By grouping the coding scheme in this way, it allowed for another layer of information to be identified in the observed teaching styles. Are the teachers providing the students with feelings of competence or lack of competence? Relatedness or lack of relatedness? Autonomy or lack of autonomy? As an example, one can imagine a teacher prompting a proposal for change / improvement in two very different ways: “What if you were to re-consider the location of this wall – how would that alter the functionality of this space?” or “You need to
move this wall here or else this space won’t function correctly.” Both comments would fall under the same category in the Goldschmidt coding scheme, however, the presence of autonomy is starkly different.

Upon reaching the end of the semester, the same judges that evaluated the pre-test interviews reconvened to score the post-test interviews. Again, the judges were asked to agree on a consensus 1-9 score for each student that was representative of the students’ current position in the Perry scheme.

Table 1. Pre- and post-test scores of cognitive positioning based on consensus ratings.

<table>
<thead>
<tr>
<th>Student</th>
<th>Pre-Test Score</th>
<th>Post-Test Score</th>
<th>Change in Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student C</td>
<td>9</td>
<td>8</td>
<td>-1</td>
</tr>
<tr>
<td>Student O</td>
<td>7</td>
<td>6</td>
<td>-1</td>
</tr>
<tr>
<td>Student E</td>
<td>7</td>
<td>5</td>
<td>-2</td>
</tr>
<tr>
<td>Student G</td>
<td>7</td>
<td>5</td>
<td>-2</td>
</tr>
<tr>
<td>Student I</td>
<td>5</td>
<td>4</td>
<td>-1</td>
</tr>
<tr>
<td>Student H</td>
<td>5</td>
<td>6</td>
<td>+1</td>
</tr>
<tr>
<td>Student A</td>
<td>5</td>
<td>7</td>
<td>+2</td>
</tr>
<tr>
<td>Student P</td>
<td>4</td>
<td>6</td>
<td>+2</td>
</tr>
<tr>
<td>Student M</td>
<td>4</td>
<td>6</td>
<td>+2</td>
</tr>
<tr>
<td>Student D</td>
<td>4</td>
<td>5</td>
<td>+1</td>
</tr>
<tr>
<td>Student K</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Student L</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Student F</td>
<td>3</td>
<td>5</td>
<td>+2</td>
</tr>
<tr>
<td>Student J</td>
<td>2</td>
<td>3</td>
<td>+1</td>
</tr>
</tbody>
</table>

At this point, there were pre- and post-test ratings for each student that signified their cognitive position relative to Perry’s scheme at the beginning and end of the semester - and there were coded desk critiques revealing the teaching styles used by the teachers throughout the semester. While this study does not attempt to draw conclusive causal links between motivational typologies and cognitive development, it is the hope that the correlations presented in the results will encourage similar studies of larger sample sizes to take place.

7 RESULTS

7.1 Change in Cognitive Positioning: Pre- and Post-Test Scores

Analysis of the pre- and post-test scores reveals that the fourteen students included in the study represented a wide range of cognitive positions on the Perry spectrum. The lowest pre-test score being a 2, and the highest being a 9, with almost every degree of the scheme represented. The average pre-test score amongst the students was a 5.0, and 4 was the most common pre-test score. Most intriguing about the results of the pre- and post-test ratings, however, is that a clear division exists in the net change of cognitive position scores between the highest-rated cohort of pre-test scores and the rest of the study sample. As seen in Table 1, a regression of scores for those with a pre-test rating of 7 or higher, seems to coincide with an advancement of scores for those with a pre-test rating of 5 or lower.
7.2 Other Influencers: Student Pairings

Equally deserving of attention is the cognitive movement of individual students within pairings that represented class partnerships throughout the majority of the semester. Unbeknownst to the researchers while developing the methodology for this study, was the intent of the two teachers leading the instruction of this course to propose a series of projects throughout the semester that would, in large part, require the students to work in pairs. Starting in early October and lasting until the end of the semester, the students worked on projects with the same partner. Coupling the results of the pre- and post-test cognitive positioning scores of the students to match these partnerships, as seen in Table 2, shows that a correlation exists between the two students within each pair. In every instance except for one, the student with the higher pre-test score regressed in their post-test score, while the inverse occurred for the student with the lower pre-test rating. The group that did not follow this trend saw both students stagnate in their pre- and post-test scores, with a net change of zero. In short, it appears that the two students are seemingly meeting-in-the-middle within these pairings, in terms of their individual cognitive positioning.

Table 2. Group pairings with pre- and post-test scores of cognitive positioning based on consensus ratings.

<table>
<thead>
<tr>
<th>Group</th>
<th>Student</th>
<th>Pre-Test Score</th>
<th>Post-Test Score</th>
<th>Change in Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Student A</td>
<td>5</td>
<td>7</td>
<td>+2</td>
</tr>
<tr>
<td></td>
<td>Student B</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Group 2</td>
<td>Student C</td>
<td>9</td>
<td>8</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>Student D</td>
<td>4</td>
<td>5</td>
<td>+1</td>
</tr>
<tr>
<td>Group 3</td>
<td>Student E</td>
<td>7</td>
<td>5</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td>Student F</td>
<td>3</td>
<td>5</td>
<td>+2</td>
</tr>
<tr>
<td>Group 4</td>
<td>Student G</td>
<td>7</td>
<td>5</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td>Student H</td>
<td>5</td>
<td>6</td>
<td>+1</td>
</tr>
<tr>
<td>Group 5</td>
<td>Student I</td>
<td>5</td>
<td>4</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>Student J</td>
<td>2</td>
<td>3</td>
<td>+1</td>
</tr>
<tr>
<td>Group 6</td>
<td>Student K</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Student L</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Group 7</td>
<td>Student M</td>
<td>4</td>
<td>6</td>
<td>+2</td>
</tr>
<tr>
<td></td>
<td>Student N</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Group 8</td>
<td>Student O</td>
<td>7</td>
<td>6</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>Student P</td>
<td>5</td>
<td>6</td>
<td>+1</td>
</tr>
<tr>
<td>Group 9</td>
<td>Student Q</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Student R</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
7.3 Tendencies in Teaching Styles: Coded Desk Critiques

While audio-recording devices were utilized by teachers throughout the semester on a consistent basis, there were some days that did not require use of the devices because of: field trips, classes with a lecture/open discussion focus, and classes that only included audio recordings of some but not all of the students. The four days of audio recordings selected for analysis include: one day of recordings prior to the students being put in the previously-discussed pairings, and three days of recordings within those pairings. Each of the four days included desk critiques with every student enrolled in the course, and included discourse with both teachers giving desk critiques to each pair of students together.

In general, the desk critiques seemed to take on a similar coded pattern. Initial questions or statements of competency regarding the state of the students’ design would set the stage at the beginning of most critiques. Whereas a steady diet of autonomy-related dialogue of proposals for change / improvement would constitute the end of most critiques. The middle third of critiques largely consisted of back-and-forth feedback that would zig-zag across the categories of: competency, relatedness, and autonomy, however this varied with each critique.

Table 3. Portion of a coded desk critique with depiction of non-autonomous cluster.

<table>
<thead>
<tr>
<th>Move #</th>
<th>Competency</th>
<th>Relatedness</th>
<th>Autonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74</td>
<td></td>
<td></td>
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<td>75</td>
<td></td>
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<td></td>
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<td>76</td>
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<td>77</td>
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<td>90</td>
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<td></td>
</tr>
<tr>
<td>91</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KEY:**
1. Report / Review / Analysis of the state of the design
2. Clarification questions
3. Reference to design precedents / examples
4. Explication of design issues using theories / principles / norms
5. Praise / Expression of satisfaction
6. Dissatisfaction / Pointing out mistakes
7. Proposals for change / improvement
8. Statements regarding design methods / presentation
   / AUTONOMOUS proposal / statement
| Non-autonomous proposal / statement
\ Non-autonomous cluster

What became most clear after listening to the language in the critiques, was the difference between autonomous and non-autonomous instruction in the word choice used by the teachers. Specifically, looking at
the phrases that fell into the categories: proposals for change / improvement, and statements regarding design methodology / presentation, and assessing each phrase for its inherent sense of autonomy, or lack thereof, on a binary basis. Proposals and statements that: issued a general direction or way of thinking, allowed students to pursue a requested direction, or referenced a teachers’ drawing as an example of process, would all be coded as autonomous. Example:

Teacher: “If the goal of the green space is to host a wide range of activities… then you might want to re-visit how the arrangement of your programmed areas contributes to that idea.”

Proposals and statements that: issued a specific direction or way of thinking, deterred students from pursuing a requested direction, or referenced a teachers’ drawing as the accepted direction, would all be coded as non-autonomous. Example:

Teacher (while drawing on plan): “If you moved the parking over here and oriented it like this, that would allow you to have a much more open green space in the middle here.”

Dissecting critiques in this format begins to peel back some of the subjectivity typically associated with autonomy, and contends that this type of instruction is either pointing to a directed product or a guided process. Does the comment draw a straight line from point A to point B? Or does it leave the door open for a self-discovered response? Table 3 illustrates what an excerpt of one critique looks like after comments from the teacher have been fully coded.

7.4 Tendencies in Teaching Styles: Correlation with Cognitive Growth

Table 3 also demonstrates an example of a non-autonomous grouping of phrases referred to as a non-autonomous cluster. These clusters illustrate instances where the teacher would use non-autonomous directives either back-to-back or only separated by one phrase. Clusters varied in length, ranging from two comments in a string of phrases all the way to twelve, and occurred more frequently in some critiques than others. Tracking the frequency, length, and percentage of non-autonomous phrases / clusters within the autonomy category revealed relatively consistent trends across the study. Students that belonged to the most common, average cohort of pre-test cognitive ratings (those with scores of 4 or 5, n=8), appeared to elicit post-test cognitive position ratings directly correlated with the amount non-autonomous instruction they received. The results can be seen in Table 4, which highlights all of the students that represent the cognitive average amongst pre-test scores. Although the sample size is small, the data draws attention to a breaking point where too much non-autonomous instruction tends to hinder the cognitive development of the average cohort of cognitive pre-test positions. Additionally, though not as consistent of a trend, greater frequencies and average lengths of non-autonomous clusters seem to coincide with greater percentages of non-autonomous instruction as well.

8 DISCUSSION

8.1 Potential Explanations for the General Advancement of the Average and Lowest-Rated Pre-Test Scores

The cognitive advancement of students with pre-test scores of 5 or lower signifies a rather cohesive acceptance from these students of the teaching styles and / or group pairings posed by the teachers of this studio. Though there are many external factors that may influence the advancement of these students, this study assumes that the discourse during desk critiques and in paired settings are significant contributors to the cognitive development of design students. According to the Perry scheme, students with these ratings are said to fall under either the dualism or the multiplicity / relativism positions of cognitive development. Students in these positions are said to be either concerned with obtaining knowledge, skill sets, and facts, or looking for an environment that informs them of an array of possible outcomes and processes - and interpretation beyond that is the prerogative of the individual. Considering these descriptions to be true, it should not be a surprise that the amount of non-autonomous feedback was amongst the highest proportions for groups including students with the lowest-rated pre-test scores.
The amount of directed instruction they were receiving was likely feeding the exact mechanism they were comfortable operating. Perhaps the teachers were providing just enough autonomy to nudge them into

<table>
<thead>
<tr>
<th>Group</th>
<th>Total # of Moves</th>
<th>% of Total Moves in Autonomy Category</th>
<th>% of Autonomy Category Moves with Non-Autonomous Coding</th>
<th># of Non-Autonomous Clusters</th>
<th>Average # of Moves per Non-Autonomous Cluster</th>
<th>Student: Pre-Test Scores / Post-Test Scores &amp; (Change in Scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>238</td>
<td>29.8%</td>
<td>52.1%</td>
<td>10</td>
<td>2.8</td>
<td>Student M: 4 / 6 (+2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Student N: N/A (N/A)</td>
</tr>
<tr>
<td>8</td>
<td>207</td>
<td>27.1%</td>
<td>53.6%</td>
<td>7</td>
<td>2.6</td>
<td>Student O: 7 / 6 (-1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Student P: 4 / 6 (+2)</td>
</tr>
<tr>
<td>4</td>
<td>203</td>
<td>26.6%</td>
<td>53.7%</td>
<td>10</td>
<td>3.1</td>
<td>Student G: 7 / 5 (+2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Student H: 5 / 6 (+1)</td>
</tr>
<tr>
<td>1</td>
<td>229</td>
<td>24.9%</td>
<td>57.9%</td>
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<td>33.5%</td>
<td>71.4%</td>
<td>11</td>
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<td>88.3%</td>
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<td>Student R: N/A (N/A)</td>
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higher post-test scores, or perhaps the amount of responsibility and free-will they were immersed with in the pairings was enough to push these students higher.

Conversely, the students with pre-test scores amongst the class average that saw the highest gains in post-test scores had some of the lowest proportions of non-autonomous feedback in their critiques. These students are moving to either more advanced positions of *multiplicity / relativism* or to the beginning positions of *commitment* (where a student begins to identify a sense of self within their work). For these students, the lower percentages of non-autonomous feedback likely gave them the room to expand their own processes that better align with their own value sets, not the ones necessarily imposed by someone else. The dynamic of the paired settings for these students, however, was likely from a different perspective than of the lowest-rated pre-test students. Instances where a student with a pre-test score of a 4 or 5 was paired with a student having a higher pre-test score, the student with a pre-test score of a 4 or 5 always advanced in their post-test scores. However, when the same type of student was paired with either a student of the same pre-test score, or a lower pre-test score, the post-test scores either regressed or stagnated. This outcome seems to indicate that the cognitive development of students was somewhat influenced by their partnerships. Students with a pre-test score of a 4 or 5 that advanced in their post-test scores might have felt free to self-discover processes and responses without fear of jeopardizing the group dynamic. Whereas students with a pre-test score of 4 or 5 that regressed in their post-test scores might have felt restrained to stay within processual parameters in order to maintain a balanced group dynamic.

### 8.2 Potential Explanations for the General Regression of the Highest-Rated Pre-Test Scores

Students with pre-test scores of 7 or higher were believed by the interview judges to have at least the beginning positions of *commitment* in their arsenal. While it is plausible to claim too much non-autonomous instruction, or estranged roles within pairings as the responsible party for this regression, a caveat in the Perry scheme exists that offers a different explanation:

“In any of the positions in the main line of development a person may suspend, nullify, or even reverse the process of growth as our scheme defines it… growth, as we saw it, was rarely linear and more usually wavelike. Growth, we felt, usually occurred in surges. Between the surges, a person might pause to explore the implications of his new position. Or he might lie fallow, waiting for the resurgence of strength to meet the next challenge. On occasion he might even have to detach himself from the whole business, or retreat to old positions, in order to assure himself that he was still his own man. Then, after having found that he was still free to choose, he could know any reengagement to be an authentic act, not an enslavement (Perry, 1970).”

It is likely that this regression is a completely natural phenomena amongst these students - that when entering an entirely different field, an initial regress sometimes occurs before further advancement can ensue. Follow-up interviews with these students at later dates would be necessary in order to test this theory. However, within the one semester duration of this study, it is not possible to determine whether this regression is part of a longer natural process, or an example of teaching styles and group pairings having an adverse effect on the cognitive development of these students.

### 8.3 Appropriateness of Group Pairings in Studio Environments

Collectively, the results from this study bring into question the legitimacy of traditional conventions used for forming groups in studio environments. Many times, teachers form groups that attempt to guarantee at least mediocre results from each group – often pairing someone that is highly skilled in one area, with someone that lacks the same rigor or competency of the same skill. While these pairings typically deliver average, or even above-average outcomes, the formation of the groups in this way emphasizes product over process. What if groups were formed based on cognitive positioning? What if groups were formed based on similar or differential value sets, as opposed to skill sets? Furthermore, are group pairings even an appropriate tool for students with a cognitive score of 7 or higher? If the regression of students with the highest-rated pre-test scores is in any way attributed to adverse effects of group dynamics, the argument could be made that these students would be better off using self-learning pedagogies. While there are inherently other intangible benefits to working in groups, perhaps the aggregate cognitive development of these students could be further advanced using other mechanisms.

Observation of the student-led comments during the desk critiques also brings the effectiveness of group pairings as a tool into question. In some cases, the student with the higher pre-test score dominated the
amount of discussion coming from the student side of the table. When this is the case, does this devalue the currency of critiques to only benefit one student? Are the students with lower pre-test scores than their partners almost entirely learning from their partners’ decisions, rather than input from the teachers? Future studies in accessing group dynamics would be needed to provide responses to these questions, but this study nonetheless brings these issues to the fore of studio make-up.

9 IMPLICATIONS

9.1 Student Placement in Courses and Programs

In considering the placement of students in a studio course, much like most courses in the collegiate experience, a tabulation of pre-requisite courses is typically used to determine a students’ readiness for a particular course. The assumption being that if a student has simply passed a previous set of courses, then they should be equipped with the tools to take on a more technically-advanced course. However, passive observation of previous studio courses, and of the audio recordings from this study in particular, expose the difficulty that teachers have in mastering the mental gymnastics involved in bouncing around from one student to the next – often having to switch gears from talking to a student with a lower cognitive rating, to one with a higher rating, and then back to a lower rating in back-to-back-to-back succession. By nature, the teacher seems to default to a sort of middle-ground nomenclature of language that can somewhat satisfy the needs of all students without much consideration of an individual’s cognitive positioning. This was especially evident in some of the desk critiques involving students with the highest pre-test ratings from this study. Instructing in this format may be an effective tool in nearly assuring that the collective of students in a course meet the middle-ground standards of expectation, however, the results of this study make the case that this type of discourse may be adversely affecting the cognitive development of those yearning a different kind of student-teacher interaction.

What if students were placed in some courses, like studios, based on parameters other than a passing grade in a pre-requisite series of courses? What if students in these courses were placed on the basis of a combination of cognitive standing and self-interest? While future studies would be needed to assess the cognitive movement of students in a course with almost entirely similar cognitive pre-test scores, it is a safe assumption that the role of the teacher in generating individualized discourse would be a much easier task. Perhaps even allowing for more appropriate types of discussion to take place as teachers would only need to adjust their discourse within a narrow range of cognitive typologies.

At an even broader scale, what if students were admitted to programs or placed within programs based more heavily on factors of cognitive positioning? Many design programs have historically placed a large value on the display of technical competency in applicants’ portfolios. However the ability to produce an artful expression of one’s work does not necessarily correlate with future cohesion within a program, or provide insight to an applicant’s own motivations for growth.

9.2 Evaluating Growth

In the context of academic institutions, cognitive growth can be defined in many ways. Much of the American education system, starting at the earliest stages in primary school and many times transpiring all the way through colleges and universities, is focused on meeting pre-determined performance goals at certain checkpoints along the way. Taking into account the diverse make-up of students’ cognitive positions within any given course, is it really fair to evaluate change based on a unilateral metric of performance for the entire class? Perhaps a metric more focused on individualized mastery of topics would be more appropriate in this scenario – particularly for students with a score of 7 or higher in the Perry scheme that are seeking to more closely identify their work with a sense of self.

10 LIMITATIONS & FUTURE DIRECTIONS

10.1 Potential for Varying Definitions of Growth among Different Ages, Genders, and Cultural Backgrounds

Furthermore, can it even be assumed that all students have the same definitions of growth in academic setting? Noted in many earlier criticisms of the Perry scheme, is the lack of consideration for age, gender, and cultural biases that may exist. While the Perry scheme, and this study, assumes a general consensus among students to covet positions of commitment as the most-advanced positions of cognitive development, this may not necessarily be the opinion of all students. Future studies that use self-defined interpretations of growth for
each student as the metric of pre- and post-test evaluation could provide additional insights into unpacking these biases.

10.2 Lack of Desk Critiques with Individual Students and Individual Teachers

Due to the students working in pairs for nearly the entire semester, it is not possible for this study to determine what differences in teaching styles and cognitive development may have ensued if a more individualized approach were utilized. Additionally, the most prevalent use of the audio-recording devices appeared to occur during studio sessions when both teachers would talk to the student pairings at the same time. While there were occasions when an individual teacher would conduct desk critiques with student pairings without the presence of the other teacher, the use of the audio recording devices in this setting tended to be not as common or would only capture a handful of conversations with some of the students, thus were not included for analysis in this study.

Given this scenario, it also becomes difficult to create a baseline desk critique typology for each student, as opposed to treating the two students in a pairing as one. Had there been a series of desk critiques with individual students throughout the semester, in additional to the critiques with the pairings, it would have been possible to discern which students were heavily influencing the structure of the group critiques. While this study did examine a desk critique with different student pairings from early in the semester, it was not possible to establish an individual baseline from these critiques due to the presence of another student and limited sample size.

10.3 Sample Size and Duration of Study

As previously acknowledged, although the student sample size and duration of this study is limited, it has never been the intent to draw statistical significance from any of these findings. Rather, the purpose of this study is to bring into question some of the traditional techniques that have been long-used in design pedagogy, and to provide a general framework for analyzing student-teacher interactions in relation to cognitive development. Although it would be difficult to increase sample size to levels of statistical significance without expanding to other universities/programs, a more longitudinal approach could yield intriguing results and would be more easily achievable. Would students that regressed in this study experience newfound levels of cognitive growth in the future? Would students that advanced their cognitive position in this study continue on a linear path toward higher levels of commitment? In ways similar to the original Perry studies, it would be interesting to follow students from inception to completion of a program, and track their development through interviews and audio-recordings throughout the process.

10.4 Scoring of Data

Though formulating consensus cognitive positioning ratings for each student was done by the judges with relative ease, a larger sample size would have proven useful to further verify the scores given. In many cases the judges would narrow down possible scores for a student to one of two options (i.e. “she’s definitely either a 6 or a 7” or “I think he’s either a high 4 or a low 5.”), and then they would have to further delve into discussion of specific quotes from the student interviews in order to agree on a final rating. While the judges seemed to exert a high degree of confidence with each score given, changing some of the cognitive position ratings up or down one point would have likely made a difference in the findings of this study.

With this in mind, the willingness for each student to speak and provide explicit details of their beliefs played a prevalent role in the judges determining of ratings. Those that were more extroverted in expressing their thoughts provided more than enough data points to confidently assign a score. Whereas students that were more introverted during the interviews were subject to having larger weight being placed on the comments that were said.

For the desk critiques, using the Goldschmidt coding scheme proved to be an effective method for categorizing teachers’ comments. However, the methodology used for coding non-autonomous clusters would likely need more definition if used in future studies. In the vast majority of cases it was clear to determine whether the instruction of the teacher was said with autonomous or non-autonomous intent. Being said, intricacies of word choice (i.e. “should” vs “could”) and tone (i.e. trustful vs disbelieving) would need more clarification for the metric to be a more encompassing tool in future studies.

10.5 Potential Reactivity of Participants from being Knowingly Recorded

It is plausible to believe that individuals, both student and teacher, may have somewhat altered their behavior as a result of an awareness to being observed. Attempts were made, however, to effectively mitigate
this as a defining factor in this study. During the pre- and post-test interviews, part of the interviewer’s role in the beginning stages of each conversation was to establish a sense of rapport with each student as much as possible. These attempts ranged from quick discussions on topics other than those relevant to the study, to clearly explaining the purpose of the interviews as being purely about the students’ opinion, and that ‘right-and-wrong’ answers did not exist. While there were some students that exhibited a physical hesitancy to speak freely in the pre-test interviews, these tendencies were all but absent in the post-test interviews, and did not seem to be much of a factor from the audible nature of the recorded desk critiques. If future studies wished to address this concern with more bravado, then perhaps using an interviewer with a longer-held relationship to the students would be more appropriate.

11 CONCLUSION

Despite the small sample size of students / coded critiques and duration of the study, the correlations found in the cognitive development of students and in tendencies from the desk critiques appear to follow consistent patterns. In particular, the results point to four linkages that were most noteworthy:

1. The general advancement of students with the average and lowest-rated pre-test cognitive scores.

2. The general regression of students with the highest-rated pre-test cognitive scores.

3. The tendency of individual students’ cognitive positions within each pair to gravitate toward each other over the course of the semester.

4. The correlation between more frequent use of non-autonomous clusters with stagnation or regression of students in the average cohort of pre-test cognitive positions (4 and 5).

Collectively, these linkages bring into question many of the common practices associated with design studio pedagogy. Should critiques be more focused on individual cognitive positioning? Is group work an effective learning mechanism for all students? Should means other than pre-requisite credits be considered for placing students in studio courses? Should there be parameters for evaluating student growth and development other than exemplifying a competency to meet performance goals?

Responses to these questions could serve as the impetus for future research; which is in many ways in high demand due to the lack of educational training that the design educators of today receive. As Dr. Ryan Hargrove, professor in the Landscape Architecture Department at the University of Kentucky, explains (2007, p. 3):

“An examination of design education reveals the lack of instructors’ formal training in education / learning theory. While many design instructors are accomplished professionals, this competency does not automatically translate into the skills needed to help others reach their creative potential... Refusing to acknowledge the shortcomings and limitations of the current educational approach is creating inferior conditions across all design professions.”

Design educators need access to this sort of information. For many, the intricacies involved in educational training or learning theory are all aspects that must be learned on-the-job. While this lone study does not seek to provide answers to these topics, it is the hope that both the methodological framework and findings presented can serve as a useful platform for future research endeavors.

12 REFERENCES


PERSONALITY TYPE AND STUDENT PREFERENCE IN THE DESIGN STUDIO

BARTHELMEH, MIKE
Lincoln University, Canterbury, New Zealand. mike.barthelmeh@lincoln.ac.nz

1 ABSTRACT
Some authors believe that student learning outcomes can be improved by catering for different 'learning styles', while others suggest that there is little evidence to support a pedagogical approach based on learning styles. One approach to understand how people learn best is to establish how they prefer to take in and process information. The Myers-Briggs Type Indicator (MBTI) reveals these preferences through type: 'personality type' may be a better identifier of appropriate learning strategies than 'learning styles'. A pilot study investigated student achievement and experience using different levels of content in two landscape architecture studio project briefs. One brief was deliberately open, allowing interpretation, while the second was detailed with explicit requirements. Student MBTI types were established as predominantly Intuitive-Feeling (NF; 63%). NF students tended to prefer the 'open' brief, while Intuitive-Thinking (NT) and Sensate-Feeling (SF) students preferred the detailed brief. Teachers need to be aware that their own preferences for learning may need to adapt to the likely range of personality types in each student cohort, to enable teachers to appeal to the learning preferences of as wide a range of students as possible. There is also merit in considering other implications for learning of understanding type and preference.

1.1 Keywords
landscape education, learning styles, personality type, MBTI
INTRODUCTION
Teaching in a landscape architecture design studio is sometimes challenging but always rewarding, working with creative students on aspects as diverse as understanding complex relationships between natural and cultural systems, the resolution of frameworks of green and blue infrastructure, or the development of sensitive responses to landscape change while enhancing cultural connections to place. Writing the brief for a studio project can also be challenging, balancing the directive (I want you to be able to demonstrate this) with the open (I wonder what might happen if we first create a haiku about the emotion of place). It can be challenging for students receiving a brief too; some students seem to respond better to a very detailed studio project brief which carefully itemises everything that they need to do to complete a successful project, while other students seem to prefer a more open brief which sets out a broad direction but leaves plenty of room for interpretation, and the form of a final submission. This observation gives rise to questions, including: Why do some students prefer one type of studio brief, while others prefer a different type? What might drive these preferences? Do these preferences affect the student learning experience or levels of achievement?

A research question evolved from these initial musings: "Do the levels of information provided in a studio brief affect student experience and performance?". If the answer is yes and we can understand what those effects are, then we will be in a position to potentially improve the learning experience for students, catering for a wider range of preferences. In this study, 'preference' means the expression of our behavioural tendency for optimal choice; we like one alternative more than another alternative.

LEARNING STYLES
Much research on student learning is based around the notion of 'learning styles'; for example: Ashraf, Fendler, and Shrikhande, (2013); Fowler and Thomas, (2015); Kim, Gilbert, and Ristig, (2015); and Kozhevnikov, (2007). The general premise of this work is that people learn best in different ways; they vary in their preference for particular teaching approaches and if learning opportunities are provided that suit their learning style, academic achievement will be 'better'. There are many theories about learning styles, comprehensively summarised by Cassidy (2004), but well known examples include 'experiential learning' which led to the Learning Styles Inventory (Kolb, 1984; 2015), and the VARK model (Fleming & Mills, 1992).

The VARK model is a system of categorising learners by how they best absorb and remember information (and thus learn better), with four suggested modes:

V - Visual (seeing images, diagrams)
A - Auditory (listening to lectures, discussion)
R - Read/write (books, articles, taking notes)
K - Kinaesthetic (practical, experience, hands-on)

In this model, visual learners for example prefer to access information "...in maps, spider diagrams, charts, graphs, flow charts, labelled diagrams, and all the symbolic arrows, circles, hierarchies and other devices, that people use to represent what could have been presented in words." (VARK, 2016). Fleming (1992) suggests that if we can identify those visual learners in a class, teaching materials could be refined to appeal to their learning 'style' and thus they would learn better, their experience would be better, and their academic achievement should improve.

Theories such as the VARK model generally propose that we should modify our teaching approaches to cater for particular learning styles, since this will improve student learning outcomes. However, work by authors including Cuevas (2015); Lilienfeld, Lynn, Ruscio, and Beyerstein (2010); Pashler, McDaniel, Rohrer, and Bjork (2008); Pashler and Rohrer (2012); and Willingham, Hughes, and Dobolyi (2015) suggests that there is little evidence to support the adoption of a pedagogical approach based on learning styles. Since these authors do not support a link between teaching approaches which target specific learning styles and improved student learning, is there something else which might underpin student expressions of preference for different teaching approaches?

Teachers also have their own preferences for learning and it is likely therefore that they will tend to deliver their material in a way that is influenced by those preferences. Some teachers may be more comfortable presenting ideas or information using a facts-based approach, while others might prefer presenting the same material using a broader, big-picture lens. If we consider say auditory learners (which the VARK model suggests prefer listening to information), then we know that the lecture they are attending could be delivered in several ways, for example as a detailed facts-based presentation, or as a series of broader themes which touch on the wider contextual aspects of the topic. One of those lecture approaches is likely to appeal more to some students...
than the other approach, even if they are all auditory learners. This suggests that the VARK 'learning styles' modes could be understood as a 'secondary layer' that is influenced by something more fundamental.

Preferences for the ways in which information is presented, how we take in that information or process it to make decisions might be a more useful fundamental measure or explanation of difference. The expression of these innate behavioural preferences, or our personality, is a potential contender for that underlying role. Thus, a supplementary research question arises: "If levels of information provided in a studio brief affect student experience and performance, is this related to their personality?". To answer this, we need to understand how to categorise personality.

4 PERSONALITY TRAIT AND TYPE

Personality is "the complex of characteristics that distinguishes an individual or a nation or group; especially: the totality of an individual's behavioral [sic] and emotional characteristics." (Personality, [Def. 3a], n.d.); and "Personality refers to individual differences in characteristic patterns of thinking, feeling and behaving." (Personality, n.d.). Personality then is defined very much on an individual basis, the aggregation and expression of a wide range of different facets possessed by each person. As with learning, there are many theories about how to understand personality; there are also many instruments which can be used to uncover or establish personality type.

These instruments are normally based on trait or type theory. Trait instruments are designed to establish regular and consistent patterns of behaviour resulting from the combination of particular factors being measured along a continuum. Type instruments are designed to establish individual preferences for equally viable alternatives, based upon the assumption that one will be inherently more appealing than the other. A key difference between these two approaches is that participants using a trait instrument can gain a high or low score for a particular trait such as intelligence, for example; it is about having 'more' or 'less' of that trait, a measure of the degree to which that trait is expressed. Conversely, type systems are sorting systems, which determine the level of clarity that participants identify for each of their preferences rather than the 'amount' of that particular preference (Myers, McCaulley, Quenk, & Hammer, 2009). Quenk (1993) further elaborates by noting that measuring trait assumes "...a normal distribution and continuous scores" (p. 9) whereas type is "...not normative; there is no 'normal' or 'best' score to obtain or type to be." (p. 11).

Trait instruments include attributes which can be valued differently, such as intelligence as noted previously, or age. For example, it is 'better' to have higher intelligence than low, and in some cultures (Maori or Chinese communities, for example) older people are valued and respected for their experience and knowledge while in other (predominantly Western) cultures, older people can be deemed less relevant or useful to society. Fleeson and Jayawickreme (2015) suggest that trait theories do not show how these differences are expressed in individual behaviour. In type theory, all attributes are valued equally; they are simply describing the way we are without prioritising one aspect over another. Most personality theories or instruments such as the Revised NEO Personality Inventory (NEO PI-R) are trait-based.

The NEO PI-R was developed by Costa and McCrae in 1992 from their work researching age-related changes in personality, based upon a Five Factor Model (FFM) which measured the following factors (Hogrefe Ltd., n.d. a):

- Neuroticism (identifies individuals who are prone to psychological distress)
- Extroversion (quantity and intensity of energy directed outwards into the social world)
- Openness (the active seeking and appreciation of experiences for their own sake)
- Agreeableness (the kinds of interactions an individual prefers), and
- Conscientiousness (degree of organisation, persistence and motivation in goal-directed behaviour)

Costa and McCrae (1992) believe that this is a useful instrument in clinical psychology practice, to describe the behavioural characteristics of an individual. There are six sub-elements under each of the five factors in the NEO PI-R, and particular combinations of these categories provide a comprehensive assessment of normal adult personality. The NEO PI-R is used in the occupational market for job-related assessment, vocational guidance, and counselling (Hogrefe Ltd., n.d. b).

The most well-known type-based instrument is the Myers-Briggs Type Indicator (MBTI), which measures preferences, rather than abilities. The MBTI was developed by Katherine Briggs, an American intellectual who studied and applied psychiatrist Carl Jung's theory of personality, which was published in his seminal work "Psychological Types" in 1921. Jung developed a theory of personality from his observations that differences between people are not random, but form patterns which he considered to be 'types'. In 1943, with
her daughter Isabel Myers, Briggs assembled the first version of the MBTI instrument, providing a vehicle to understand basic preferences of behaviour in four areas:

- How people focus their attention (Extroversion-Introversion: E-I);
- How they take in information (Sensing-iNtuition: S-N);
- How they process that information to make decisions (Thinking-Feeling: T-F); and
- How they engage with the world (Judging-Perceiving: J-P).

The combination of preferences for one of each of these dichotomous pairs of attributes results in 16 basic types each with a unique four-letter code; further refinement occurs with five aspects expanding on each attribute. The MBTI theory regards all types as equal and seeks to better help people understand themselves and others rather than using type to select or limit choices say in job-related decisions. The instrument must be taken voluntarily and results are confidential to the individual (Myers and Briggs Foundation, n.d. a).

Confusion still exists in the literature about the differences between trait- and type-based instruments. For example, the MBTI is incorrectly referred to as a prominent trait model in Matz, Chan, and Kosinski (2016); Ashraf et al. (2013) similarly refer to "MBTI traits" in their work on learning styles (p. 50). It is clear that although both the NEO PI-R and the MBTI seem to be useful in attempting to explain or understand the ways in which people express different preferences, there is still some confusion about their theoretical foundation; they are also both subject to ongoing critique.

4.1 Critique of personality instruments

There is general critique of the value or efficacy of personality instruments, as well as specific critique on the NEO PI-R and the MBTI. Psychologist Linda Berens (Berens, 2013) suggests for example that we each have many different facets that are richer than can be explained by the responses to a simple questionnaire; her view is that we have a core self overlaid with a contextual self (which is more adaptable to circumstance) and a developed self which has responded to both nature and nurture. The question she poses therefore is about which self is responding when completing an instrument which claims to help us understand who we are: behaviour is subjective and largely contextual. Both the NEO PI-R and the MBTI have also been criticised because of the vested interests of the commercial entities which promote them.

Pashler et al. (2008) presented a clear argument about a lack of evidence to support the value of 'learning styles' in education; they suggested that any claimed effect of a specific teaching practice on student learning must be objective and measureable. A similar criticism applies to both trait and type models of personality, in terms of their validity (do they actually measure what they claim to measure) and their reliability (does the same result occur if the test is retaken at a later date). A review of arguments that support or critique the validity and reliability of both the NEO PI-R and the MBTI can be found in Carey and Barthelmeh (2016), but it is helpful to repeat some of those arguments here.

The validity of the fundamental basis for the NEO PI-R, the Five Factor Model (FFM), has been called into question by many authors including Block (1995; 2010); Bouchard (2016); Boyle (2008); Fleeson & Jayawickreme (2015); Gurven, von Rueden, Massenkoff, Kaplan, & Lero Vie (2013); and Juni (1995) who suggested that since the FFM was 'phenomenological' and not based upon theory, its popular use could be attributed largely to Costa and McCrae's influence on fellow psychologists. Boyle (2008) concludes that the FFM should be expanded to acknowledge the dynamic components of personality, while Ben-Porath and Waller (1992) noted that factors of dishonesty and social desirability would improve the NEO Inventories. More positively, Sherry, Hewitt, Flett, Lee-Baggle & Hall (2007) found a high level of internal consistency in the NEO PI-R scales, confirmed by McCrae and Costa (2010).

McCrae and Costa, developers of the NEO PI-R instrument, have critiqued the MBTI (McCrae & Costa, 1989) as have Barbuto (1997), Boyle (2008), and Pittenger (2004), while Capraro and Capraro (2002) and Lloyd (2012) provide support. Much of the critique of the MBTI appears to be based on an incorrect assumption about what the instrument is measuring; for example that preferences are expressed as absolutes. Rather than an 'amount' of Extroversion, for example, the MBTI identifies the clarity of a preference for Extroversion.

Given the questions asked in this pilot project, and the specific characteristics of trait and type instruments, on balance "...the MBTI appears to be the most suitable instrument to use in investigations of learning preferences in the design studio." (Carey & Barthelmeh, 2016, p. 8). Establishing the profile types of students may help teachers to better understand the preferences expressed by learners for particular approaches to teaching; 'type' may be a better identifier of appropriate strategies than continuing to focus on 'learning styles'.

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4.2 MBTI type characteristics

Expressing a preference for one of each of the dichotomous pairs in the MBTI underpins a process which enables the determination of a best-fit type for those taking the instrument. Each of the 16 'types' identified by the MBTI features a particular combination of likely characteristics, but since everyone articulates different behaviours depending upon circumstance and their own mind-set at the time, these characteristics are not rigid or limiting but merely indicators of basic preference; people are likely to use both poles of each dichotomous pair at different times. As noted earlier, individuals articulate preference with different degrees of clarity; each of the four dichotomies is reported with a Preference Clarity Index (PCI; a score of 1-30), where a lower number indicates "...almost equal votes for each opposite pair in a dichotomy." (Myers et al., 2009, p 8). Competence in a particular facet such as Intuition (N) cannot therefore be inferred from the PCI score, unlike trait scores which measure an amount of each characteristic.

Brief descriptions of the attributes of each of the dichotomous pairs are listed in Table 1.

Table 1. MBTI facet characteristics.

<table>
<thead>
<tr>
<th>Preference</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrovert (E)</td>
<td>Focus on and energised by interaction with the external environment; immediate response to questions; sociable and active, assertive, outgoing, action oriented</td>
</tr>
<tr>
<td>Introvert (I)</td>
<td>Focus on personal thoughts and inner experiences; likely to need processing time when asked questions; attention on beliefs and ideas, reflective, accommodating</td>
</tr>
<tr>
<td>Sensate (S)</td>
<td>Facts and realities about present day events; ideas based on observations or concrete experience; systematic, conventional, practical, precise, stable, methodical/sequential</td>
</tr>
<tr>
<td>Intuitive (N)</td>
<td>Theories and possibilities, future oriented; find patterns serendipitously; imaginative, idealistic, creative, bored by routine, prefer abstract conceptualisation, use hunches</td>
</tr>
<tr>
<td>Thinking (T)</td>
<td>Objective judgement through systematic enquiry; logical and impartial, analytical, rational, systematic, assertive, consistent</td>
</tr>
<tr>
<td>Feeling (F)</td>
<td>Subjective values-influenced judgements, with empathy; more subjective, non-linear, demonstrative, loyal and sensitive, implications for people</td>
</tr>
<tr>
<td>Judging (J)</td>
<td>Able to make a decision as soon as enough information gathered; seek closure, plan activities, methodical and controlled, organised and disciplined, structured, conscientious</td>
</tr>
<tr>
<td>Perceiving (P)</td>
<td>Likely to suspend making a decision and continue to gather information; open-minded, spontaneous, flexible, adaptable, tolerant, inquisitive, spontaneous</td>
</tr>
</tbody>
</table>

Note. Table 1 is adapted from a range of sources including Gardner and Martinko (1996); Horten, Clarke, and Welpott (2005); Myers et al. (2009); and Ross and Francis (2015).

The preferences of these different types suggest that certain methods of instruction are likely to suit some types better than other methods. The two important dichotomies to consider in regard to learning preferences of landscape architecture students are how people take in information (S or N) and how they process that information (T or F), making four combinations (NF, NT, SF, ST). The findings show that these are also the two dichotomies in which the respondents in this pilot project and the general population differ the most.

5 PILOT STUDY

To investigate learner preferences, a pilot study was initiated in a third-year landscape design studio course (N=14); approval was obtained from the University Human Ethics Committee. The study was designed to investigate whether or not there is an effect on student experience and performance from the levels of information provided in a studio brief, and if there is an effect, whether or not this is related to personality type.

The class was informed that they would be undertaking two x two-week projects with the same studio tutor, and that approval was being sought to use their experience as part of a research project. The students completed the first two-week project using a brief which was 'open' (with few constraints) and then completed a similar two-week project using a 'detailed' brief (with all requirements explicitly noted). Both projects were marked and moderated using normal school processes and incorporated into students' final studio grades.

Once this formal process had been completed, all students in the class were invited to take part in the research project, which involved them completing a short questionnaire about their experiences in the projects and taking the MBTI instrument. This approach of waiting until final grades had been confirmed was taken to
avoid any perception that taking part or not in the research project might influence final course grades. About half of the class (n=8) chose to take part in the research, reporting that class mates who did not take part cited pressure from other work prevented their involvement.

Since the pilot project was attempting to identify if there was any relationship between the level of information provided in a studio brief and student experience as well as any relationship to personality type, protocols for the research were adapted from Pashler et al. (2008) who were commenting on learning styles. In summary, Pashler et al. (2008) suggest that to reveal whether or not a specific interaction exists between learning and type of instruction:

- Students should be divided into groups on the basis of their learning styles,
- Those in each group are randomly assigned one of multiple instructional methods,
- Students then take a final test or project that is the same for all students.

Pashler et al. (2008) concluded that to prove the efficacy of a teaching approach targeting a particular learning style, students with a preference for learning style 'A' would need to perform significantly better in a final test than students with a preference for learning style 'B', if both groups had been taught with an instructional method designed for learning style 'A'.

In this current pilot study, the whole population (N=14) undertook two different projects rather than splitting the group with each half taking one of the two projects. This means that instruction variation was experienced by the whole group, all students had the same studio teaching approach, and all students had to complete the same project submission. Work was marked by the same tutor and moderated according to standard school processes. This approach provides an opportunity to identify the levels of information preferred by students and ascertain whether or not their preferences had any relationship to achievement or personality type.

Of the students who chose to participate in the research project and complete the MBTI instrument (n=8), two did not finish the second project and so although their type can be reported, it is not possible to also consider their experience of both types of brief.

6 FINDINGS

The research question has two parts: Do the levels of information provided in a studio brief affect student experience and achievement, and if so, is this related to their personality type? This leads to three sets of observations:

- Student experience of each type of brief
- Student achievement
- Student personality type

6.1 Student experience

Students who elected to take part in the research project (n=8) completed a short questionnaire about their experiences. Respondents were asked whether they strongly agreed, agreed, were neutral, disagreed, or strongly disagreed with each of the following statements: "This type of more open project brief suited my design approach better than a brief which is too prescribed."; and "This type of more detailed project brief suited my design approach better than a brief which is too open.". Aggregated responses (strongly agree and agree = yes; disagree and strongly disagree = no; a neutral response = 0) showed four students reporting that the ‘open’ brief suited their design approach better, while two reported that the detailed brief suited their design approach better (one student preferred both, one preferred neither…). The distribution of these responses is shown in Table 2.

Some participants also commented about their experiences of the projects, expanding on their preferences for a more open or more detailed brief: (#2 - ‘open’ better) "The open brief was a nice beginning to the project. Usually on day one when the project is introduced to you, as you haven’t got stuck in yet, it seems extremely daunting. You can’t imagine ever finishing it in 4 weeks and the concepts seem so foreign, so it was nice to have a free sounding brief and it gave you space in your head to think about what you could do, and be creative."; (#5 - ‘open’ better) "The less information was more enjoyable easier to work with and less confusing."; (#6 - ‘open’ better) "It is more beneficial to have a "tick list" of points on the brief to work with, but this seems to limit creativity ( unlike the open brief). With the open brief there was [sic] no 'wrong' answers."; (#7 - ‘detailed’ better) "It was a good indicator about what I preferred and the process I am more comfortable [with]. Although
the first project was a learning curve for me and pushed my boundaries, I was more comfortable in the second project.”.

6.2 Student achievement

Student achievement in project work was determined by grade differences between the two projects. A higher grade in the first project (‘open’) = 1, a higher grade in the second project (‘detailed’) = 2; the same grade in both = 0. Those who did not complete both projects = NC. The distribution of grade differences is reported in Table 2.

6.3 Student personality type

Administration of the MBTI instrument is governed by an ethical process which provides for each participant to identify their best-fit type. The results are confidential to each person, but are able to be shared if the participants agree to do so. In this case, all participants agreed to share their best-fit four-letter type to facilitate discussion about profile differences. Five of the participants were Intuitive-Feeling (NF) types, two were Intuitive-Thinking (NT) types and one was a Sensing-Feeling (SF) type. The distribution of type is shown in Table 2.

Table 2. Summary of brief preference, type, and achievement.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Information in brief</td>
<td></td>
</tr>
<tr>
<td>'Open' better</td>
<td>0</td>
</tr>
<tr>
<td>'Detailed' better</td>
<td>0</td>
</tr>
<tr>
<td>Student achievement</td>
<td></td>
</tr>
<tr>
<td>Higher in 'open' or 'detailed'</td>
<td>NC</td>
</tr>
<tr>
<td>Personality type</td>
<td></td>
</tr>
<tr>
<td>MBTI profile</td>
<td>ENFJ</td>
</tr>
</tbody>
</table>

Table 2 shows that six students were clear in their expression of preference for one type of brief over the other. It also shows that of the three students whose grades either decreased or stayed the same in the second ‘detailed’ project, all expressed a preference for the first project with a more open brief (NF, NF, and NT). Three students’ grades increased in the second ‘detailed’ project; two expressed a preference for the detailed brief (SF and NT) while one had no clear preference. Two students did not complete the second project.

7 DISCUSSION

The personality type profile of the students in this pilot study is similar to that found previously by Brown et al. (1994) in their study of landscape architecture students. The 1994 study used the Keirsey Temperament Sorter "...an easily administered questionnaire to determine the MBTI characteristics of learners." (Brown et al. 1994, p152). The authors showed that their student cohort had a larger proportion of intuitive (N) learners when compared with the general population. The MBTI ‘general’ (base) population, or National Representative Sample (NRS), was carefully selected to match the "...1990 U.S. census on gender and ethnic groups." (Myers et al., 2009 p156). Thus, comparisons of other populations with the NRS mean that conclusions can be drawn about similarities or differences from the general US population.

Table 3 lists the NRS proportions in the first column, with a Multicultural Sample of University Students in the U.S. aged 18-25 (MSUS) in column two adapted from Table 14.3 in Myers et al. (2009, p381). A New Zealand sample of convenience (NZS) is shown in column three for local context, but may not represent the type characteristics of the whole population (Schaubhut & Thompson, 2016). Column four shows the findings of this pilot project (LUS: Lincoln University Students) derived from Table 2, showing a clear difference from the other samples in the S and N dichotomy.

Table 3. Type distribution and comparison with pilot study.

<table>
<thead>
<tr>
<th>Preference</th>
<th>NRS</th>
<th>MSUS</th>
<th>NZS</th>
<th>LUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extroversion</td>
<td>49.3</td>
<td>56.0</td>
<td>59.0</td>
<td>62.5</td>
</tr>
</tbody>
</table>
Brown and Hallet (1994, p. 153) reported S=33% and N=67%, similar to the LUS; their figures, supported by the current findings, indicate that the landscape student population could include two to three times as many people as the general population who prefer an Intuitive approach to learning. Adding the second dichotomy of Thinking and Feeling, Brown and Hallet (1994, p. 153) found that the ratio of NF = 55%; this current research found NF = 63%, compared with the NRS proportion of 16.5%.

We would expect that those who prefer Intuition would be more likely to favour a studio brief that allows them to achieve a creative design response in a flexible manner, while those who prefer Sensing would be more likely to respond positively to a brief which is quite explicit in its requirements. Table 2 shows that expectation to have been met by the pilot group, with three NF students (and one NT) preferring the 'open' brief (the remaining two NF students did not indicate a clear preference), and the 'detailed' brief preferred by the SF student (and one NT student).

It is clear that establishing type in a student cohort, and for teaching staff, will facilitate the opportunity to better meet the learning preferences of landscape architecture students. Many of these students are likely to prefer N and F approaches to teaching; Intuitive learners prefer abstract concepts, innovation in problem-solving complementing Feeling learners who prefer a more holistic, subjective approach. But, we must cater for other preferences: e.g. Sensing learners are more practical and seek hands-on concrete experiences using a methodical process, complementing Thinking learners who want facts presented in a systematic and logical way with a more objective component.

We also need to understand teacher profiles; understanding the profile of students while being aware of their own profile allows teachers to reflect on how best to target learning strategies to meet the learning preferences of as wide a range of students as possible. For example, a colleague who prefers Sensing will tend to deliver material in an objective, methodical, factual manner, expecting to see evidence-based design decisions in the studio supported by a clear inventory of facts. A colleague who prefers Intuition is more likely to present ideas with a subjective, 'big picture' focus, expecting to see an emotional response to the landscape (how it 'feels'), and design decisions to be based upon an individual, subjective response to the poetry of place.

In classes where some students prefer S approaches and others prefer N, teachers who are aware of their own preferences will be able to modify the expression of their own preferences to facilitate connection with more students. A simple summary of the differences between S and N learners in the design studio is shown in Table 4.

<table>
<thead>
<tr>
<th>Activity</th>
<th>MBTI facet</th>
<th>The N student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project initiation</td>
<td>Begins with facts then develops a 'big picture' to suit those facts</td>
<td>Begins with the 'big picture', then finds facts to suit that overview</td>
</tr>
<tr>
<td>Inventory, site visit</td>
<td>A focus on context and experience; notices facts, remembers details; practical</td>
<td>A focus on impressions or patterns; sees new possibilities, works with symbols and theories</td>
</tr>
<tr>
<td>Process approach</td>
<td>Works logically through facts, but may miss new possibilities; concrete experience; adaptive</td>
<td>Leaps between possibilities, but may miss key facts; abstract conceptualisation; innovative</td>
</tr>
<tr>
<td>Learning approach</td>
<td>Prefers sequential learning and collaborative work; fact retention</td>
<td>Prefers holistic learning and independence; idea generation</td>
</tr>
<tr>
<td>Design character</td>
<td>Methodical; pragmatic, 'bottom line'</td>
<td>Intuitive; idealistic, 'visionary'</td>
</tr>
</tbody>
</table>

Brown and Hallet (1994, p. 153) reported S=33% and N=67%, similar to the LUS; their figures, supported by the current findings, indicate that the landscape student population could include two to three times as many people as the general population who prefer an Intuitive approach to learning. Adding the second dichotomy of Thinking and Feeling, Brown and Hallet (1994, p. 153) found that the ratio of NF = 55%; this current research found NF = 63%, compared with the NRS proportion of 16.5%.

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Note. Table 4 is adapted from Sensing or Intuition (The Myers & Briggs Foundation, n.d. b) and The Sensing-Intuition Dichotomy (Myers et al., 2009, p. 263).

Given that we are likely to have both S and N students in a cohort, the Sensing colleague will need to cater for an inventory that also includes poetry and serendipitous elements. The colleague who prefers Intuition will need to cater for those who want to collect the facts before embarking on design possibilities.

Myers et al. (2009) suggest that Sensing types move "…from the particular to the general…" (p. 263) while Intuitive types follow the reverse process; they confirm that both approaches are useful in learning. They further note that expectations can differ between staff and students; for example when Sensing type students ask a teacher to repeat a point, "…they mean it literally. Instead, Intuitive types tend to paraphrase, or to say things in other words, which appeals to their own interest in variety and change. Such an approach can frustrate Sensing types…" (Myers et al. 2009, p. 266). They note that Sensing types need exact repetition for reassurance that they understood correctly.

There were too few respondents to confirm a clear relationship between brief preference and personality type, although the expectation of preference was broadly met, providing a useful guide to a likely relationship. What this pilot study did establish however was a method to test these ideas with a larger cohort of students, as well as finding that the profile of this group was similar to that established previously for landscape architecture students.

7.1 Limitations
This research was undertaken as a pilot study for future work on student learning in the design studio; to establish protocols for ethics approval, test the research design, establish an approach to involve students further in their own learning about themselves, and investigate ways in which the studio learning experience for students can be improved. As a pilot study, certain limitations were evident, including: a small number of potential participants; a relatively small proportion of the population agreeing to be part of the research project; the sequential nature of the two projects and their order; and project timing at the end of semester, with increased pressure from other assessment deadlines. The study does, however, establish a method for future investigation.

8 CONCLUSIONS
Improved student learning is a goal of all teachers. Designing a pedagogy around 'learning styles' has not been proven to be helpful in regard to enhancing student learning or the student learning experience. The insights that can be gained from understanding the preferences of a student cohort should enable teachers to deliver a project or learning activity that appeals to a wider range of learners. Behavioural preference as expressed through 'type' is likely to be a more appropriate method to influence teaching approaches than catering to 'learning styles'; the findings of this study suggest that there is likely to be a relationship between type, experience and achievement. Staff profiles are also important; teachers who prefer S will deliver material in quite a different way to someone who prefers N; both types of teacher need to acknowledge the value of the other approach.

Study limitations could be addressed by adopting the following protocols:

- Number of participants: work with a larger cohort of students to obtain sufficient data for statistical analysis. If small numbers eventuate from a modest or large cohort, use focus groups to understand qualitative experience of alternatives and potentially refine the research question.
- Timing: run a project earlier in the semester, to reduce pressure from other project deadlines and allow more reflection on process and outcomes.
- Project order: Either split the class randomly and run both project variations for each cohort, swapping the project order in each group; or work more closely to the project requirements but adopting a teaching approach which appeals more to sensate students in one half and one which appeals to the intuitives in the other half, to test student experience and achievement.
- MBTI protocols: Ethical use of the MBTI requires participants to know that undertaking the instrument is voluntary, so that it would be possible for an entire cohort to decline to take the instrument; provided project work was a normal part of the course requirements and met the appropriate learning outcomes, students would not be disadvantaged although the research aspect would be terminated.
• Perceived advantage or disadvantage: project learning outcomes need to make an essential contribution to the course learning outcomes, so that students get the right tuition and skills regardless of whether or not there was a research project or whether any of them chose or declined the opportunity to learn about their type.

There is further value in establishing type through the MBTI; comment made by those who attended the MBTI workshop was positive in terms of insight gained into why they may have thought or reacted differently from their colleagues during design studio. It also helped some students to better understand their own preferred way of working, and that their colleagues who worked in a different way were simply expressing different preferences, not working better or worse than they were.

We should be flexible in our approaches to teaching delivery and be open to difference; understanding how others might prefer to take in and respond to information in a way different from our own way can help staff refine their teaching approach to help a wider range of learners enjoy their learning more, potentially improving learning outcomes. It is important that we do not stereotype our students or limit learning possibilities; someone whose profile type indicates that they prefer an intuitive approach to their learning may still need facts and enjoy hands-on activities. It would be interesting to conduct a larger study to test these ideas further, working with both staff and students to not only apply targetted learning strategies but also help understand why others may respond differently to the same level or type of instruction. Following a cohort of landscape students over their whole programme while recording matters such as levels of information in a brief and student performance would provide an opportunity to test these ideas further.

This pilot study suggests that students of landscape architecture as a group are different from the reference adult population, in terms of their personality types and thus their preferences for particular types of instruction. It also highlights that the type and therefore preferences of academic staff for teaching delivery may match the learning preferences of only a proportion of their class. Academic staff need to remember that there are differences in student learning preferences, and that we need to be aware of these differences to target learning opportunities that meet the needs of as wide a range of students as possible. There is also the opportunity to investigate a wider range of applications of understanding difference or preference expressed through type, such as group work, design communication, or the balance between practical and theoretical learning in a programme.

9 REFERENCES


DESIGN IMPLEMENTATION

Edited by Yi Luo & Paul Coseo
NATURAL SWIMMING POOLS (NSPS) – PRINCIPLES AND TRIALS WITH SITE- CONFORM VEGETATION

ANDREAS, THON
Hochschule Geisenheim University, Germany. Von-Lade-Str.1, 65366 Geisenheim, andreas.thon@hs-gm.de

WOLFRAM, KIRCHER
Anhalt University, Bernburg, Germany. Strenzfelder Allee 28, 06406 Bernburg, wolfram.kircher@hs-anhalt.de

1 ABSTRACT
Natural swimming pools (NSPs) offer a new way to swim in fresh water that has not been treated with chemicals or preservation agents. Only biological processes purify the water. (Kircher & Thon, 2016, derived from FLL, 2006 & 2011). NSPs are purified by three different filtering methods, which effect either a phosphorus (P-) or a carbon (C-) limitation to guarantee clear water and low string-algae stock. Awareness of growth control by limitation of one nutrient is derived of basic plant nutrition research from Sprengel and v. Liebig (Liebig, 1876), transferred on anthropological NSPs including normative regulations such as FLL 2006 & 2011 and Önorm 2013. As a side product of the Phosphorus limitation, the nitrogen content in NSP waters tends to oligotrophic conditions. Most plants, which are generally used on filter bodies in NSPs, grow weakly and show severe deficiency symptoms (Kircher, 2007).

The authors tested plants from oligotrophic bogs and fens on filter bodies of the “Technical Wetland” principal with three different variants of water percolation. These trials were run at Anhalt University to find resilient plant combinations for filter zones of NSPs. Good results were achieved mainly from fen plants, which are recommended for P-limited pools, since these comprise the necessary water hardness and a high pH value. For C-limited systems with low hardness, plants from acidic bogs are suitable. Sphagnum mosses however must be selected carefully since capabilities of Sphagnum species depend strongly on the water percolation.

1.1 Keywords
natural swimming pool, planting design, nutrients, water purification, bog, fen, Sphagnum
2 INTRODUCTION

Natural swimming pools (NSPs) are sealed against the subsoil and comprise a swimming area and a regeneration area. They are designed especially for swimming. Water must not be treated with any chemicals or UV radiation (FLL, 2006; ÖNORM, 2013; Grafinger 2004). NSPs integrate well into the environment, are gentle on eyes and skin. Only biological processes purify the water so there are no harmful side effects of chlorine, chlorine dioxide, mineral salts, organic biocides or ozone, which usually are added to the water of conventional swimming pools. Chemical treatment as well as UV radiators are not acceptable in natural pools because it reduces or disables the desired biological activity (Kircher & Thon, 2016, derived from FLL, 2006 & 2011).

NSPs can play an important role as a part of stormwater management by reducing the discharge speed of rainwater and unburden local sewage systems (Thon, 2009, Dunnett & Clayden, 2007). In private gardens NSPs promote the biodiversity by increasing the flora and fauna species compared to a conventional garden design which emphasises lawn or monoculture plantings (see Thon, 2009, Abromas, Grecevicius, Marcius, 2007).

2.1 Filtration types of NSPs

Depending on scientific results of the trial at Anhalt University, on water movement, filtration techniques, partitioning and construction type of the swimming area the authors distinguish between four models of NSPs (table 1):

1. Standstill water body: densely planted filter zone (="Hydrobotanical System")
2. NSP with surface flow + Hydrobotanical System (HBS)
3. NSP with percolated planted filter bed (=Technical Wetland; TWL) + Hydrobotanical System
4. NSP with quickly percolated filter bed (= Biofilm accumulating Substrate Filter; BSF).

Microorganisms developing on the surfaces of the filter granulate form a biofilm that provides a very effective filtration. In Type 4 plants function as a decoration only (FLL, 2006; ÖNORM, 2013).

Table 1: Different filter models of NSPs (Kircher & Thon 2016).

<table>
<thead>
<tr>
<th>Limological classification and planting</th>
<th>Hydrobotanical System (1)</th>
<th>Hydrobotanical System (2)</th>
<th>Technical Wetland (3)</th>
<th>Biofilm accumulating Substrate Filter (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limological classification and planting</td>
<td>Standing water body with densely planted filter zone without surface flow or water movement</td>
<td>Slowly perfused with densely planted filter zone with surface flow</td>
<td>NSP with slow and possibly intermittently percolated, planted filter bed; should be combined with a Hydrobotanical System</td>
<td>Intensively, mainly vertically percolated filter beds with high water permeability, planted only for decoration. Permanent fast water movement</td>
</tr>
<tr>
<td>Main purification</td>
<td>Plants and plankton</td>
<td>Plants and plankton</td>
<td>Substrate, helophytes and microorganisms adjacent to roots and stems</td>
<td>Microorganisms developing on the surfaces of the filter granulate form a biofilm which provides a very effective filtration</td>
</tr>
<tr>
<td>Maintenance requirements</td>
<td>Trimming and harvesting plants</td>
<td>Trimming and harvesting plants</td>
<td>Trimming and harvesting plants</td>
<td>Regularly backwashing the Substrate Filter</td>
</tr>
</tbody>
</table>

Physical treatment, such as UV radiation, subsonic devices, copper salts and any items, which effect a non-selective impact on the water biology do not meet the requirements of guidelines for NSPs (FLL, 2011, ÖNORM, 2013). To guarantee clear water and a low string-algae stock, either phosphorus (P-) or carbon (C-) limitation should be envisaged (see Jaksch, Wesner & Fuchs, 2013).

Inundated zones of meso- to eutrophic standing waters accommodate a diverse range of plant species. In NSPs with percolated filter systems, such as Technical Wetlands, the nitrogen level constantly declines to a
very low level due to nitrification and denitrification processes (Baumhauer & Schmidt, 2008). The low nitrogen content will even effect oligotrophic conditions. Thus, most plants, which are generally used on filter bodies, grow weakly, mainly in NSPs of type 3 and 4 (Kircher & Thon, 2016).

2.2 Partitioning types of NSPs

Natural swimming pools can be designed as a single unit or as a series of two or more water bodies. The regeneration area comprises the filter as Hydrobotanical System, Technical Wetland or rather Biofilm accumulating Substrate Filter.

Partitioning type A
In situ: Regeneration area completely within the swimming area
(single-chamber system)

Partitioning type B
In situ + ex situ:
Regeneration area partly outsourced
(here: multiple-chamber system)

Partitioning type C
Ex situ: Regeneration area completely outsourced
(here: double-chamber system; the regeneration area could also comprise several bodies)

Figure 1. Schematic Partitioning Types for NSPs (Kircher & Thon, 2016)
2.3 Construction types of NSPs

The following principle-sketches show simplified sections of four possibilities how to frame the swimming zone (Kircher & Thon, 2016):

<table>
<thead>
<tr>
<th>Sketch</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="No wall sketch" /></td>
<td><strong>No wall:</strong> The edges of the swimming area are only modelled into the underground with a more or less steep slope and covered by the sealing. A covering of stones may be set on the slope to embellish its appearance.</td>
</tr>
<tr>
<td><img src="image2" alt="Wall on sealing sketch" /></td>
<td><strong>Wall on sealing:</strong> A vertical wall framing the swimming area is constructed on the sealing. Natural stone walls or timber constructions are commonly used. Outside a special substrate is filled between sealing and wall, implementing the filter systems or planting zones.</td>
</tr>
<tr>
<td><img src="image3" alt="Wall under sealing sketch" /></td>
<td><strong>Wall under sealing:</strong> The vertical wall defining the swimming area is built with concrete, masonry or special plastic elements. Outside sand is filled up to the intended depth of the regeneration area and compressed. Finally the sealing is placed on top.</td>
</tr>
<tr>
<td><img src="image4" alt="Separate pool sketch" /></td>
<td><strong>Separate pool</strong> (analogous to partitioning type C): A pool without any regeneration area is built separately (regeneration area completely outsourced). A rectangular pool without any marginal plantings offers the possibility of covering the surface with a protection roller when not in use. This is the easiest variant for converting existing traditional pools into naturally purified ones: from the integrated skimmer the water will no longer be conventionally treated, but bypass through a filtration pool or chamber.</td>
</tr>
</tbody>
</table>

A detailed description of these characters as well as of the following models is given in Kircher & Thon, 2016.

2.4 Principle models of NSPs

The 4 basic models of natural swimming pools are defined according to their filtration equipment. Table 2 shows possible or rather recommended pool constellations.
### Table 2: Four hydraulic and filtration types combined with three partitioning types result in nine models of NSPs (derived from Kircher & Thon, 2016)

<table>
<thead>
<tr>
<th>Partitioning type + recommended construction types</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In situ:</strong> Regeneration area entirely within the swimming area (single-chamber system)</td>
<td>1A</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>In situ + ex situ:</strong> Regeneration area partly outsourced (double- or multiple-chamber system)</td>
<td>2A</td>
<td>2B</td>
<td>---</td>
</tr>
<tr>
<td><strong>Ex situ:</strong> Regeneration area completely outsourced (double- or multiple-chamber system)</td>
<td>3A</td>
<td>3B</td>
<td>3C</td>
</tr>
</tbody>
</table>

- **1** Standing bodies of water without technical installations
  - only natural circulation
  - **HBS ≥ 65 % densely planted area**

- **2** Bodies of water with surface flow
  - water slowly flows through planting zone
  - **HBS ≥ 50 % densely planted area**

- **3** Bodies of running water with Technical Wetland filtration
  - Percolation at moderate speed (<300 l/m²/hr) through planted filter bed
  - **HBS ≥ 30-40 % densely planted area on percolated substrate**

- **4** Bodies of running water with Biofilm-accumulating Substrate Filter
  - Controlled fast percolation
  - (>> 500 l/m²/hr) through substrate filter
  - **BSF ≥ 25 % filter area**
  - (≥ 5 - 20 % for professional systems); can be combined with TWL and HBS

---

**HBS** = Hydrobotanical System; **TWL** = Technical Wetland; **BSF** = Biofilm accumulating Substrate Filter

#### 2.5 The limiting factor as main approach to combat algae

According to the rule of the limiting factor from Sprengel and v. Liebig (Liebig, 1876) the main strategy of natural pools is to bring either carbon (C) or phosphorus (P) into minimum to combat algal emergence. These strategies demand contradictory measures to work successfully: C-limitation works best in soft water and at low pH, whilst phosphorus is eliminated through sedimentation as insoluble compounds, such as apatite, in hard water with a pH around 8.3 (Jaksch, Wesner & Fuchs, 2013). Pools of model 1 to 3 will work successfully with both, C- or P-limitation. Model 4-pools should operate with P-limitation only. The biofilm in the BSF grows best with high pH and hard water. To promote this, the filter substrate should contain carbonates, so often dolomite gravel is added. In an NSP it is not only P or C which decreases to very low levels, but also nitrogen. Mainly in facilities of model 3 and 4 (table 2) severe nutrient deficiency symptoms and a very weak and unsatisfactory growth occur at the conventionally used plants (Kircher, 2007). Percolated filter bodies are
mostly completely submerged. The range of plant-species, which accept both, oligotrophic conditions as well as a water level of more than 20 cm, is very restricted (Thon, 2014).

3 PROBLEM STATEMENT AND AIMS AND OBJECTIVES

NSPs are defined by purification of water free from chemicals. Due to nitrification and denitrification processes the N-level is often low. Therefore NSP designers and building companies recommend N fertilization to support the vitality of plants, microorganisms and biofilms. This is not consistent to the authors’ and most NSP-customers’ expectations in terms of a purely natural treatment.

NSPs with Technical Wetland or Biofilm accumulating Substrate Filters comprise limnologically a running water system with a low trophic level. The range of suitable plants for oligotrophic running waters is low (Kircher & Thon, 2016).

A research project at Anhalt University, Bernburg, aimed in testing alternative plantings of helophytes on filters and banks of NSPs, which provide an inundated substrate body with a shallow water level (Thon, 2014). The tested plant ranges derive from experiences made with pilot projects of model 2- and 3-pools (Kircher, 2007). Peat mosses (Sphagnum species) dominate certain types of acidic bogs. They even decrease the pH by their ability to exchange absorbed nutrient-cations with H+. Besides testing plant species for their suitability in terms of sustainable vitality the trial should proof, if Sphagnum mosses were able to thrive in NSPs and their impact on string-algae growth. In P-limited NSPs it is crucial to minimize the influx of phosphorus with the refilling water, so the plants’ transpiration should be as low as possible, which also was assessed in the trial.

Trial objectives of the research project at Anhalt University, Bernburg at a glance:
- Finding recommendable plant ranges to use on filter zones of NSPs with hard water (P-limitation, models 1-4, mainly model 4, or soft water (C-limitation; models 1-3)
- Testing the possibility to reduce string algae development by Sphagnum mosses
- Reducing water losses by using plants with a low transpiration rate

Besides the scientific approach to gain more information about the interaction of water quality and plantings in NSPs the authors intend to inform professionals about site conform plantings, which ensure its lush and vital development.

4 METHODS

The authors run the following experimental setup to comply with the objectives stated above. Plants from oligotrophic bogs and fens were tested on filter bodies of the “Technical Wetland” principal. In difference to Biofilm accumulating Substrate Filters this purification method allows hard water as well as soft water (aiming P- or rather C-limitation).

Wooden containers, sealed with a PVC liner (l x w x h = 1,15m x 0,9m x 0,80m) represented smaller sized NSPs of model 3A (see table 2). As filter area (TWL) plastic boxes (l x w x h = 0,80 m x 0,60 m x 0,60 m) were inserted and filled with a substrate: mixture of 50% rhyolite-gravel and 50% lime-gravel (grain sizes in stratification according to the section drawing below). As substrate for the “acidic bog” planting variant (see below) only pure rhyolite (siliceous magmatite) was used.

By investigating plant ranges in oligotrophic natural wetland habitats a significantly higher amount of species occur on emerged sites (bogs and fens), not on inundated sites. For that reason the surface of the filterbodies in the trial were adequately located about 5 cm above water level.
Substrate stratification:
Layer height $\rightarrow$ grain size

- Cover layer according to planting
- 4 cm $\rightarrow$ 2/5 mm
- 10 cm $\rightarrow$ 2/16 mm
- 20 cm $\rightarrow$ 16/32 mm

Figure 2: Section sketch of a trial container with bottom-up percolation. (not to scale) (figure by the authors)

Figure 3: Trial setup which represents NSPs with plastic boxes as filter beds. (figure by the authors)

10 Factor vegetation:
1. Without planting
   - cover layer = gravel 2/8
2. Conventional planting
   - cover layer = Sand + standard substrate
     (“Patzer-Einheitserde”) 1:1
   - Plants per replicate:
     1. Acorus calamus
     1. Carex elata
     1. Myosotis palustris
     1. Mentha cervina
     1. Typha shuttleworthii
     1. Lythrum salicaria
     1. Iris pseudacorus
     1. Caltha palustris
3. Lime fen
   - cover layer = Sand + bog peat 1:1
   - Plants per replicate:
     6. Allium suaveolens
     3. Eriophorum latifolium
     3. Carex viridula
     3. Carex davalliana
     3. Parnassia palustris
     1. Epipactis palustris
     1. Dactylorhiza Hybr.

4. Acidic bog
   - Cover layer = bog peat
   - Plants per replicate:
     2. Eriophorum vaginatum
     2. Sarracenia purpurea
     2. Erica tetralix
     2. Pogonia ophioglòssoides
     2. Narthecium ossifragum
     2. Vaccinium oxycoccos
     - Covered with Sphagnum palustre

11 Factor percolation:
1. Not actively percolated:
   - wall of the plastic box perforated:
     122 holes with 13 mm Ø

2. Percolated top - down:
   - 1500 l/m²/day;
   - On/off in 30 minute intervals

3. Percolated bottom - up:
   - 1500 l/m²/day;
   - On/off in 30 minute intervals

Three variants of plantings (factor vegetation) and three variants of percolation through the filter (factor percolation) were tested by the authors with four replicates (two per container). “Conventional planting” means
helophyte species, which are mostly used on filter zones of NSPs. Most of these species do naturally occur in meso- to eutrophic wetlands. "Lime fen" represents a mixture of species from oligo- to mesotrophic fens with a distinct lime content, effecting an accordingly high pH. "Acidic bog" consists in species from meso- to oligotrophic bogs with very low carbonate content. The pH of the latter is usually below 6. The trials were installed in 2007, assessments followed in 2008, 2009, 2010; further observations - until 2014. Total phosphorus (Ptot), nitrate (NO3) and carbonate hardness (KH) were analyzed. Besides the water quality, water loss due to transpiration, algae growth (dry weight of string algae) and plant vitality were assessed in the trials at Anhalt University managed by Prof. Dr. Kircher.

Increasing the replicates was not possible for monetary reasons. A further research project on a larger scale of NSPs with standardized methods of influencing factors is in progress.

5 RESULTS:
Table 3 shows the enormous fluctuations of dissolved phosphorus (Ptot). The ammonium content was low enough to keep it unmentioned. The very low nitrate values refer to oligotrophic conditions.

Table 3: Measured values in the pool water 31st calender week 2009 (ranges of individual measurements) (Table by the authors).

<table>
<thead>
<tr>
<th>Variant</th>
<th>Ptot / µg/L</th>
<th>NO3 / mg/L</th>
<th>KH / mmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without planting</td>
<td>4,7 – 215,2</td>
<td>&lt; 1</td>
<td>0,4 – 0,8</td>
</tr>
<tr>
<td>Conventional planting</td>
<td>4,7 – 359,5</td>
<td>&lt; 1</td>
<td>1,3 – 1,4</td>
</tr>
<tr>
<td>Lime fen planting</td>
<td>2,4 – 42,6</td>
<td>&lt; 1</td>
<td>1,0 – 1,6 (3,6)</td>
</tr>
<tr>
<td>Acidic bog</td>
<td>23,6 – 288,5</td>
<td>&lt;1 - 4</td>
<td>0,3 – 1,0</td>
</tr>
</tbody>
</table>

It were mainly the fen plants, which brought good results concerning visual effect of the planting and low evapotranspiration losses. Fen vegetation is recommended for P-limited pools, which comprise the necessary water hardness and a high pH value. For C-limited systems with low hardness, plants from acidic bogs have been proven suitable.

NSPs without fertilization can reproduce good water quality with low algae growth though the poor nutrient content will also reduce the activity of microorganisms and biofilm. The comparison of the string algae’s dry weight showed significantly differences between the four planting variants. Figure 4 shows the results from the measurements in 2009. The significantly lowest string algae production occurred in the acidic bog variants, but also the top-down percolated lime fen plots were rated similarly low. Sphagnum mosses formed attractive cushions and could reduce the emergence of string algae in the pool water, though they effected a great fluctuation of the pH. Sphagnum palustre thrived in standstill water, whilst on percolated filters only Sphagnum squarrosum worked well. From these results as well as from practical experiences with case studies of NSPs (Kircher, 2007) the authors derived recommendations for plant combinations in P- and C-limited pools in Kircher & Thon (2016).
Figure 4: Dry weight of string algae in the pool water 2009. Different letters above the variants show significantly different results (T-Test; $\alpha = 0.5$) (figure by the authors).

Even in 2009, in which the conventional vegetation still showed good growth, the acidic bog plots lost more water by evapotranspiration than all other variants. Though Sphagnum-mosses form dense cushions, their transpiration rate must not be underestimated! The water loss effected by lime fen plots was not significantly higher than the loss of non-planted filters. The influence of the percolation direction was low, but bottom-up percolation effected significantly more transpiration than non-percolated plots.

Figure 5: Refilled water in 2009. Different letters above show significantly different results (T-Test; $\alpha = 0.5$) (figure by the authors).
6 DISCUSSION AND CONCLUSIONS:
Mainly on Biofilm accumulating Substrate Filters (BSF), as used in NSPs of model 4, a planting with vegetation from oligotrophic lime fens is site conform, since this technology aims in lime containing hard water with a pH up to 8.4 to support P-limitation (ÖNORM, 2013). Typical lime fen species thrive on saturated substrate rising slightly above water level.

Kircher & Thon (2016) show planting lists for NSPs with lime fen plants in wetland and swamp area plus appropriate species in the neighboring areas. The distribution pattern follows the strategy of randomly mixed plantings according to Kircher et al. (2011). The fen vegetation reduces water loss through transpiration, so there is less need for refilling.

NSPs, which aim C-limitation, provide soft water and can look very attractive if surrounded with Sphagnum moss carpets in the wetland and swamp zone. Within the Sphagnum layer, attractive specialists of acidic bogs can thrive. In addition, the emergence of string algae can be low in a pool with Sphagnum vegetation, which supports C-limitation. It is an option only for NSPs of model 1, 2 and 3 and works best in a moist climate with cool summers and low evapotranspiration rates. Under such conditions, the high transpiration rate of Sphagnum mosses will be acceptable. Sphagnum palustre is suitable for areas with moist climate with cool summers and low evapotranspiration rates. Under such conditions, the high vegetation, which supports C-limitation, provide soft water and can look very attractive if surrounded with Sphagnum mosses formed attractive cushions and could reduce the emergence of string algae in the pool water, though they effected a great fluctuation of the pH. Sphagnum palustre thrived in standstill water, whilst on percolated filters only Sphagnum squarrosum worked well. Recommendations for plant combinations in P- or C-limited pools are given.

Table 4 lists recommendable species for plantings on filter zoos, which provide a wetland habitat slightly above water level for P- as well as for C- limited NSPs. The listed species proofed to be successful in the described trials or rather in several case studies (Kircher, 2007).

Table 4: recommended plant species for C- and P-limited NSPs, hardy in Central Europe, to be used on TWL filters if the substrate protrudes 0 – 5 cm above water level (table by the authors).

<table>
<thead>
<tr>
<th>Plants for P-limitation (species from oligo- to mesotrophic fens and close related sites)</th>
<th>Plants for C-limitation (species from oligo- to mesotrophic bogs and close related sites)</th>
</tr>
</thead>
</table>

7 SUMMARY:
Depending on water movement, filtration techniques, partitioning and construction type of the swimming area the authors distinguish between four models of natural swimming pools (NSPs). To guarantee clear water and a low string-algae stock, either a phosphorus (P-) or a carbon (C-) limitation should be achieved. Parallel to this the nitrogen content in the water will tend to oligotrophic conditions. Most plants, which are generally used on filter bodies in NSPs, grow weakly. In trials at Anhalt University plants from oligotrophic bogs and fens were tested on filter bodies of the “Technical Wetland" principal with three different variants of water percolation. Good results were achieved mainly with lime-fen plants, which are recommended for P-limited pools, since these comprise the necessary water hardness and a high pH value. For C-limited systems with low hardness plants from acidic bogs are suitable.

Sphagnum mosses formed attractive cushions and could reduce the emergence of string algae in the pool water, though they effected a great fluctuation of the pH. Sphagnum palustre thrived in standstill water, whilst on percolated filters only Sphagnum squarrosum worked well. Recommendations for plant combinations in P- or C-limited pools are given.
8 REFERENCES:
CELA MEDIA STATEMENT

NATURAL SWIMMING POOLS (NSPS) – PRINCIPLES AND TRIALS WITH SITE- CONFORM VEGETATION

Prof. Dr. Andreas Thon, Hochschule Geisenheim University, Geisenheim, Germany. Andreas Thon teaches and researches in landscape construction. He is interested in NSPs, irrigation and water filtration techniques.

Prof. Dr. Wolfram Kircher, Anhalt University, Bernburg, Germany. Wolfram Kircher teaches and researches in planting design and vegetation techniques. His main interest is in NSPs, perennial plantings, maintenance techniques, greening of buildings.

MEDIA STATEMENT:
Natural swimming pools (NSPs) offer a new way to swim in fresh water that has not been treated with chemicals. Only biological processes purify the water by different filtering methods. As a side effect of the filtering, the nitrogen concentration declines, which causes weak growth of most traditionally used plants. In trials at Anhalt University, Bernburg, plants from nutrient-poor bogs and fens were successfully tested on “Technical Wetland” filters. The authors give application recommendations in their presentation and in their book “How to Build a Natural Swimming Pool” (2016, Filbert Press, UK).
HISTORY, THEORY AND CULTURE

Edited by Judith Wasserman & Stefania Staniscia & Elisabeth "Lisa" Orr
FORMS, TRANSITIONS, AND DESIGN APPROACHES IN LANDSCAPE ARCHITECTURE: A “FEMALE” PERSPECTIVE

CHENG, TAIHSIANG  
University of Massachusetts Amherst, taihsian@yahoo.com

1 ABSTRACT
Do female landscape architects design differently than their male counterparts? For many decades, this seemingly simple question has been often contemplated, but little answered. This issue remains an uneasy topic of conversation to people in our discipline. Although previous scholars have made contributions toward examining the questions of gender, culture and landscape, there has yet to be a definitive work that outlines and explores the potential gender issues that today’s landscape architecture professionals may encounter. Among those issues, an inquiry into women as creators of designed landscapes provides a general framework for the study: what are the forms, transitions and approaches that female designers use when building landscapes? Through the process of literature review, primary data collection and survey analysis, an understanding of how female designers consider their gender identity influence the design process emerges. Although findings suggest that gender may influence design process but not outcome, and designed landscapes without specific forms come from both male and female creators, it gives a novel perspective to landscape designers of any gender, and encourages them to consider how their innate female personality might potentially influence design thinking. This study may provide a good opportunity for researchers and students to challenge the gender stereotypes in our discipline.

1.1 Keywords  
gender, female, landscape form, design approach, transition
2 INTRODUCTION
Perhaps we don’t need to overemphasize the importance of women’s contributions to landscape architecture today. In the United States, the numbers of women in landscape architecture have experienced a significant increase for decades. A recent report indicates that about half graduates of accredited landscape architecture programs are female in 2015, and 36% ASLA members are female in 2016 (WILA PPN). This number corresponds to the percentage of new licensed women architects in 2016 (NCARB 2017 Demographic). Historians may notice that there was only one female member of the total eleven founding members when ASLA was established in 1899. Although the growth of female members parallels the growth of male members, women represent less than 30 percent of ASLA fellows today.

In the early twentieth century, women were somehow considered naturally adapted to the profession (Way, 2009). Several renowned female pioneers in our field solidified the foundation for later development, and their professional performances in multiple scales ranged from residential garden design to community development and children’s playgrounds. Today, women are becoming leaders in all types of landscape projects. How do they bring a unique insight to the transition of landscape architecture profession over time?

Previous discussions of gender issues in landscape have been broad: Some focused on historical narratives such as the lives of early female pioneers and their contribution to landscape gardening; others focused on cultural metaphors such as using the phrase "Mother Earth" to link gender and landscape. Still others focused on the people and environment; that is, women as creators or users of the built landscape. Discussions in gender and landscape, if not properly addressed, may result in the Mars vs. Venus thinking that sounds outdated today. Decades ago, Elizabeth Meyer reminded us we should be skeptical of gender affiliations to the landscape which are often considered as “female”: irregular, emotional, and even chaotic (Meyer, 1997). Besides, in his article “Gender, Landscape, Culture: Sorting out Some Questions”, Robert Riley suggested the importance to classify gender issues in the landscape even before we start to talk about it (B.Riley, 1994). Among these issues, a female’s perspective on landscape design provided a theoretical framework for this study: what are the forms, transitions and approaches that women may take during the design process? By reviewing the literature and asking for women professional’s advice, I attempt to explore the potential gender issues that landscape colleagues may encounter in the future.

To be more specific, the purpose of this study can be categorized into three topics: (1) to understand how women professionals think about their gender identity may influence design process. (2) to look into the idea of “Female Landscape Forms” in theory and practice. (3) to examine the historical transitions of women’s approach to landscape design since the early twentieth century to the present day.

3 REVIEW OF LITERATURE
3.1 Female’s Approach to Landscape Design
In this study, the concept of a female’s approach to landscape design may be considered an opposing one to males, which focused on how individuals remained distinct but shared the experience of being women. Karen Madsen and John Furlong, in their article “Women, Land, Design: Considering Connections,” have mentioned female’s approaches could be described as “women’s way of reasoning and relating, teaching and learning, designing.”

Women may think different than men in the policy making process. In her article “Gender, Moral, Voices, and the Making of Environmental Policy: A Case Study in Norway’s Ministry of Environment”, Kristine Hill suggested: “Male policy makers favored balancing competing rights in ethical reasoning, while women favored a strategy of response to the needs of affected parties, particularly children.” She further added: “Women are more likely to see emotion as an important component of an effective policy-making process, while men either did not address it or found it a negative influence.” (Hill, 1994) They might be more emotional because there is a biological basis for those differences between men and women. Turning to the design aspect, when being asked “what might feminist landscape look like?” Deborah Ryan answered, “There is a woman’s way of designing and that it is non-patriarchal, collaborative, temporarily. It is constructed of devalued or discarded materials, and it fosters connections, respects the intrinsic value of the land.” (Karen Madsen, 1994)

Gender-based difference may not only exist in landscape but also in architecture design theory. Margrit Kennedy suggested that there were several hypotheses based on female and male principles in

Looking back at twentieth century, women were praised for their good-natured skills for gardening. Two faculty members at Harvard University believed that "Women turn more naturally than men to landscape work." (Close, 1996) Henry Frost, the founder of The Cambridge School in 1915, agreed that female do better work than male in the field of residential design because "they have a flair for design related to the human and pay more attention to details." (Anderson, 1980). A social activist in Boston made such comment in 1902: "A woman has a feeling about dirt which men only pretend to have." (Lawson, 2012).

3.2 Female Landscape Forms

We can see designed landscape form as a cultural vehicle for gender construction. It conveys a designer’s aesthetic experience including his/her sexuality as a whole. In this study, the idea of female landscape form proposed by Robert Riley refers to the forms “women designers themselves, free to create, would make for themselves—forms expressing their gender experience and their biological sexuality.” Look into the field of fine art, there might be two common characteristics shared by feminist artists: First, artworks are often associated with the image of female body. Second, they are created in a way that may reflect the social beliefs of “mother nature”. Female artists utilize organic mediums such as mud, seed, and grass to reconstruct the gender identities through creative process. The works of Ana Mendieta, Marie Yates, and Michelle Stuart have shown us how materials are collected to represent the feminist aesthetic.

In most cases, female landscape forms can be actually created by anyone since gender is “socially but not naturally constructed” (D.Garrard, 1994). There is a huge difference between the way people perceive landscape as creators and viewers. Maya Lin’s Vietnam Veterans Memorial is a good example to explain this idea. She addressed the creative process for Vietnam Veterans Memorial in her biography: “I think the most important aspect of the design was that I had originally designed it for a class I was taking at Yale and not for the competition. In that sense, I had designed it for me—or, more exactly, for what I believe it should be.” However, a school project for her self-expression may not be perfectly accepted by public, at least to those who opposed to the design, it was a “black gash of shame” that generated considerably controversy (McGirr, 1994).

![Figure 1. Vietnam Veterans Memorial (Photography by author).](image)

3.3 Transition in Women’s Approaches to Design

Women’s history in landscape architecture is a broad topic. If we only look at the United States from the early twentieth century to the present, during the short period of the City Beautiful movement in late 1890s, female groups worked on various types of projects including street improvement, civic gardens and
playgrounds. This movement is recognized by planners and urban historians as grass-roots driven activity that focused on smaller projects completed by women, which is a direct contrast to the "classically-inspired, grand scale such as the white marble constructed, straight boulevards, and monumental architectures" that were planned by their male counterparts in a male-dominated political structures (Szczygiel, 2012). About the same time, children’s playgrounds became a project type with which women frequently got involved. In her article “Turn of the Century Women’s Organizations, Urban Design, and the Origin of the American Playground Movement” Suzanne Spencer-Wood mentioned women have deeply contributed to children’s playground design as social reformers. A playground as a social place for both children and mothers became significant for stepping out of the domestic domain and to enter the public one. During the 1930s and 1940s, Work opportunities for women in the landscape architecture business were dramatically reduced due to the impact of the Great Depression. However, in the 1940s housing shortage, females became competitive with male practitioners in the work involving residential yards, gardens and planting design due to their well-trained design skills as well as their horticultural knowledge (Spencer-Wood, 1994).

Landscape historian Thaisa Way, in her book: “Unbounded Practice: Women and Landscape Architecture in the Twentieth Century” suggests that typically women treat the home garden differently than men; other than a place for family entertainment and visual comfort, the home garden was an integral part of their own residence, and the whole community landscape. In contrast, men tend to treat the garden as a place for appearance and maintenance, and pay more attention to the construction details of the house for functional concern. That is, females may have a more sensitive and holistic idea of the residential landscape than males (Way, 2009).

World War II is a significant watershed for women’s changing role in the development of American landscape architecture. Before the war, most of the women professionals— well educated from high society— chose to work for high society. The garden designs of 1890-1930 historically titled the Country Place Era, female landscape architects mostly focused on the design of high-end residential projects where their artistic expression were highly visible (Streatfield, 2012). After the 1960s, although American society had experienced dramatic social and economic changes, women were not fully accepted in the design profession. After the 1970s, rising environmental awareness, ecological issues, and the feminist movement had a major influence on changing gender roles. Middle class women began to work in all types of professions, and female landscape architects were gradually getting involved in public affairs.

4 METHODOLOGY
The purpose of selecting a methodology is to examine the ideas we have gained from literature review. To better inform the study, this researcher conducted a survey in order to collect important information that may be directly related to research topics. In doing so, a series of first-hand data was available for analysis. We should be aware of the fact that the exploratory nature of this study may not lead to a firm conclusion, but should at least provide reliable results that help readers to identify the findings.

4.1 Survey Process
The first step of the survey process is to select the potential participants. The researcher had to look into a range of subjects who met the defined set of criteria. In order to ensure the reliability of the results, the participants should be knowledgeable enough to understand and answer the questions. With this in mind, the survey includes female landscape professionals who currently hold a managerial position in landscape architecture firms, including principals, project managers, licensed landscape architects, and contractors in the United States. Each of the potential subjects was sent an email request to participate in the survey with a questionnaire. Personal information of all participants will not be revealed for privacy concern.

4.2 Survey Questions
The written survey contained three questions as follows:

1. Would you think there are “female landscape forms” created by female landscape architect/designer?
2. What is your opinion about the statement “women’s design approaches are different than men’s”?

3. What do you think about the “transition in women’s design approaches” since the early 20th century when ASLA was founded to the present day?

4.3 Data Analyzing

The “Basics of Qualitative Research: Grounded Theory Procedures and Techniques” set up a basic theoretical framework for data analysis: it includes readings and coding processes of the qualitative data from a written survey. Selective coding is defined as “The process of selecting the core category, systematically relating it to the other categories, validating those relationships, and filling in categories that need further refinement and development.” (Anselm Strauss, 1990) Categories are referred to as the three research topics in this study.

5 ANALYSIS AND RESULT

A total of 83 survey questionnaires were sent out, and 21 were returned. The response rate was about 25%. All survey respondents are currently holding a principal position in a landscape architecture firms. Regarding the participants’ locations by state, about half (9 participants) are from California; one-third (7 participants) are from Massachusetts, and the rest are from New York, Connecticut, Tennessee and Texas. Other information including participants’ age, level of education, and experience in professional practice was not acquired. The following results will be built on the responses of 21 women professionals.

Table 1. Geographic distribution of survey participants.

<table>
<thead>
<tr>
<th>State</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>9</td>
</tr>
<tr>
<td>Massachusetts</td>
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5.1 Female’s Approach to Landscape Design

According to the survey results, female design approaches can be (but are not necessarily) different from men’s. During the design process, women can be better communicators in design and they tend to consider more the emotional experiences of their clients. A respondent suggested: “I think we are more thoughtful about design. Men usually approach a problem with an engineering eye, while my female friends approach a problem with an artful eye, then make the engineering work for it.” Also, they tend to formulate more networking groups and collaborative efforts with other women designers. “Women in general work better with groups of people to build consensus and welcome collaboration with other disciplines in the design process,” another respondent pointed out: “They may be better listeners and more interested in addressing the needs of the user groups by encouraging their involvement, discussion, and input”. Females may bring a more collaborative spirit to the design process, which can be an advantage or disadvantage depending on the design and challenge at hand. Also, they “seem to make things more complicated while men keep things fairly simple.” “Men are more linear in the thoughts process while women are more geometric”, one participant said, “Men tend to follow a list regardless of priority, women synthesize and translate easier.”
In contrast, some of the survey participants would not distinguish between genders in a design oriented world. One respondent suggested: “I think the design process is non-gender specific. We all bring our personal sensibilities to our work, female or male. But they are more about personal aesthetic, background, education, travel…” another respondent said: “In my experience, I haven’t seen a difference between the approach of man and woman toward design. Most of my design mentors are male and I believed my design approaches are similar to theirs”, and still another said: “Landscape architecture is comprised in equal part the designer’s vision and the demands of the program and site. Designers rely on many influences as they develop their oeuvre – their personal history, and their education, among other things- which have tremendous influence on them. I do not believe gender would be primary.”

It is worth mentioning that some survey participants offered different viewpoints to this issue. One respondent pointed out: “I think that, insofar as people are acculturated to think of women and men as different in their thinking and psychology, there may be different design approaches assigned to women and men,” she continued: “But I also think that your inquiry only holds true for those few women who are either designing individually, or are the unquestioned lead designer on a project. In our current professional world, most landscape architects work as teams, and their gender is more likely to affect their power position in the company and on their teams than their design approach.” Also, one respondent suggested that even the question can be controversial when it singled out the design on the basis of gender: “This hypothesis was too broad and vague, although there might be some truth depending on what you mean, specifically. It might have more to do with the Mars and Venus thinking, and the collaborative vs. hierarchical comfort levels.”

5.2 Female Landscape Forms

First, there was a question from a survey respondent: “It depends upon how you’re using the term female. As an archetype/symbol, as biology, as social-cultural reality?” she continued: “Perhaps we are all influenced by everyone else; that is, men designers are influenced by women and vice versa (and by hermaphrodites, and by transgender people, and so forth). All these are currents of influence that could all be analyzed separately as female.” Also, one respondent was aware of “a social bias that considers some forms to be male and some to be female”. Five participants agreed that female landscape forms could be created by both genders. “I prefer curvilinear forms and shapes, which might be considered feminine” one said: “but I do not see this preference as gender based within the field of LA. I think that ‘female landscape forms’ are used by both genders.” Another one added: “Yes, I see female forms/forms that are organic, curvilinear, of the earth, by both female landscape architects and male landscape architects. I also see strong, rectilinear forms designed by both sexes as well.” “Landscape in itself is both male and female - Ying/yang sort of thing which if done correctly contains elements both masculine and feminine. That is nature. One could analyze certain styles of architecture and design to be very masculine = dark bold colors, angular large forms, modern Bauhaus type buildings, etc and a cooler palette, softer lines, Art Nouveau era to be feminine.” “I think of curvier, flowing forms as feminine (created by anyone) and angular forms as masculine (created by anyone).I think we all have varying doses of male and female energy.”

Besides, one respondent reminded me to be broader on this issue: “I think if we’re talking about gender issues in form making, we lose sight of the other gender identities and the forms that come from different perspectives or gender identities. It is bigger than male/female, it’s male/ female/ straight/ gay/ transgender and everything in between. I don’t think you can look at a landscape form and have any idea who created it.” One respondent concluded: “Good landscape design without specific forms come from both male and female designers. As a good designer you look for the poetry of the landscape expression. I would not distinguish between genders in order to achieve one or the other.”

5.3 Transitions in Women’s Design Approaches

According to the survey response, the transition shows the role women have played in landscape architecture has changed. "Early on we were merely ‘gardeners’ while today we are problem solvers.” One respondent pointed out. “I think first of how so many designers of the early 20th century were cast as “horticulturists” because they were women. I think it must have been very hard for them to break out of the stereotype that women were good at flowers and plants and men were to be relied on for bigger, bolder changes on the landscape.” Besides, respondents indicated that today female landscape architects are free to work however they choose. One respondent said: “My guess is we are less driven to be like men and more free to practice as we see fit. We do not have to play by the rules of the past. On our projects we are
recognized as equal members on design teams”. Another said: “I do think we have more freedom to openly be ourselves, and more opportunity in the workplace.” “I would go further with that question on a global level and not just look at the USA.” As one respondent put it, “I think more women took the opportunity to study design and became professionals and there are many reasons for that....so not the approach changed but the number of women influencing the design in general changed. Landscape as a whole went through a huge transition and both genders contributed to it.” Besides, survey results shows gender inequality in today’s landscape professions might have greatly improved. One participant pointed out: “I spent about 12 years working in the public sector. There were many rules being applied in the work force during the 1980’s and ’90’s in order to correct long-standing practices of discrimination and harassment based on gender differences.” Another respondent suggested: “I have my own prejudiced perspective on this because I was very happy at an all girl’s high school and then went to an all male Ivy League college where they were just beginning to admit women. In the architecture department there I always felt like an outsider (professors would address the class with “Now, men...”). Women were not so welcome. But that was 30 years ago and I think it is much much better now.” The other respondent pointed out gender equality has yet to be improved today, “I still perceive some prejudice in this part of the country. For example, when I tell people in western Mass. where I live that I am studying landscape architecture, they remember only that I design gardens, although that may be just a lack of ignorance about what landscape architects do. In fact the profession may still be suffering from the mistaken notion that landscape work is just gardening work—like what women do!”

Two survey participants offered different viewpoint to the issue. “I am unaware of this transitions”, one recalled: “When I look back at early days of American landscape architecture, I see work that result from strong professional training and education for male and female designers (though, of course, there were many fewer female designers then). I see that good contemporary designs have similar roots.” “I think the way designers approach their work has transitioned because of changes in knowledge, technology, land use and other changes that have affected the entire profession,” another suggested: “I believe there are proportionally more women landscape architects than there were at the founding of the ASLA, but I think their design approach has evolved parallel to that of their male counterparts.”

As one participant concluded: “Early 20th Century women landscape architects worked for high society. Today’s women landscape architects work for all society. The approaches can be somewhat different depending on the different needs of people, but, in general, fulfilling the need of poor people and of rich people both require an understanding of those needs, an understanding of the site to be designed, the budget, and the maintenance support which will be available now and later.”

6 DISCUSSIONS AND SUGGESTIONS

To sum up, this survey’s findings in female’s approaches to design generally correspond to the literature review. Females might be more sensitive and thoughtful about design, they pay more attention to issues regarding fairness justice, and equity; they also emphasize taking care of the needs of disadvantaged groups such as children, and seeking connectedness among different things. Such characteristics may result in collaborative approaches, taking clients’ emotions into consideration, and specializing in community, school and playground projects. From this viewpoint, it may explain the ideas presented in “Seven hypotheses on female and male principles in architecture”: “Female designers are more user-oriented than designer-oriented” because they may have more empathy for users, especially minority groups. “Female designers are more flexible than fixed” because they are more comfortable with mutability as a design process. “Female designers are more complex than one-dimensional” perhaps due to the fact that it is women’s nature to make things more complicated while men keep things fairly simple. “Female designers are more holistic than specialized” because they might think inclusively and build connections in a holistic way during decision making processes.

Turning to the discussion of “female landscape form”, according to the literature review, it refers to the work created by female artists to reflect their lives and experiences. However, most of our survey participants comes from the real business world of landscape architecture so they may have different viewpoints to this issue than the artists who free to create for themselves. Therefore, this term may need further clarification to fit more precisely into the discussion. That being said, the majority of the women who participated in the survey agreed that “Female Landscape Forms” are products of social bias which can be created by anyone.
Finally, findings suggest changes in female’s approaches to design parallel to the transitions in the entire design profession, which are due to changes in knowledge, technology, land use and other factors within society over time. This is not surprising because “landscape as a whole went through a huge transition and both genders contributed to it.” Women have much more freedom in the workplace but great challenges have followed. In general, women had lower social status than men in the early twentieth century, where gender discrimination occurred much more frequently than today. Therefore, few early successful women professionals would have had stronger advocates in issues of gender and practice against their male counterparts than today. Beatrix Jones and Ellen Shipmen, for instance, are considered pioneers who worked closely with male professionals as mentors and competitors (Krall, 2012).

Another issue that comes to mind is the geographic distribution of survey participants. Although the survey was conducted in western Massachusetts, the results show about half of the respondents are from the California area, which may indicate that female landscape architects in the west coast are more willing to answer gender-related questions. In addition, a nationwide survey suggested that the percentage of women having a licensed to practice in California is higher than any other state in the country (Clements, 2012).

A livable environment in California has provided rich and diverse cultural settings for talented landscape artists to create vital communities. A 2011 documentary “Women in the Dirt” directed by Carolann Stoney introduced seven female landscape architects from the west coast of the United States. This film not only raised public awareness on beauty and sustainability in our surroundings, but also remarked on their groundbreaking works in a poetic way. However, throughout the movie, we did not see any specific approach to landscape design that only women would take. In that sense, one of the most important findings in this study is not to address how or why female may design differently than male, but to suggest that gender stereotypes do not necessarily align with our expectations. To avoid the fallacy of binary thinking, as Elizabeth Meyer has reminded us earlier, we must be carefully examining the gender affiliation in the built landscape. Finally, I am fascinated by the hypothesis that “the men who are attracted to LA are more in touch with their anima (Carl Jung) than most American males.” Do you agree with this statement? Perhaps we all have male/female side that may potentially influence our design thinking. This issue deserves more in-depth explorations from researchers in our discipline.

7 REFERENCES


AN EXPLORATION INTO THE SPECIAL IMPLICATIONS OF AGRICULTURAL LANDSCAPE IN CHINESE ROYAL GARDENS

JI, QIAN
Tianjin University, China, jiqian005@hotmail.com

ZHANG, CHUNYAN
Tianjin University, China, francezcy@163.com

1 ABSTRACT
Chinese royal gardens have had a long tradition of including agricultural landscape. Taking the ancient monarchs as the research objects, this paper explores several pivotal reasons why agricultural landscape was often included in royal gardens. Firstly, in ancient China, agriculture was the foundation of society, and the monarchs had to show that they valued agriculture and attached importance to their people's livelihood. Secondly, from the monarchs’ personal point of view, they generally had a desire to escape reality, and longed for the life of an ordinary farmer, so the agricultural landscape can be seen as a symbol of escapism and this was reflected in their royal gardens. Finally, after analyzing the theories of the early thinkers and the worship of Heaven of the early monarchs, a new and more profound reason can be found for the extension of agricultural landscape into Chinese royal gardens - the ruling class’s awe of ‘the way of Heaven’, which legitimized their dominance according to traditional Chinese thought.

1.1 Keywords
Chinese royal gardens, agricultural landscape, the way of heaven, ritual
2 INTRODUCTION

One of the main origins of Chinese traditional gardens is the nursery garden. The nursery garden was created by the early ruling class with a main focus on small-scale agricultural production (Zhou Weiquan, 2008). The nursery garden is regarded as the early garden rather than a farm as its planting is as much for ornamental value as it is for food production. Therefore the embryonic form of Chinese classical gardens was derived from the aesthetic of agricultural landscape (Yu Xiaosen, 2010). The royal garden is the mainstay of the early gardens, and the royal gardens are closely linked to agriculture (Yin Beizhi, 2008). By the Qin and Han Dynasties, the form of Chinese royal gardens reached maturity and agricultural landscape had already become a key feature. This tradition has been extended throughout the history of Chinese royal gardens all the way to the final Qing Dynasty. China’s royal gardens are usually large-scale, rich in content, and generally contain small mountains and water features such as lakes and rivers. Agricultural landscapes in different royal gardens have different proportions, and sometimes it can form an independent section as a ‘Garden within garden’.

In its early stages, the agricultural landscape of Chinese royal gardens had functions of sacrifice and production, but later it increasingly began to play a role for in entertainment and enjoyment. The production function can be seen as the most obvious reason for the emergence of agricultural landscape in Chinese royal gardens. Dating back to the Han Dynasty (206 B.C. - 220 A.D.), which was a period of low social productivity, there were a number of orchards, vegetable gardens and even livestock farms in the giant imperial garden, Shang-Lin Yuan. The fruits, vegetables and meat produced in the garden were transported directly to the royal palace for royal family members to eat. At the same time Shang-Lin Yuan was the royal ritual site, used to pray for the agricultural harvest. According to historical records, every spring the Queen of the Han Dynasty would work in Shang-Lin Yuan. This pious labour was the ruling classes’ way of expressing to Heaven the high value which they placed on agriculture. According to the “Shui Jing Zhu”, in the Sixteen Kingdoms period (A.D. 304 - 439), a large number of mulberry trees were planted in the famous royal garden Shang-Zi Yuan, and every year in the spring the emperor would pick mulberry leaves with his wives in this garden. From these we can see that the royal families offered sacrifices in the productive gardens.

In the Tang Dynasty (A.D. 618 - 907), the Jin Yuan garden located in north side of the royal palace, contained orchards for pears and other fruits as well as vineyards. According to the historical records Jiu Tang Shu, Emperor Zhongzong regularly held entertainments and hosted banquets for his ministers in these orchards. This proves that the agricultural landscape in the royal gardens already had a recreational function. At this time the sacrificial function of agricultural landscape had been separated. For example, a separate ritual place – Can Tan Ting - was built. After the Tang Dynasty, it was obvious that the importance of production of the royal gardens had been gradually weakened. Alternatively, it could be said that a clear differentiation between productive gardens, sacrificial gardens and recreational gardens began to be made. The recreational gardens began to show the farming scenes just as part of the landscape, and pastoral scenery became more about fun and performance. In the Song Dynasty (A.D. 960 – 1279), according to Emperor Huizong’s own description in Gen Yue Ji, his grand garden Gen Yue contained a ‘Garden within garden’ called the ‘Western Village’ which was designed and built to imitate the life of ordinary farmers, and the wheat, beans, nettle and other crops were only planted in order to form a farmland scene. When Kublai ruled China, Jing-Shan garden was the place where the royal family of Yuan Dynasty (A.D. 1271– 1368) enjoyed agricultural landscape, even if the rulers were nomadic. To the Ming (A.D. 1368 – 1644) and Qing Dynasties (A.D. 1644 – 1912), the agricultural landscape within the royal gardens reached a peak, both in terms of area and quality. Some of them were agricultural ritual places, such as Xian Can Tan and Can She while others were used for entertainment and viewing. The most famous one was the area around the Long River in the northern Yuan Ming Yuan. Dan Bo Ning Jing, Xing Hua Chun Gau, Shui Mu Ming Se, Ying Shui Lan Xiang and other scenic groups formed a large area with a strong pastoral scenery (Figure 1). Similar agricultural landscape groups also appeared in the Summer Palace and the Summer Resort.
These are the development of agricultural landscape of Chinese royal gardens, and it is easy to see that agricultural landscape had a variety of functions. There are complex reasons why the agricultural landscape occupied an important place in Chinese royal gardens for thousands of years. Previous researchers (Yu, 2010, Zhang, 2012, Ren, 2008) have often linked the existence of agricultural landscapes in the royal gardens simply to economic productivity, and some other important reasons such as the emperors' preferences, beliefs and the legitimacy of their regime, have been overlooked.

3 AGRICULTURE AS THE FOUNDATION OF SOCIETY

The emergence of agricultural landscape in Chinese royal gardens, in essence, is linked with socio-economic factors. These links go back to the ancient China's main production model. From a geographical point of view, China is a continental country, so in ancient times, China naturally became an agricultural country. For ancient China, land and farming were the fundamental foundation of society, and agriculture was the most basic mode of production. The agricultural economy not only supplied the consumption needs of other sectors in traditional society, but also occupied the main part of the authoritarian state's fiscal revenue. From the point of view of the composition of the social classes, the peasant families undertook the main tax burden, and farmers' social status was not low. In A Short History of Chinese Philosophy, Feng Youlan said: "Chinese people's inherent thoughts include the ideas of the so-called 'fundamental' and 'final' occupations. 'Fundamental' here refers to agriculture, and 'the last' means business." Ancient Chinese social class status from high to low were: scholar, farmer, craftsman, and businessman, and so the social status of a farmer was second only to a scholar's. Thus ancient China was a country based on agriculture, both at a social and economic level. It is for this reason that all of the ancient Chinese regimes took a clear policy of attaching great importance to agriculture.

Every ancient emperor knew that the agricultural yield would directly affect the stability of social order and his ruling. Therefore the emperor needed to express his attitude towards agriculture, and attending to farming personally was a good way to show it clearly. An emperor who was able to do farm work was easily able to establish a good image, and could become a role model for his people. Since the beginning of the Zhou Dynasty (1046 B.C. – 256 B.C.), every Chinese monarch would undertake an ablution on a special day every year nine days before the beginning of the spring and then hold a grand ceremony with his ministers at the start of spring, at which he would do farming work personally. The purpose of holding a grand ceremony was also to show the country's determination to agriculture. This tradition was held in China for over three thousand years, and it was also one of the grandest celebrations of the royal family.

The place where the monarch held the agricultural ceremony was usually chosen in the royal gardens. Therefore, the agricultural landscape in the royal gardens had a practical value; it can be seen as a place that the emperors used to show self-image and raise prestige. Agricultural landscape, located in Chinese royal gardens, was a manifestation of the social status of agriculture, and also was a symbol that ancient rulers always paid attention to people's livelihood and always looked after the farmers.
4 THE EMPERORS’ OWN AESTHETIC PREFERENCES

For the royal gardens’ owners, including emperors, the existence of agricultural landscape in the royal gardens was a reflection of their own personal preference. Devoted garden owners attempt to create ideal spaces that reflect their own mind and the way they look at the world. Chinese scholars’ private gardens tend to be seen as the owners’ paradise which allows them to escape from reality, and sometimes the royal gardens are the same. The emperors regarded their gardens as their ideal spaces, and put their own spiritual worlds into the gardens.

In Chinese royal gardens, there were not only some spaces to show that the world was united and the national power was strong (such as Jiu Zhou Qing Yan in Yuan-Ming Yuan, which had political complexion), but also some spaces for escapism. For men at the pinnacle of power, ancient autocratic monarchs still had the same desires as ordinary people — to escape from everyday life. In this regard the emperors had different tendencies. Some envied immortal life, so they built wonderlands in their gardens (This gradually formed another important tradition of Chinese royal gardens). Some of the emperors yearned for civilian life. There are a lot of classic stories about Song, Ming, and Qing Dynasty emperors traveling in disguise and living with everyday people, such as Emperor Huizong of Song, Emperor Zhengde, Emperor Qianlong. In these stories, the ordinary farmers’ life was particularly favored by some emperors, especially those of the Qing Dynasty. The Qing emperors, left more than sixteen groups of the Farming and Weaving Pictures which is an amazing number for it far exceeds the sum of all the previous dynasties (Zhang Xiaolei, 2015). and given this data, the scale of agricultural landscape can be said to have reached its peak during the Qing Dynasty.

For instance, Emperor Yongzheng (1678 – 1735) made a prominent contribution to this growth. While the purpose of other emperors to publish the Farming and Weaving Pictures was to emphasize the importance of agriculture, Emperor Yongzheng had a personal preference for agricultural landscape. In his Farming and Weaving Pictures, the protagonists were no longer ordinary farmers or peasant women but he and his wife. These groups of pictures show Emperor Yongzheng and his wife dressed as peasants and cultivating the fields, and they reflect the joy of the emperor (figure 2). Emperor Yongzheng, in his poems Yue Xin Ji, said that he dreamed of a simple, quiet life, and wanted to live with indifference to fame or wealth, and he also called himself “the world’s most leisurely person”. There is other evidence which shows his dream of becoming an ordinary farmer living a civilian life. For example, the Paintings of the Amusement of Emperor Yongzheng show the Emperor dressed as fisherman, huntsman and farmer. All of them reflect the emperor's longing for pastoral life. From his special preferences, the emperor built a large area of agricultural landscape in YuanMing Yuan, and then when his successor inherited this wonderful garden, he enhanced the quality and the scale of the agricultural landscape, and let it become the most prestigious agricultural landscape in the history of Chinese gardens. This achievement was driven by the emperor's personal preference.

![Figure 2. Yong Zheng Farming and Weaving Pictures. (China Palace Museum).](image)
In above analysis, some of the agricultural landscape of Chinese royal gardens can be seen as the link between the emperors and the pastoral life. These agricultural landscape were valued and loved by emperors themselves, and they were built to satisfy the emperors’ own wishes, and became their owners’ spiritual ballast.

5 THE LEGITIMACY OF THE RULER AND THE WAY OF HEAVEN

Focus on the emperors themselves and it can be found that the emergence of agricultural landscape in Chinese royal gardens was linked to the power of the ruling class. In ancient China, every monarch would claim that he was obedient to the will of Heaven to rule the people—a declaration which was even written at the beginning of each edict. This kind of thought was a tradition in ancient China for thousands of years and was related to the status of Heaven in the eyes of ancestors.

In the pre-scientific period, Heaven was regarded as having supernatural force, and was treated as the creator of the world. The ancients thought that Heaven determined everything in the world. Shang-Shu considered Heaven as “the mother of all the world’s creatures”, Confucius said that Heaven was the greatest force in the world. The ancients thought that Heaven had emotions, and the way how Heaven treated the world was ‘the way of Heaven’. As early as ancient times, monarchs began to try to contact Heaven. For instance, the Emperor Yao (around 2377 B.C. – 2259B.C.) and Shun (around 2287 B.C. - 2067 B.C.) had religious rituals recorded in Shang-Shu. When the country became a centralized bureaucratic state in the Western Han Dynasty, the theory of the ‘divine right of kings’ was presented systematically by the outstanding thinker and politician Dong Zhongshu (197 B.C. - 104 B.C). This theory had a deep-rooted influence on the ruling class of China for thousands of years.

Dong advocated that the true master of the world was not human, but the sacred Heaven. However, Heaven could not command the world directly. The only way to achieve its will was to give power to someone in the world, and the chosen one would become the monarch. Dong’s theory established the direct connection between the monarchs and Heaven, and put the monarch in the mortal world’s most sacred position (Li Mian, 2013). Thus, the way in which the rulers acquired power became “legalized”. This theory was accepted by the ruling class of ancient China for thousands of years. Dong’s theory consolidated the monarchy, but also acted as a warning to the monarch. He emphasised that, since rulers got power from Heaven, they should rule in obedience to the will of Heaven. If they violated this will, Heaven would cause disasters to show its anger. The occurrence of a disaster represented Heaven blaming the ruler and which meant the legitimacy of their rule was being questioned. “The root cause of calamities is the improper conduct of the ruler, and the calamity is a condemnation from Heaven”, as Dong wrote in Chun Qiu Fan Lu. It can be seen that he regarded the human monarch as the person responsible for the calamity. His purpose was to encourage the rulers to be diligent in the political affairs in order to prove the legitimacy of their own dominance. Almost all of the ancient Chinese monarchs accepted this claim.

Agriculture played a very important role in this theory as it was often the victim of disasters. Whether it was earthquakes, landslides, droughts and floods, the harvest was usually the first to be affected. In other words, agricultural output could directly reflected the scale of a disaster and thus the scale of Heaven’s anger. For the ruler, a terrible harvest was a clear danger sign to his regime.

So from the rulers’ point of view, the theory of the “divine right of kings” placed agriculture in a more sacred position, and made agriculture closely connected to their regime. Rulers attached importance to agriculture, not only for economic considerations, but more from the fear of faith. This also created a very interesting phenomenon in Chinese traditional culture: once a drought, flood or other disaster damaged agriculture and started to cause distress to the population, emperors would issue an edict named Zui Ji Zhao, to admit to the masses his own failures. In the Han Dynasty, there were a dozen emperors who issued nearly sixty of these edicts (Wu Qing, 1995), and each of the edicts had to be written with caution. The emperors called themselves “talentless”, and were “shamed to cause such a calamity to the people”, “very fearful of the loss of agriculture”, and so on. It is not difficult to see from these words that these monarchs carefully reviewed their own negligence and treated themselves as the culprit for causing disaster to agriculture. The success of agriculture had become a manifestation of a ruler’s performance, and the stability of agriculture conveyed the satisfaction from Heaven to the ruler, that is, agriculture had become the standard of testing the legitimacy of the ruler’s regime. That also explains the phenomenon that before becoming more about entertainment, the agricultural landscape in Chinese royal gardens served as a ritual site in most cases.
In the early days, in addition to production needs, the purpose of putting the agriculture-related elements into their gardens was for prayer, and the elements expressed an attempt to establish contact with Heaven. The ancient monarchs' activities in the early agricultural landscape were more like a consolation to Heaven. There was a delicate connection between agriculture and Heaven that the rulers feared, so that the agricultural landscape that appeared in the early royal gardens had a special sacred position. Putting the agricultural landscape into their gardens was a convenient way for the emperors to pray for a long and stable rule, and also make a reminder of agriculture's importance for themselves.

6 CONCLUSION

The need for production was the most basic reason for the birth of agricultural landscape in Chinese royal gardens. Agriculture was the foundation of the country, and the rulers expressed their attention to agriculture and the concerns of the people's livelihood by means of the agricultural landscape in the royal garden. With the improvement of productivity and social development, agricultural landscape become an aesthetic demand, and some rulers had a special preference for such designs, so agricultural landscape played a large part in their gardens. The emperor Yongzheng was the most prominent one of them. There is also an invisible reason in that the agricultural landscape is also a reflection of the rulers' longing to establish contact with Heaven under the influence of the theory of the 'divine right of kings'. This exploration into the special implications of agricultural landscape in Chinese royal garden helps to re-examine the role of agricultural landscape in the royal garden and brings new inspiration to the modern agricultural landscape design. Moreover, the significance of agricultural landscape in social, aesthetic and religious fields reflects the value of Chinese classical garden protection. Previous research on agricultural landscape in Chinese classical royal gardens rarely made the link with the emperors' preferences, beliefs and the legitimacy of their regime. However, the reasons are not simply limited to these factors. While this paper has attempted to explore some issues ignored so as to further broaden the vision of academic research, it still leaves much space for further explorations, for example, whether the agricultural landscape in the royal gardens also served as a place to conduct agricultural experiments. For example, Emperor Wu of the Han dynasty tried for several years to introduce lychee, olives and other produce into the Shang-Lin Yuan (Sima Xiangru). It could also be studied whether the location of the agricultural landscape in the royal gardens layout reflected the ecological concept of the ancient Chinese. These questions are worthy of further study.

7 REFERENCES


Study of the Composition, Value, and Overall Protection of the Cultural Routes in the Han River Basin Against the Backdrop of Population Migration

Wang, Le
Huazhong Agricultural University, Wuhan, HZAU, wangle@mail.hzau.edu.cn

Zhang, Zhiyuan
Huazhong Agricultural University, Wuhan, HZAU, 907607840@qq.com

Dai, Weijia
Huazhong Agricultural University, Wuhan, HZAU, 1119467035@qq.com

Liu, Siyu
Huazhong Agricultural University, Wuhan, HZAU, 375143511@qq.com

1 ABSTRACT
Due to its unique geographical location, the Han River Basin has historically been an important corridor for north-south population migration. In this paper, cultural routes in the Han River Basin are used as a research setting for a thorough study of selected post roads, water systems, trade routes, and other routes that play a role in population migration. The formation and evolutionary mechanisms of the cultural routes are analyzed, their heritage value is investigated, and ideas about heritage protection in general and protection of basin sites in particular are proposed. The study uses literature collection, map reading, data statistics, and other historical research methods to comb through the many migration routes left by population flows throughout history and the large number of heritage sites that resulted. Migration activities are summarized in four historical stages, based on differing motivations for population migration, and combined with the results of superimposing derivative routes on surrounding heritage sites to analyze their spatial distribution characteristics and element compositions. The heritage sites along the cultural routes fuse the characteristics and cultural attributes of different areas. There were inherent inheritance and succession relationships between heritage sites of different periods, indicating that population migration had a persistent, significant effect on the exchange and development of areas within the Han River Basin. The preliminary investigation into the composition, value, and protection of the cultural routes in the Han River Basin was undertaken with a view to promoting the organic development of the cultural heritage of the Han River Basin under the mastery of history and the guidance of culture.

1.1 Keywords
Heritage protection, population migration, cultural routes, overall protection, Han River Basin
2 FOREWORD

The Han River Basin is situated in the transition zone of north-south cultural exchange, with a unique geographical location, a suitable climate, diverse vegetation, superior farming conditions, and abundant resources, all of which have given rise to frequent population migrations that have had pronounced effects on the culture, economy, population, and other aspects of the basin. On the one hand, population migration brought an abundant labor force and advanced production technology to the Han River Basin, as evidenced by the poem, “Refugees come crossing the Mian, dragging cattle that bear their wives and children”. On the other hand, the Central Plains culture, the Bashu culture, and the Qinlong culture fused with the local Chu culture, causing the Han River Basin to become a cultural exchange center for north-south gathering and a place where many types of people lived, leaving abundant post roads, water systems, trade routes, and so on, in the process. Together with the plentiful heritage sites, these migrations formed cultural routes with unique basin characteristics.

At present, domestic research on cultural routes in the Han River Basin mainly focuses on a single route and divides into several aspects: excavating the historical background of the route, textual research on the historical development of the route, the composition of the route’s heritage and value identification, and assessment of the cultural route and its application to the List of World Heritage Sites. On this basis, research related to the construction, overall value identification, and protection of cultural routes and heritage networks within the basin is undertaken in this paper in hopes of mining thoughts on protection of the heritage characteristics of the basin.

3 COMPOSITION OF THE CULTURAL ROUTES IN THE HAN RIVER BASIN

3.1 Survey of population migration in the Han River Basin

In this section, the four main stages of population migration in the Han River Basin are sorted by organizing research findings from historical sources, ancient books, and related fields.

(1) Pre-Qin Dynasty (21 Century BC—221BC)

As early as the pre-Qin Dynasty, the Han River Basin was an immigration channel and an early human settlement. People in the Xia and Shang Dynasties had reached the lower reaches of the Han River basin, and in Western Zhou Dynasty, the Nanyang Basin was an area into which there was additional population migration. Some ethnic minority peoples, such as the Nanzheng tribe, also migrated along the Baoxie Road to the Hanzhong area.

(2) Qin Dynasty (221BC—207BC) to Six Dynasties (AD222—AD589)

During the Qin and Han Dynasties, the number of immigrants moving into the Han River Basin increased greatly relative to the previous period; the range of migration involved the Hanzhong Basin, the Suizao Corridor, the Nanyang Basin, the lower reaches of Han River Basin, and other areas, and the ethnic composition of the population that moved in was richer. In Volume 37 of the Book of Song, the Three Prefectures of Jin, the following was recorded: “With the death of Hu and chaos in Di, refugees from Yongzhou and Qinzhou mostly went south to Fanzhou and Mianyang; Emperor Xiaowu of Jin began in Xiangyang.”

(3) Tang (AD618—AD907) and Song (AD960—AD1279) Dynasties

“In the Tianbao Rebellion, Yuan Jie from Ru was on the river bank, leading the neighbors move to Xianghan, preserving over 1,000 families.” In the Late Tang Dynasty, the Central Plains were in chaos, which many northerners moved into the Jingmen-Xiangyang area to avoid. The Old Book of Tang—Geographical Records states: “From the beginning until after the reign of Emperor De (756), the Central Plains had many incidents; the people of Xiangyang and Dengzhou wore the dress of two capitals and went to the area of the Yangtze River and Xiang River. Therefore, Jingnan had wells and cities 10 times its beginning.” In the Central Plains, after the chaos of war spread to Xiangyang and Dengzhou, the residents continued to move southward. During the Northern Song period, the vast area of the middle and lower reaches of the Han River were sparsely populated and became an important immigrant destination.

(4) Yuan (AD1271—AD1368), Ming (AD1368—AD1644), and Qing (AD1644—AD1912) Dynasties

As described by Wei Yuan, in the Water Conservation Theory of Huguang: “In the final phase of the Ming Dynasty, the people were exhausted by the massacre in Shu by the thief Zhang; then, under Chu, there was less suffering in Jiangxi. After things settled down, the people of Jiangxi moved into Chu, and the
people of Chu moved into Shu.” There was indeed a rhyme about “Jiangxi filling Huguang, Huguang filling Sichuan.” The immigrants took full advantage of the Yangtze River-Han River transportation arteries; immigrants from the middle and lower reaches of the Yangtze River, mainly from Jiangxi, moved into Huguang, and residents from Huguang and other areas moved into Sichuan (as shown in Figure 1).

![Figure 1. Map of population migration. Diagram by the authors.](image)

3.2 Composition of the cultural routes in the Han River Basin

Combing through the process of population migration in the Han River Basin, we summarize the main population migration routes and derivative routes by time period and the heritage sites surrounding them. The main conclusions are as follows: (1) Population migration activities were frequent within the Han River Basin and had prominent effects; cultural diversity within the basin was significant. (2) Types of cultural routes in the basin mainly divide into ancient post roads, ancient tea roads, ancient salt roads, ancient river courses, and so on. (3) Heritage sites along the routes have diverse characteristics; they include ancient cities, religious buildings, buildings that house classical learning academies, landscape architecture, residential buildings, and many other types of structures.

3.3 Characteristics of the cultural route distribution in the Han River Basin

Crisscrossed land and sea transport - Frequent population migration in the Han River Basin was encouraged not only by the advantages of the terrain but also by the relatively convenient water transport conditions of the Han River Basin; land and sea were equally important. On the basis of its unique geographical conditions, the cultural route distribution in the basin area exhibited two trends: north-south and east-west. The north-south direction was mainly land route-based, and the east-west direction was mainly waterway-based.

Highlighted central control points - Hanzhong, Xiangyang, Nanyang, and Wuhan were the central control points of the cultural routes in the Han River Basin, radiating in four directions. In the historical period, people grouped about these cities, providing a labor force for local development, promoting cultural exchange and fusion between areas and providing an impetus for the formation of an all-inclusive culture arising from the proximity of many different peoples (as shown in Figure 2).
Formation and evolution of cultural routes in the Han River Basin

Studies of the formation and evolution of cultural routes in the Han River Basin have mainly employed historical research methods. In particular, they have used longitudinal research, written records, and textual research to extract the mechanisms of dynamic change in the cultural routes in the Han River Basin. Therefore, routes with relatively full and accurate records of population migration that made prominent contributions to the cultural landscape have been selected as the main subjects of analysis (as shown in Table 1). In particular, land routes studied include the Baoxie Road, the Wuguan Pass, the pass between Xiangyang and Nanyang, and the ancient road between Jingzhou and Xiangyang, while waterways studied include the trunk stream of the Han River and the tributaries of the Danjiang River and the Tangbai River.

4.1 Baoxie Road

Initially, Baoxie Road ran from the Xie Valley upstream to Wulipo, entering the upper reaches of the Bao River to head south along the Bao River Valley through the two counties of Taibai and Liuba, then exiting the Bao Valley to arrive at Hanzhong. The road was a thoroughfare used in opening Guanzhong to the Han River Basin. During the period of the Western Zhou, Wei, Jin, Northern, and Southern Dynasties, Baoxie Road got its name, as it started from the south at the mouth of the Bao River Valley in Hanzhong and ran along the two waterways of the Bao River and the Xie River. Rebuilding, which made the surface of the road wider, flatter, and more convenient, occurred during the Eastern Han and Northern Wei periods: "A 40-foot wide pavilion, a 60-foot wide road, the sage does not do it, even it is difficult to imagine things, have achieved today." (Inscription at Shimen). Baoxie Road, connecting Guanzhong to the Hanzhong area and bearing commercial and trade transport, was relatively prosperous until the Ming Dynasty; the period of its prosperity is thus recorded in Volume III of the Trivial Records on Jinchuan: "The pass is full of business travelers, and the river is full of tea boats." In addition to population migration and commercial and trade transport functions, Baoxie Road was a road with which military strategists had to contend and over which economic and cultural exchanges had to pass. The Biographies of Merchants in Records of the Grand Historian recorded: "The thousands of miles of plank road pass through everything; only Baoxie controls the hub of communication at its mouth." We can see that for quite a long historical period, Baoxie Road was a thoroughfare for military affairs, commerce and trade, and cultural communication, providing a bridge for north-south economic and cultural exchanges.

The presence of the Green Bridge (Qingqiao) Post and the Horse Road (Madao) Post during the period of the Qin and Han Dynasties are proof of early transportation functions. After the Tang Dynasty,
population exchanges as well as cultural, commercial, and trade exchanges were more frequent; the Jingguang Temple of the Tang Dynasty, the River-watching Pavilion (Wangjianglou) of the Song Dynasty, the Storm (Fengyun) Temple of the Ming and Qing Dynasties, and so on, clearly demonstrate that Baoxie Road provided an important channel for cultural exchange. The Ancient Chinese Dias was left after the Chu-Han war, proving its military status. These remains witnessed the evolution and development of Baoxie Road, which also increased their historical value.

Figure 3. Map of Baoxie Road and the distribution of its surrounding heritage sites. Diagram by the authors.

4.2 Wuguan Pass (Danjiang River)

The Wu Pass started from Changan, went through Lantian, and passed the Qinling Mountains to go down along the Qipan River, a tributary of the Danjiang River, to reach Nanyang; it was an important traffic route linking Guanzhong with the Nanyang Basin and to the vast areas of Jingzhou and Xiangyang. In the 25th Year of Duke Xi of Lu, the Commentary of Zuo recorded: “The State of Qin and the State of Jin cut down the State of Ruo during the Autumn period.” The State of Ruo was located on the left bank, southwest of the Danjiang River in Xichuan County, Henan Province; it was a fortress on the Guanzhong Plain, which ran from the Wuguan Pass to Nanyang. The attack by the State of Qin and the State of Jin on the State of Ruo very possibly passed through the Wu Pass. This is currently the earliest recorded use of the Wu Pass.

“Went up from Nanjun and returned by the Wu Pass” (cited in the Basic Annals of the First Emperor of Qin); “In the eighth month, the King of Han used the plan of Han Xin …… He ordered the generals Xue Ou and Wang Xi to go out of the Wu Pass” (cited in the Chronicle of the Originator of the Han Dynasty); “There are people who walk the road of fame and fortune on Mount Shang even at night” (cited by the Late Tang Dynasty poet Wang Zhenbai); “Nowadays, people who enter the State of Qin from Nanyang in Henan and from Xiangyang and Yunyang in Huguang must take the Wu Pass” (cited in Volume LII of Essentials of Geography for Reading History).

These few passages in literature document the important historical position of the Wuguan Pass in politics, military affairs, the economy, and so forth. Additionally, they show the endless changes in function of the Wuguan Pass, playing an irreplaceable role in exchanges between the Han River Basin and the Guanzhong Region in the historical development of the area. The existing, rich historical heritage along the Wuguan Pass includes a large number of transportation buildings, such as the Cengfeng Post, the Double Theater (Shuangxilou), and other heritage sites that embodied the fusion of northern and southern cultures, proving that the pass had once been a channel for north-south exchange. The heritage sites and the Wuguan Pass jointly became the elements that constitute this section of the cultural routes.

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4.3 Ancient road between Jingzhou and Xiangyang

From ancient times until today, the ancient road between Jingzhou and Xiangyang has been an important traffic route between north and south, connecting the three major central cities of Jingzhou, Jingmen, and Xiangyang. Xiangyang gradually rose up after unification under the State of Qin and, along with Jingzhou, became an important military hub. As Zhao Qi, a personage of the Three Kingdoms, observed: “Today the sea collapsed inward, only Jingzhou had the wide territory and resources…… Scaling the old valley alone, the soldiers are short of a full complement.” “A trail of five hundred from Xiangyang to Jiangling, the situation is close. Without Xiangyang, Jiangling will be attacked by the enemy” “Will victory in Huguang take place in Wuchang? In Xiangyang? Or is it planned for Jingzhou? Say: Speaking of the world, the focus is on Xiangyang; speaking of the Southeast, the focus is on Wuchang; speaking of Huguang, the focus is on Jingzhou.” We can see that from the Qin and Han Dynasties to the Ming and Qing Dynasties, Jingzhou and Xiangyang were important political and military sites; because both are located on the ancient road between Jingzhou and Xiangyang, we know of the historical military importance of the ancient road.

In addition, the ancient road between Jingzhou and Xiangyang also bore an important commercial transport function. As early as the Spring and Autumn Warring States Period, the State of Chu had drawn support from the profusion of products transported on the ancient road between Jingzhou and Xiangyang: “Goji, Chinese catalpa, and leather, thus, the State of Chu will carry on. Though the State of Chu has the materials, the State of Jin finds them useful” “Wine is mellow, and the flowers cover the bridge in Yicheng. The green ducks quack and bite in the clear sand. …… Having a long dream while a brocade of straws is in the golden furnace, the owner’s chicken crows to sound the morning.” “The pedestrians leisurely stroll along the river’s edge at dusk. Remarkably, Jingzhou cannot yet be seen at the hilltop.” From the records of these ancient poems, the bustling scene of the ancient road between Jingzhou and Xiangyang can be seen. While the ancient road between Jingzhou and Xiangyang played an important role in transportation, it also took on a role in politics, military affairs, and commerce and trade.

In summary, it is known that the ancient road between Jingzhou and Xiangyang has always borne the function of transportation in the historical development process, providing an important channel for population migration and leaving large numbers of settlement sites and cultural remains. Among the latter are the ancient settlements of the Qujialing site from the Neolithic Age, the Chenjiagang site from the Eastern Zhou Dynasty, the cultural remains of the Lumen Temple from the Han Dynasty, and the Eastern Pagoda (Dongbaota) from the Sui Dynasty. Military sites include the Xiangyang ancient city wall, built during the Western Han Dynasty. These historical remains not only bear witness to the historical evolution of the ancient road between Jingzhou and Xiangyang. They also enrich its connotations, making it a cultural route with historical value.

The sorting analysis shows that Baoxie Road and other important routes in the Han River Basin were important channels promoting the prosperous development of the economy, culture, and other aspects of the Han River Basin and that they played an important role in population migration. Although the reasons
for forming the individual routes differed, as did the evolutionary mechanisms involved, the routes promoted north-south exchange and witnessed historical changes, leaving rich historical remains.

Figure 5. Map of Ancient road between Jingzhou and Xiangyang and the distribution of its surrounding heritage sites. Diagram by the authors.

Table 1. The statistical table of heritage sites in ancient road

<table>
<thead>
<tr>
<th>The ancient road</th>
<th>Heritage sites statistics</th>
<th>Sites</th>
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<tbody>
<tr>
<td></td>
<td>Agricultural heritage</td>
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<tr>
<td>Wuyuan Road</td>
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<td>Jinsha canal</td>
<td>Zhaohui canal</td>
<td>Jingzhou city, Xiangyang city</td>
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<td>Jinsha canal</td>
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<td>Xiangyang city, Shuangning city</td>
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<td>Jinsha canal</td>
<td>Zhaohui canal</td>
<td>Shuangning city, Shuangning city</td>
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5 Thoughts regarding the overall value and protection of the cultural routes in the Han River Basin

5.1 Overall value of the cultural routes in the Han River Basin

5.1.1 Important channel of population migration

The Han River Basin has a unique geographic location, with superior natural conditions. As the region continued to develop, important cities along the shores of the Han River, such as Hanzhong, Xiangyang, Nanyang, Hankou, and others, attracted large numbers of immigrants, giving rise to an enormous amount of migratory activity in the region. Lu Xiqi observed that during a period of turmoil from
the Late Han Dynasty to the Six Dynasties, refugees from the north left Hanzhong through the Wuguan Pass, went down to Nanyang through the Fangcheng Pass, and gathered in the Xiangjiang and Mian River Valleys or the Nanyang Basin, documenting that population migration activities had occurred in the Han River Basin.

5.1.2 An important bridge for cross-regional cultural exchanges

The cultural routes in the Han River Basin covered a wide range, greatly promoting the blending of cultures. Drawing from the advantages of its unique location, the network of cultural routes in the Han River Basin went north through the Central Plains and linked to the Wu and Yue Kingdoms in the east, building a bridge for cross-regional cultural exchanges. For example, the guild hall for merchant fleets on the north shore of the Danjiang River combines the solemn generosity of the north with the gorgeous details of the south, gathering the essence of northern and southern architecture in one structure; it thus provides a model of cultural fusion in the Han River Basin. These cultural routes brought cultures from different regions to the Han River Basin, promoting the cultural style of the Han River Basin as a place where all types of people lived together.

5.1.3 Rich heritage sites with a long historical span

The Han River Basin has a long history and a rich heritage. The cultural routes within the basin contain many types of historical remains, tracing human activities and their related histories and cultures and embodying the historical changes that have occurred in the Han River Basin; according to historical records, human activity has been present in the Han River Basin since the Paleolithic Era, for example, at the site of the Meipu Man in Yunxian County.

5.2 Thoughts on the overall protection of cultural routes in the basin

The main framework of the cultural routes in the Han River Basin arises from the routes generated, with clear time continuity, by population migrations. Such migrations transported a series of production and living activities and facilitated exchange between heritage sites and cities. The geographic location of the cultural routes in the Han River Basin is an area where all types of people lived together, and the land was rich with innate superiority. The heritage sites in the area share natural and humanistic environments in the linear space of the Han River Basin.

Given the inherent complexities of the cultural routes in the Han River Basin and seeking to respect the historical development of heritage sites, cultural exchanges and inheritance relationships, the inherent succession mechanism was used to establish a “three-dimensional” heritage protection framework that highlights the historical and cultural values of the cultural routes.

(1) Improve time continuity. The remaining cultural routes show not the face of a certain historical snippet but a dynamic evolutionary process formed by superimposing different historical periods upon one another. Therefore, the style and features of all historical periods should be protected and exhibited in the protection process. Through the collection of historical information on the heritage sites in the Han River Basin, a complete sequence of ideas on historical development should be sorted out, the meanings and values of different historical periods should be revealed, and continuity and renewal should be pursued.

(2) Build spatial links. All heritage sites on the cultural routes share the same linear space; at the same time, the promotion of linear links drove exchange between different areas. The historical and socioeconomic reasons why the heritage sites in the Han River Basin drove the development of routes should be uncovered, and the heritage sites generated under the influence of the routes and their courses of development, which ultimately formed cultural routes that mutually associated the sites, routes, and surfaces, should be found.

(3) Look for derivative associations. Interactions between heritage sites in the Han River Basin and routes drove each other, which developed symbiotically (or disappeared) with the natural environment. Some core heritage sites in their own development process drove the development of secondary heritage sites, and the values they carry also continues in inheritance, succession, and development over time.

After construction of the protection framework for the cultural routes in the Han River Basin, it is also necessary to take specific protective measures. That is, research on heritage sites that require protection and repair should be undertaken. Such research should place these sites against their historical backdrops. Links with history in terms of material selection, scale, historical style, features, and other
aspects should also be elucidated. At the same time, it is necessary to fuse these historical sites with contemporary developments to endow them with meaning in a new era.

6 CONCLUSION

Combining the special geographical location and rich resources of the Han River Basin, population migration played an important role in promoting inherent associations between the cultural routes in the Han River Basin. The study has found that the cultural routes in the Han River Basin exhibit linear spatial distribution characteristics in the two directions of north-south and east-west. The types of routes formed are plentiful and diverse, and the heritage sites along the routes are of many types, e.g., military, religious, landscape garden, residential, and so forth. The cultural routes demonstrate the value of strong channels, cultural fusion, and rich heritage sites over long time periods. Efforts to protect these routes should seek overall protection in terms of time continuity, spatial linkages, and internal derivative associations between routes.

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COLOR(FUL) PREDICAMENTS IN LANDSCAPE ARCHITECTURE

ENGLER, MIRA
Iowa State University, miraengl@iastate.edu

1 ABSTRACT
In this paper, I examine the history of ideas, themes, and debates about color in landscape architecture. I use the successive theories of five prominent English landscape and garden designers—Humphry Repton, J.C. Loudon, William Robinson, Gertrude Jekyll, and Sir Reginald Blomfield—who dominated the evolving color taste in 18th- and 19th-century England. These color outlooks provide a lens for understanding several discursive themes that were active in the evolving Western discourse on color and landscape architecture, including natural versus artificial, native versus exotic, and sensation versus concept. I use primarily primary texts to map affiliations, oppositions, and intersections of theoretical color models and ideas between landscape design and the disciplines of art, architecture, optics, chemistry, and botany of the time. I demonstrate specific shifts in color concepts from structural color, to decorative color (or blinding polychrome), to natural color harmony, to pointillism, to plain color mass, the latter of which continued to dominate the modern garden scene. I further show that color propensities in landscape architecture have been historically linked to media technologies and, especially, to disciplinary attitude about nature and art, a perpetual conceptual dichotomy that have perhaps muted the creative use of color to affect and transform human experience.

1.1 Keywords
color theory, landscape architecture, art-nature debate, print media technology, 18th- and 19th-century England
2 FROM PAINTING TO LANDSCAPE

Landscape architecture, as opposed to gardening, acquired its status among the Western arts in 18th-century England. Conceived as a copy of 17th-century landscape painting it translated 2-D image into 3-D reality. In this paper, I examine ideas about color through the writings of five prominent English landscape and garden designers—Humphry Repton, J. C. Loudon, William Robinson, Gertrude Jekyll, and Sir Reginald Blomfield—who dominated the evolving color taste in in 18th- and 19th-century England. I show that color propensities in landscape design have historically been linked to disciplinary attitudes to the opposite concepts of nature and art. I highlight several color thematics; central among them is natural versus artificial, and its corollaries, color versus line (i.e., colore versus disegno), design versus draftsmanship, sensation versus concept, and native versus exotic. I also elucidate links between the color ideas and practices in landscape architecture and those in the related art and design disciplines, the sciences, and social sciences as well as technological and botanical advancements.

A central point in this paper is that arguments concerning color have often misused the nature-art concepts or used them carelessly. Thus, seemingly similar words were muddled, meaning different things at different times and often implying opposite ideas and vice versa.

2.1 Privileging Color Over Line: Giorgione and the Landscape Painting Genre

The discursive underpinnings of 18th-century English landscape gardening, for which landscape painting served as a guide, followed an earlier discourse on the relationship between nature and art that coincided with the emergence of the landscape painting genre in 16th-century Italy. Giorgione di Castelfranco of the Venetian school of painting, who is credited for the first painting that took landscape as its object, La Tempesta (1508), is also the first to be singled out for his use of color without prior line drawing. When Giorgione began painting directly with color and without a sketch he replaced Leonardo da Vinci’s soft lines and shadow gradation (or “chiaroscuro”) with inventive warm and cool tints. The modern art historian E. H. Gombrich argued that this radically new conception of the landscape genre presented art as an autonomous activity and a source of sensation and pleasure rather than of intellect and religious spirituality (Gombrich, 1971).

Gombrich’s 16th-century counterpart, Giorgio Vasari, agreed with this assessment, referring to Giorgione’s production as “the most pleasurable and realistic relief-like pictures of any time,” but considered it a regression of art (Vasari, 1868, p. 395). In his seminal collection, Lives of Artists (1563), Vasari argued that art relied on the rigor of line and form rather than on the ambivalence and sensation of color, as expressed in the new landscape painting genre. Vasari believed that proximity to nature compromised art and that color meddled with and muddled form and composition. “Concept,” he contended, “does not manifest to the eye when attractive color takes precedent” (Vasari, 1868, p. 247). Vasari’s criticism of Giorgione (and Titian) and alternately his praise of Michelangelo and Raphael clearly laid out a division within painting, and the debate over color versus line, sensation versus concept, and nature versus art. The realism, illusion, and sense of pleasure that color afforded Giorgione was passed on to his 17th-century successors, Claude Lorraine and Salvador Rosa, and in turn became the basis for landscape discourse among English intellectuals and the newfound bourgeoisie, who avidly collected these masters’ paintings, yet remained loyal to the line-concept preference when it came to gardens.

The debate on line versus color in 18th-century art and architecture circles must also be understood within the context of printmaking. The lack of effective color print technology promulgated an orthodox opinion in the growing academies of art and led to a broad preference for the line. According to the print historian Susan Lambert printmaking in the mid-18th-century was therefore fundamentally associated with draftsmanship and was correspondingly dissociated from color. “Colour,” she argued, “being as it were a grace note added to the image, [was] unnecessary to the true connoisseur and possibly a distraction from the elegance and significance of the image” (Lambert, 1987, p. 87).

2.2 Green Shades and Golden Hues: The Colors of the Picturesque

The early 18th-century English garden makers followed the teaching of art connoisseurs and aestheticians on landscape painting and gardening. Their style came to be known as the “Landscape” or “Picturesque” garden school. In his exposé, Essays on the Picturesque, the aesthetic authority Sir Uvedale Price considered colors to “have the power of exciting emotions,” yet he confirmed Vasari’s assertion that tint is inferior to form and composition. He began his instruction on color with the statement “I have said little
of the superior variety and effect of light and shade in scenes of this kind, as they of course must follow
variety of forms and of masses, and intricacy of disposition” (Price, 1842, p. 72). Price’s key principles of
landscape design were therefore form, mass, and the experience of movement that sets the scenes in
motion, and to which light, shadow, and color were merely subordinate.

Price concurred with the painter’s favorite colors, or “the painter’s season,” those deep and mellow
effects of autumn colors resulting from age and decay, and he argued that autumn colors are the most
suitable picturesque colors. He further reasoned that bright colors of fresh spring blossoms “are not those
which are best adapted to painting,” because they destroy the richness of variety and gradation of distance.
They produced glare and spottiness, thus ruining the harmony of a picture, “whether in nature or imitation”
(Price, 1842, pp. 138–139). Deeming the colors of Claude Lorrain and Peter Paul Rubens “more fresh” and,
therefore, inferior to the Venetian school of painting, he wrote of his preference of Giorgione’s and Titian’s
golden hues of autumn, “which gives [their paintings] such superiority over all others” (Price, 1842, p. 141).

Explicating on gardening, Price laid out the dichotomy of structural color versus ornamental color.
Accordingly, structural color agreed with the form and volume of objects and space, whereas ornamental
color was independent of space and akin to decoration. His preference for the colors of tree foliage,
especially evergreens, that accentuated solid masses and scenic composition over the spotty, merely
ornamental color of flowering trees and blossoms became a guide to the early renowned gardeners William
Kent and Capability Brown. Kent and Brown favored the varieties of green shades and textures in landscape
composition and relegated brightly colored flowers to the kitchen garden.

3 FROM REPTON TO BLOMFIELD: FIVE COLOR THEORIES

3.1 Structural Color: Humphry Repton and the Landscape Gardening School

Kent’s and Brown’s successor, Humphry Repton both followed and expanded Price’s teachings.
Repton, an avid theategor and watercolor artist, labored to unite the art of landscape painting and
gardening through his writing and drawing. From 1787 until his death in 1818, he built only a few gardens
but made over 400 design proposals, half of which were compiled into bound books, known as “red books.”
He became famous for his inventive before-and-after watercolored drawings (see Figure 1).

Like his predecessors, Repton preferred the color of verdure for the chief compositional tint and
agreed with the propriety of Price’s golden colors of autumn foliage. He also concurred with Price’s primacy
of structure over color. Repton held two main color propositions. The first, distinguished between landscape
and artifact, including building, reserving different color tastes and schemes to each. The second, conceded
to nature the role of colorist. By relegating the role of colorist to nature, Repton freed himself to “scape” the
land, that is, to shape the garden form and space and choreograph the experience in it. This concession
however involved a highly controlled color design, which among other sources borrowed selective tints from
paintings. Yet, Repton was not a purist. He developed his color sensibilities based not only on the
picturesque aesthetics of Price but also on the science of Isaac Newton’s color theory of light and on the
more subjective visual perception of the observer.
The mathematical harmonies that Newton found in nature and in music fascinated Repton and instigated his own experiments. The use of color, he argued, must not be directed by “the effect of chance and fancy but guided by certain general laws of nature” (Repton, 1907, p. 218). He experimented with registering light through a prism on a white paper fastened against a black cloth and systematically observed the change of light across the day (Repton, 1907, pp. 245–247; Repton, 1982, pp. 49–51). He recorded the succession of color from the neutral tints of brown and gray prior to sunrise to the rainbow colors in full sun and noted the aerial perspective and color and light variations between distant and near objects and before and after sunrise (see Figure 2). Unlike Newton’s pure optics, however, Repton was also concerned with how color relate to perception and affect the spectator. For example, he argued that the contrast of dark
green woods and light green lawn does not satisfy the eye and requires more variety of colors. He thus called to add objects, such as rocks, water, a bench, a gravel road, and cattle, the latter of which added off-white highlights and animation to the scene (Repton 1794, p. 39).

Repton also used color to manipulate perception and produce spatial illusion and even deception through camouflage, as did other landscape gardeners at the time. To realize picturesque scenes, the landscape gardener refashioned and “improved” the land through topographic and planting alterations using a variety of camouflage tactics to disguise the change, thus presenting the artificial as natural. The capacity of color to disguise and deceive was integral to this cosmetic procedure. Natural materials of earth, plants, and water were the artist’s “paint” in the gardener’s hand, elements used to control perception and stimulate emotion. Repton quoted Edmond Burke’s dictum, “A true artist should put a generous deceit on spectators,” and explained the concepts of the concealment of boundary, situation, and utility in Sketches and Hints on Landscape Gardening (1794), his first book (as cited in Daniels, 1994, p. ix). In Theory and Practice (1803),

Figure 2. Humphry Repton, recording of tint scales from experiments with prism and early morning light before and after sunrise, aquatint, page spread: Public domain image from Fragments on the Theory and Practice of Landscape Gardening, 1816, The Getty Research Center, open access.
Repton elaborated on these concepts, approving of masking “undesirable” elements, such as fences and utilitarian objects but disapproving of faking architectural elements and facades, for example, by painting a brick wall to look like stucco. The first act of landscape camouflage concerned the integrity of the natural image and therefore was a legitimate disguise; it was equated with “functional and essential color.” The second act, concerned artifacts and was therefore a sham; it was equated with “decorative and superfluous color” (Repton, 1907, p. 187).

To attain perfect color effects in his publications, Repton used the new aquatint technique, which coincided with the rise of the highly illustrated picturesque villa book genre. For his plates, he used a two-step process: an initial engraved print with neutral brown and gray tints that were then glazed over by hand with rainbow watercolors (Repton, 1982, pp. 51–52; Archer, 1985, p. 712). The development of aquatint, a tonal method devised primarily to reproduce the flat washes of watercolor and could render tones and delicate gradations from light to shade, enabled the portrayal of varied textures and shadings, especially in the landscape part of the composition (Lambert, 1987, p. 77; Prideaux, 1909).

Repton considered landscape gardening “a happy medium between nature and art” and therefore a vocation that was subject to judgments beyond art principles derived from paintings. He noted several distinctions between the two arts, including the fixed color in painting versus the changing color in nature due to light, reflection, time and season (Repton, 1907, pp. 53–54). In the final years of his practice (1800s), Repton grew increasingly impatient with the aesthetic authority of erudite gentlemen, such as Uvedale Price and the like, and turned permissive of both design styles and color palettes. He diverged from picturesque forms and golden hues and permitted geometric compositions and “fresh” color to enter the garden. This shift hinged in part on the growing class of suburban cottage owner and Repton’s urge to appeal to mainstream taste.

3.2 Blinding Polychrome: J. C. Loudon and the Victorian Garden

Repton’s successor, J. C. Loudon, who shaped landscape discourse and practice in Regency and early Victorian England, continued this trend and completely overturned the picturesque color canon. Between 1811 and 1843, Loudon published a dozen magazines and encyclopedias and over 30 books on villa, country cottage, landscape gardening, and horticulture. His training in horticulture, botany, chemistry, and agriculture drew him closer to the science of horticulture and botany and distanced him further from Price’s lofty aesthetic theories as well as Repton’s artistic sensibilities. Loudon’s publications delineated his scientific standards and concern for botanical species palette expansion and horticultural practicality. As early as 1803, when Loudon first arrived in London, he was struck by the gloomy appearance of the public squares and attributed this to their limited evergreen tree palette. He then published an article in The Literary Journal, where he suggested banishing yews and firs and mixing evergreens with deciduous trees, especially ornamental trees such as Oriental and Occidental plane trees, sycamore, and almond (J. C. Loudon, 1980, p. 12).

In targeting the growing amateur gardeners and horticulturists and suburban audience, Loudon promoted highly adaptable garden layouts and varied color palettes. Among the wide range of garden styles that he privileged were the formal garden (itself an import from Italy via France); the informal, or English landscape garden (18th-century picturesque); and, his most known, gardensque style garden. The latter was a radical departure from the informal and closer to the formal garden, a garden loaded with flower “beddings” filled with color (see Figure 3). Loudon promoted color in the flower garden in two forms: the flower bed, in which flower color entered as distinct and bright-colored patterns, and the “flower border,” an elongated, rectangular edge flower bed juxtaposed with turf, the object of which was “to display a gay assemblage of colors during the season of flowers, without much regard to variety of form or diversity of character in these flowers, or the plants that produce them” (J. C. Loudon 1982, pp. 136, 137, 160; J. C. Loudon, pp. 1825, p. 798).
Loudon’s garden theory advanced an alternative position in the successive nature versus art debate. For him, a garden was a human expression and thus should display its artefactual rather than natural state. He wrote that “any creation, to be recognized as a work of art, must be such as can never be mistaken for a work of nature” (J. C. Loudon, 1982, p. 137). For Loudon, garden equaled art, but it was now inspired by the popular taste of the horticulturalist rather than the aesthetic of the painter and the aesthetician who interprets it. The shift from picturesque to “gardenesque,” or romantic eclecticism, in which the garden was to be distinctly artefactual and ornamental and the work of the gardener trumped that of nature, became a popular Victorian outlook. It introduced a stark shift from green and golden autumn shades to blinding
polychrome. Small, bright, and distinct color-saturated beds of elaborate shapes popped up everywhere, with the favorite bedding subjects of geraniums, calceolarias, and lobelias representing the most vivid tones of the three primaries. The best color arrangement was a bed of compound color next to a bed of simple color which was not contained in it. Purple flowers should have yellow next to them; orange should be contrasted with blue; and green, relieved by red.

The polychromatic appetite in gardening paralleled the growing dominance of science and the systematization of color as well as new developments in chemistry and industrial color production. Garden design, in turn, went through a process of rationalization and popularization. Methodic color scales, like those of the chemist Michel Eugene Chevreul, assisted in the collection and selection of flower color. Color theory became one of the head gardener’s job requirements (Tunnard, 1938, p. 39).

Another reason contributed to the shift from the disinterest in color in the early 1800s to the Victorian obsession for lavish, ornamental coloration. The shift was partially inspired and enabled by the influx of colorful plant introductions into England from Mexico, the Low Countries, and the American colonies (Taylor, 1980). The lack of color native flower varieties in England was replaced by a wealth of foreign flower species. The Royal Horticulture Society, founded in 1804, began promoting flower collections and endorsing the new trend. New botanical journals displayed meticulously drawn and hand-colored engravings that portrayed botanical distinctions with accuracy. Many of Loudon’s books, however, were colorless, displaying wood engraving and lithographs as a means to produce cost-effective and affordable publication (Archer, 1985, p. 510).

The 18th-century Victorian appetite for bright colors prompted a new debate on exotic versus native plants, a corollary of the artefactual versus natural garden pair. It culminated late that century in the battle between two English gardening schools—the “Wild Garden” with its avid proponents William Robinson and Gertrude Jekyll, and the “Formal Garden” or “Architectural Garden” with its advocate Sir Reginald Blomfield. The first promoted natural color harmonies and gradations; the second, distinct color masses.

3.3 Natural Color Harmony: William Robinson and the Wild Garden

By the late 18th-century, a growing wave of naturalism and empirical tendencies rivaled the Victorian trend. The economic depression between the 1870s and 1890s also contributed to the need to shift from highly intensive gardenesque annual flower beds to low maintenance perennial flowers, hardy plants, and herbaceous gardens. Furthermore, the fad was undercut by the campaign to abolish the import of foreign plants and decorative flower beds by the horticulturalist and journalist William Robinson and his publications of The Wild Garden (1870) and The English Flower Garden (1883). Joined by the gardener and writer Gertrude Jekyll, the two launched a battle against exotics plant imports, laying out the opposition of indigenous or native versus exotics. As avid gardeners, they called for careful observation of the growth of the garden and provision for the needs of the plants. Philosophically and aesthetically, both were influenced by the ideas of art critic John Ruskin, who espoused the ornamental function of color. Ruskin insisted that art should imitate nature’s color and that any color arrangements of varied materials should be decorative rather than structural, in other words, that color should be independent of form (Ruskin, 1889, pp. 126–27). He argued that color should appear as in nature in “simple masses” or “zones” as in the rainbow, clouds, marble, and shells. Ruskin based his theory on a close study of nature’s biological tints and, providing the example of the Zebra’s stripes among others, he claimed that in nature, plant and animal colors never follow form, which is arranged entirely on a different system. As he put it, “[in nature] all arrangements of color, for its own sake, in graceful forms, are barbarous” (Ruskin, 1889, p.129). For Ruskin, then, plant color had an inherently decorative quality, which rarely coincided with form.

Robinson (1900), whose writing career spanned from 1869 to 1910, promoted the “knowledge of the life of a garden” and the fitness of plants to site conditions. He maintained that whereas “the artist gives us the fair image: the gardener is the trustee of a world of fair living things, to be kept with care and knowledge in necessary subordination to the conditions of his work” (pp. 5, 7). For Robinson, art, which meant “the power to see and give form to beautiful things,” implied a complete fidelity to nature. Accordingly, the “true” garden artist knew the local conditions and plant communities, arranged plants in their “natural grouping,” and ensured their health and optimal natural form and growth. Robinson laid out the dichotomy of showy and glary color (i.e., ugly) versus true and delicate color (i.e., beautiful and harmonious), and considered not only the colors of flowers, but also those of leaves, stems, birds, clouds, and air (Robinson, 1900, p. 280). Using the term true to imply rightfulness, he turned to nature as his model, indeed, bestowing upon nature the role of colorist:
Nature is a good colourist, and if we trust to her guidance we never find wrong colour in wood, meadow, or on mountain. Laws have been laid down by chemists and decorators about colours which artists laugh at, and to consider them is a waste of time. (Robinson, 1900, p. 280)

Whereas Repton, too, relegated to nature the role of colorist, the two figures entertained different notions of nature and natural colors. Clearly, this divergence suggests that nature and its colors are in the eye of the beholder. Ridiculing scientific attempts to systematize color scales, Robinson called on the gardener instead to study the color palette of the flowers themselves and recommended the use of color for the effect of Harmony, rather than Contrast, and of Breadth of Mass and Intergrouping. He prescribed color arrangements for different seasons, replacing the bright colors of Victorian bedding patterns, or what he called the decorative style of design, with a plant grouping version whose color would drift and mix as in the wild (see Figure 4). Large effects and proper sequences of harmonies were his own subjective preferences:

There should be large effects, each well studied and well placed, varying in different portions of the garden scheme ... Many people have not given any attention to colour-harmony, or have not by nature the gift of perceiving it. Let them learn it by observing some natural examples of happily related colouring, taking separate families of plants whose members are variously coloured. Some of the best to study would be American Azaleas, Wallflowers, German and Spanish Iris, Alpine Auriculas, Polyanthus, and Alstroemerias (Robinson, 1900, pp. 281–82).

Figure 4. William Robinson, A Primrose Garden in Surrey, engraving based on photograph; Public domain image from The English Flower Garden, 1883.

More instructions followed. The plants whose flowers were related in color, for instance the family of reds and oranges, were to be grouped together to follow each other through seasons of blooming. The effect of the color mass was "to be large enough to have a certain dignity, but never so large as to be wearisome," and the color breadth in the masses was also needed "to counteract the effect of foreshortening when the border is seen from end to end" (Robinson, 1900, p. 282).

Robinson illustrated his ideas in The English Flower Garden with black-and-white engravings mostly in perspective. Many of the engravings were based on photographs. Photographic printing at the time was
still costly, though Robinson may well have preferred the old-fashioned grainy textured quality of the engraving, which suited the colorful drifts and gradations of the wild.

3.4 **Pointillism: Gertrude Jekyll and the Impressionist Garden**

Gertrude Jekyll, a gardener and prolific writer whose 60-year gardening career began in 1870, shared Robinson’s garden design principles, but she used a different lens and style. She was the first to make color schemes the primary concern of the garden, her unique contribution to garden design. In her books, *Colour in the Flower Garden* (1908) and *Colour Schemes for the Flower Garden* (1908), Jekyll defended her narrow focus by arguing that form and proportions are important but had already been treated by others, whereas color was neglected (Wood, 2006, p. 67). She experimented with color groupings and meticulously recorded the results in her own garden at Munstead Wood, which gradually evolved over the 59 years she lived there.

Jekyll differed from Robinson in that she repeatedly referred to gardens as “living pictures.” She considered the work of a painter to be a model to the gardener, and referred to colors as paint pigments in the garden, and the earth as canvas. She considered herself a person of refined aesthetics and called for a cultivated taste, especially for gardeners, whom, as she claimed, did not possess good taste. Albeit, she was neither an artist herself, nor did she qualify as an artist in Ruskin’s eyes. As is evident in the incident described below, for Ruskin, a painter and a gardener clearly saw color differently:

Jekyll once recalled that on one occasion Ruskin had asked her: “What is the colour of the grass over there?” to which she responded: “Green, of course.” “No, it’s not,” said Ruskin: “Were you to paint that grass, green is not the colour you would take from your watercolour box. It would be primrose yellow.” (Wood, 2006, p. 8)

Jekyll was a naturalist with a poetic bent and a moralistic tone, as this remark suggests: “No artificial planting can ever equal that of Nature, but one may learn from it the great lesson of the importance of moderation and reserve, of simplicity of intention, and directness of purpose” (Jekyll, 1904, p.156). Her references to art combined with her disregard for formal composition and affection for Impressionist painting landed her the title of “impressionist gardener” or “pointillist gardener,” at a time when Impressionism was fading (Wood, 2006, pp. 68–73).

Jekyll was also inspired by Chevreul’s principles of color harmony and explanations for various optical peculiarities for her herbaceous flower borders (the same source that informed the late 19th century Impressionist artists and, alternately, Jekyll’s own predecessor, Loudon). Accordingly, Jekyll used a greater variety of earthy color mixes and gradations in her color flower border schemes. In her writing, Jekyll used rich vocabulary of color descriptors to articulate desired pictorial and optical effects and avoided scientific color chart naming (Jekyll 1904, p. 80). And as the following statement indicates, she was far from rational and highly subjective and judgmental when it came to the principles of harmony and beauty:

I do not know whether it is by individual preference, or in obedience to some colour-law that I can instinctively feel but cannot pretend even to understand, and much less to explain, but in practice I always find more satisfaction and facility in treating the warm colours (reds and yellows) in graduated harmonies, culminating into gorgeousness, and the cool ones in contrasts; especially in the case of blue. (Jekyll, 1904, p. 206)

Although Jekyll designed with color in mind and had a great affection for watercolor drawings, the few illustrations in her books are colorless, and the vast majority are in plan-view. The plans show simple outlines of rectangular-shaped beds, filled with a patchwork of planting blobs including botanical plant labels, ready to be executed by a gardener (see Figure 5). Although the color lithograph technique was perfected at the turn-of-the-century, black-and-white photography became the prime vehicle for the representation and dissemination of her new ideas in landscape design, replacing perspective drawings. Photographic presentation came close to the spectator’s point of view, exuded an apparent objectivity, and brought realism in garden representation to a new height (Lipstadt, 1988, p. 28). The mechanical fidelity of photographic reproductions that was popularized in print media was in line with Jekyll’s empirical sentiments.
According to modern English landscape architect Christopher Tunnard, the camera lens and photographic frame may have had a role in shaping Jekyll’s approach to garden design, to seeing the garden as “living pictures.” The camera, an apparatus that recorded the effects of light, also, led to the development of impressionism in art. Tunnard recounts the reproduction in painting by judicious combinations of the light reflecting pigments of painters, such as Sargent, who used hundreds of different shades that were found to be necessary for successful imitation of the camera’s vision (Tunnard, 1938, p. 37). Tunnard considered this approach to be detrimental to the perception of formal composition, which he deemed to be the most important element of the modern garden. Yet, he added that these same pointillist experiments in color “enabled constructional painters like Cézanne and original romantic painters like Van Gogh to assume the significant positions they hold in the history of modern art” (Tunnard, 1938, p. 37). Turning to Jekyll, Tunnard...
slighted impressionism in the garden and planting design that appears to have ‘happened’ rather than to have been artificially planned.

Modern developments in the late 19th-century art world—the work of Cezanne being a harbinger to modernism—to which Tunnard alluded, were paralleled in landscape and garden design. The final decade of the century brought about another turn in garden design theory by the architect Sir Reginald Blomfield. Blomfield restored the architect’s involvement in garden design, a longtime practice that had been disrupted since the age of Brown and Repton, and that primarily favored form over color and formal over natural composition. Blomfield introduced a new voice to the color debate that sided with the Beaux-Arts revivalist tradition and at the same time served as a precursor to the color ideas of the modern landscape that would emerge in the early 20th-century.

3.5 Plain Color Mass: Sir Reginald Blomfield and the Beaux-Arts Garden

In the 1890s, Sir Reginald Blomfield countered the call for the wild garden with his seminal publication, The Formal Garden in England (1892). The clash between Robinson and Jekyll and Blomfield was the clash between the formal garden and the informal garden, both of which deployed color as ornament, yet of a different kind.

Blomfield instigated a garden design shift from horticulture to architecture, arguing that the landscape gardener ignored the house and created a garden without any relationship to it. It was also a shift from pictorial to spatial design, where mass and form dominated, and color merely supported the formal composition. He countered Robinson’s call for landscape gardeners to act as painters on a colossal scale and improve the grounds “with the compositions of the old masters” (Blomfield, 1901, p. 6). Furthermore, he ridiculed Robinson’s call to landscape gardeners to become “painters in the spirit of nature” and with the “privilege to make ever-changing pictures out of nature’s own material—sky and trees, water and flowers and grass” (Blomfield, 1901, p. 7). Blomfield also bluntly opposed the picturesque act of deception that conceals human-made elements, including paths and fences, so as to create an undisturbed natural scene (Blomfield, 1901, p. 5). He even rejected Loudon’s decorative gardenesque bedding-out patterns which had nothing to do with space:

In dealing with great spaces the landscape gardener seems to have little idea of mass.
He is forever breaking up the outline with little knots of trees, and reducing the size of his grounds by peppering them all over with shrubs (Blomfield, 1901, p. 226).

Blomfield was keen to expose the gardeners’ ineptness in the art and design world, which to him resided in the extreme opposite of nature. He argued that garden as a word and an idea is integral to the notion of enclosed space with clear boundaries, as opposed to unenclosed fields and woods:

The long yew - hedge is clipped and shorn because we want its firm boundary lines and the plain mass [emphasis added] of its colour; … and the flower border on either side is planted with every kind of delightful flower, so that the refinements of its colour may be enjoyed all through the summer (Blomfield, 1901, p. 233).

The context for Blomfield’s ideas was the turn-of-the-century budding of landscape architectural academic programs and professional institutions that emulated the canons of architecture schools and made the Rome Academy and its associated Beaux-Arts drawings their own model of practice. For Blomfield, the question of garden design was not one of horticulture at all, but one of design, and color was to be relegated to a secondary position:

The horticulturist and the gardener are indispensable, but they should work under control, and they stand in the same relation to the designer as the artist's colourman does to the painter, or perhaps it would be fairer to say, as the builder and his workmen stand to the architect. The two ought to work together. (Blomfield, 1901, p. 20)

Blomfield’s polemical text was interspersed with a few contemporary and mostly historical formal garden illustrations from the Renaissance, Baroque, and Medieval periods in perspective and bird-eye view.
The traditional wood engraving and lithograph techniques suited his retrospective tendency and the return to formality (see Figure 6).

Figure 6. Sir Reginald Blomfield, Engravings, The Fishpond, Wrest, Bedfordshire (top); The old garden at Brickwall, Sussex (bottom). Public domain image from *The Formal Garden*, 1892.

The emphasis on spatial design and on linking the garden and the house became key principles of modern 20th-century garden design. Color, in turn, emerged from its subordinate position to form and its role in service of the “mass,” in Blomfield’s scheme, gained its primacy once more as a partner to the creation of space and formal composition in the twentieth century modern garden.

Blomfield’s critical writing, for the first time in garden theory, took to task his predecessors’ negligence, or casual definition, of the word *nature*. Instead, he argued, they preferred to “use the word in half a dozen different senses,” adding:
The axiom on which the system rests is this—Whatever nature does is right; therefore let us go and copy her. Let us obliterate the marks of man’s handiwork (and particularly any suspicion of that bad man, the architect), and though we shall manipulate the face of nature with the greatest freedom, we shall be careful to make people believe that we have not manipulated it at all. (Blomfield, 1901, p. 4)

Blomfield’s contention corroborates a central point in this essay – that the arguments concerning color have often misused the nature-art concepts or used them carelessly. Thus, seemingly similar words were muddled, meaning different things at different times, and often implying opposing ideas and vice versa. As such, for Repton, artful meant imitation of the masters’ painting and the erasure of human intervention to achieve an ostensibly natural scene, using natural color as camouflage to deceive the eye. Conversely, for J. C. Loudon, artful meant the display of human presence as distinct from the natural landscape using bright color as contrast. For Robinson and Jekyll, artful meant fidelity to the natural condition, whereas for Blomfield, it meant severance from the natural condition. Likewise, the idea of deferring to nature the role of colorist was advocated by both Repton and Robinson toward very different ends and color schemes. Whatever artful and natural meant, the debate on color has continued to reflect landscape designers’ insistence on the false dichotomy between the concepts of art and nature. Each of the color outlooks that pervade the 18th- and 19th century English discourse and practice projected its color ideas on both nature and art.

Many landscape architects are still using the color green, for instance, to signify nature at the time that art and architecture eschewed the notion of color as signifier and replaced it with color as affect. Aided and reinvigorated by new technologies, color and artificial light have invaded the urban landscape through floor surfaces and free-skinned building facades. The practice seen in experimental garden festivals over the past two decades and urban works by West 8, Claude Cormier, and Perta Blaise, to name a few, suggest increased interest in color design by practicing landscape architects. Yet, the voice of landscape architecture is missing in the renewed discourse on color and atmosphere in contemporary architectural and urbanism. New titles in architecture and urbanism validate this interest and the need for theoretical studies that could shed light on these novel practices as well as place them historical perspective.

Finally, recently there has been increased interest in sensorial and haptic perception in landscape architecture and there is a growing body of research, though not yet books, on soundscape and fragrance. Although it is understood that human experience relies on the interdependency of the senses, this work heralds an approach that isolates sensorial and perceptual color intake in order to not only to reveal core landscape concepts and debates in our discipline, but also to uncover new design possibilities. This historiography prefigures the experiential possibilities that design with color can offer, new ways in which designers can transform color for altered perception and intense experiences.

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MEDIA STATEMENT

COLOR(FUL) PREDICAMENTS IN LANDSCAPE ARCHITECTURE

MIRA ENGLER, PH.D.
Iowa State University

In this paper, I examine the history of ideas, themes, and debates about color in landscape architecture in eighteenth- and nineteenth-century England. I use five successive theories that are configured around color as a lens for understanding several general discursive themes that are still active today, such as natural versus artificial, native versus exotic, and sensation versus concept. I show that color propensities in landscape architecture have historically been linked to disciplinary attitudes to the opposite concepts of nature and art as well as to contemporaneous discourses in art and architecture and to printing technology.
WORLD HERITAGE PERSPECTIVE ON THE THREE HILLS AND FIVE GARDENS AREA IN BEIJING’S WESTERN SUBURBS AS CULTURAL LANDSCAPE

CHEN, KANG-LIN
College of Urban and Environmental Sciences, Peking University, Beijing. kanglinchen@pku.edu.cn

QIAN, YUN
School of Landscape Architecture, Beijing Forestry University, Beijing. qybju@126.com

1 ABSTRACT
The Three Hills and Five Gardens area of Beijing’s western suburbs is considered to be one of the masterpieces of Chinese classical gardens, and was previously occupied by royalty. Across this area, man-made constructions show great respect to the surrounding natural landscape and follow the ideas of traditional Chinese philosophy. However, the values of this unique area have not yet been officially recognized, and the area is seldom seen as a cultural landscape heritage. This paper aims to rediscover this royal area via a review of its cultural landscape heritage value. It will first summarize the interactions between landscape entities and spiritual aspects of the area, including typical landscape construction under the guidance of humanistic thought, as well as the spiritual implications of the overall landscape. Next, by comparing the Three Hills and Five Gardens area with similar gardens around the world that are World Heritage listed, as well as with other well-known Chinese classical gardens, this paper seeks to determine the specific values of the area. Then, the paper interprets the criteria for the assessment of Outstanding Universal Value according to the Operational Guidelines for the Implementation of the World Heritage Convention by UNESCO, including criteria i—vi, and reviews the area’s integrity and authenticity. By comprehensively exploring the situation of this area and its heritage potential, this paper promotes an understanding of its existing resources.

1.1 Keywords
Royal garden; heritage; comparison; value assessment; conservation and management
2 CULTURAL LANDSCAPES AND THE THREE HILLS AND FIVE GARDENS AREA

The concept of "cultural landscapes" was put forward by the World Heritage Committee at their 16th session in December, 1992, representing the coexisting work of humanity and nature. Generally, it reflects the special technology needed to utilize sustainable land, the gradual evolution of human society and the influence of the natural environment, as well as the effects of societal, economic and cultural development. Furthermore, it embodies the core, unique cultural elements of a region, which mirrors its inhabitants' spiritual relationship with nature. According to the Operational Guidelines for the Implementation of the World Heritage Convention, cultural landscapes indicate the value of three different dimensions, being space, time and spirit, and emphasize the interactions between humans and their surroundings, with a focus on expressing the multiple cultural attributes of a society.

The Three Hills and Five Gardens area in Beijing's western suburbs (Figure 1) was founded in the prosperous Qing Dynasty (1616-1912). It comprises a core of five royal gardens that are supplemented by other related areas. The area is defined according to contour lines and practical demands, and totals approximately 7000ha. It includes three main parts: (i) The Summer Palace, the Garden of Perfect Brightness, the Garden of Tranquility and Pleasure, the Garden of Tranquility and Brightness, and the Garden of Everlasting Spring. (ii) The transition zones between the gardens, including mountains, lakes, paddy fields, villages and other natural features. (iii) The human environment including other gardens, official administration centres and military barracks. Being Chinese classical garden masterpieces, the Three Hills and Five Gardens have great heritage value with high historical and aesthetic significance. Yet, unlike mixed cultural and natural heritage areas, the area allows the coexistence of natural landscapes, garden groups, architecture complexes and human activity, combining "live" city culture into the landscape.

![Figure 1. Location of the Three Hills and Five Gardens area, Beijing. Diagram by the author.](image)

To summarize the relevant research on the Three Hills and Five Gardens, we found that domestic studies covered the aspects of heritage protection and regional development, historical change, water system change, visual design, specific landscape planning and landscape rebuilding. Meanwhile, non-Chinese studies are fewer, and have investigated topics such as the contemporary display of gardens, garden protection and utilization, vegetation management and historical building conservation, and ecological spirit. In short, studies that view the whole area in terms of cultural heritage are few. Besides, another representative Chinese royal garden—the Chengde Imperial Summer Resort (World Heritage listed)—had been incorporated into the cultural heritage list in 1994. Although there are studies paying attention to the heritage value of The Summer Palace and the Garden of Perfect Brightness separately, they have neglected to consider the regional heritage value of the area as a landscape and functional
complex. Based on the above, this paper takes the Three Hills and Five Gardens area as the research object and the criteria for Outstanding Universal Value (OUV) as the judging standard, and analyzes interactions between landscape entities and their spiritual implications in order to determine the unique cultural landscape value of the area. This research takes the form of an extensive exploration so as to exhibit China’s classical gardens to the whole world.

3 LANDSCAPE CONSTRUCTIONS AND CULTURAL IMPLICATIONS OF THE THREE HILLS AND FIVE GARDENS

3.1 Landscape construction under the guidance of humanistic thought

3.1.1 Terrain modification
Respect for mountains and rivers in the design of traditional settlements and geomancy determined the construction of the Three Hills and Five Gardens area. The area is located in Beijing’s western suburbs with the Beijing Plain in the east and a mountainous area in the west. West Hill is regarded as a barrier against the wind from the northwest and is also a symbol of the Dragon. The Yongding River alluvial fan lies at the foot of the undulating mountains. Natural features of this area include majestic mountains, abundant water, lush vegetation and paddy fields, all of which made it a choice site for garden construction. In addition, ideal terrain was created by artificial modification in the construction of the Summer Palace. Large-scale expansion of the lake and mountains turned a relatively isolated landscape into one surrounded by mountains and water(Figure 2).

3.1.2 Landscape pattern and function system

Integrity is the obvious characteristic of the Three Hills and Five Gardens area. The landscape of the area, with mountains in the east and lowlands in the west, means it represents a transition from mountain forest to country waterside. In the west is the Garden of Tranquility and Pleasure with its mountain forests; while in the east, the Garden of Tranquility and Brightness is mainly a water landscape, forming scenery surrounded by rice crops. Each part of the Three Hills and Five Gardens area contributes to an integral
system of functions. The five gardens are the core, with the other areas providing services through corresponding facilities. For instance, the paddy fields supply rice to royalty, Eight Banners Barracks is responsible for security, and other gardens provided convenience so that the Emperors could hold court there (Figure 3).

Figure 3. Composition of the Three Hills and Five Gardens area. Diagram by the author.

3.1.3 Visual design

The spirit of View Borrowing was presented throughout the planning of the Three Hills and Five Gardens area. Beautiful scenery is included in the landscape system regardless of its distance. The main commanding heights in this area include Koehler Valley to the high peak of XiaoXi Mountain, the Censer Peak of Fragrant Hill, Jade Spring Hill, Longevity Hill, Table Mountain and Baiwang Mountain. All of these contribute to a network which was carefully conceived according to visual relationships among the hills and gardens (Figure 4). For instance, Fragrance Hill can “borrow” the scenery of Jade Spring Hill, the Summer Palace in the east can “borrow” the scenery of Longevity Hill, with Jade Spring Hill in the distance.
3.1.4 Water systems

The exploitation of rivers was crucial to the development of the Three Hills and Five Gardens area and old Beijing city. In the Yuan Dynasty, the official Guo Shoujing introduced the river from Jade Spring to the inner city twice, and gathered water from springs in the Western Hills. In the Ming Dynasty, the river system from Jade Spring, after remediation, was introduced into the private gardens. In the Qing Dynasty, the emperors gathered nearby water resources as much as possible for garden construction. For example, an additional stone canal was built for introducing water into the extension of Kunming Lake during the reign of Emperor Qianlong (Figure 5). After several water diversion and expansion projects during several dynasties, water for the gardens was guaranteed. Moreover, the capital's main water supply system was created, providing comprehensive functions like drainage, storage, irrigation, shipping, and microclimate regulation. 

Figure 4. Visual relationships in the Three Hills and Five Gardens area. Diagram by the author.
3.2 Overall spiritual implications of the landscape

3.2.1 The reflection of political ideals
The Three Hills and Five Gardens area conveys the ideal of Qing Dynasty Emperors for the country’s permanent peace. The area was complementary to the Forbidden City and became the “court garden”, connected with old Beijing city through water channels and roads. The names of scenic spots and relevant poetry show the Emperors’ political intentions. For example, Qianlong wrote poetry for a scenic spot called “Wan Fang An He” in the Garden of Perfect Brightness, bearing implications for security and stability of the government. Scenic spots such as “Open and Above Board”, and “Diligent Administration & Respecting Worthy Persons” also aimed to embody Confucianist thought.

3.2.2 The pursuit of aesthetics
The Three Hills and Five Gardens area integrates the distinguishing gardening art in the south and north of China. For instance, the scenic spot in front of the Summer Palace takes scenery from West Lake—which carries the artistic conception in south China—as a blueprint. The Temple of Paying Great Gratitude for Longevity has water frontage with hills at the back. It rises in gradient with the ladders and presents a royal demeanor. Meanwhile, the Three Hills and Five Gardens area contains various treasures, which intensely reflect the aesthetic interests of Qing Dynasty Emperors.

3.2.3 The need for culture
The area is a carrier of multiple cultural needs. The first is for religious culture, which is mainly evident in garden constructions, which include the pursuit of wonderland and ancestor memorials. The second regards Chinese traditional culture. Emperors of Qing Dynasty learned Chinese traditional culture from childhood, and the royal gardens are infiltrated with traditional cultural implications. The third concerns Confucian ritual and musical culture. The Three Hills and Five Gardens contribute to a specific governance mode under the political system. They met the demand for recreational spaces where the Emperor and his officials could have fun together, which could not be achieved in the Forbidden City. The fourth aspect is agricultural culture. There are many deliberate arrangements of agricultural landscapes, reflecting the rulers’ attention to agriculture and solicitude for the people.
3.2.4 The witness of history

The important political status of the Three Hills and Five Gardens area during the Qing Dynasty provides us with a significant case for studying the history of the modern history of China. The rise and decline of gardens often reflects the fate of nations, and the Three Hills and Five Gardens mirrored not only the changing fortunes of the Qing Dynasty from prosperity to recession, but also the honor and disgrace experienced by the Chinese nation over the most recent three centuries.

4 THREE HILLS AND FIVE GARDENS FROM A WORLD HERITAGE PERSPECTIVE

4.1 Comparisons with similar domestic and international heritage sites

4.1.1 Comparisons with international garden-themed cultural landscapes

There has been nine garden-themed cultural landscapes in the World Heritage list until 2017. One of them is West Lake in China and we put it in the next paragraph. We have made a comparative analysis between international gardens and the Three Hills and Five Gardens area.

With respect to cultural implications, similar heritage sites around the world mostly reflect the social environment at the time they were created. In this respect, the Three Hills and Five Gardens area is an overall embodiment of royal culture over the 2000 years of feudal society in China. It reflects the political social environment of the Qing Dynasty and bears abundant humanistic implications.

As for landscape features, most international gardens can be classified into park, flower gardens and botanical gardens, which focus on the interactions between landscape and the surroundings within a relatively small scope. By comparison, the Three Hills and Five Gardens area occupies an area of about 7000ha, contains multiple landscape landforms and historical relics. The only larger garden is the Garden Kingdom of Dessau-Wörlitz in Germany.

In terms of garden art and architectural technology, similar heritage sites around the world are mostly of a certain garden type or architectural style used in a specific period. Following the Chinese classical garden model, the Three Hills and Five Gardens area drove revolution and progress in Europe in the 18th century, which makes them an outstanding representative of world garden history.

Table 1. International heritage-themed gardens in the World Heritage list.

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
<th>Scale</th>
<th>Inscribed time</th>
<th>Heritage descriptions</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden Kingdom of Dessau-Wörlitz</td>
<td>Germany</td>
<td>Property area = 14500 ha. No buffer area</td>
<td>2000</td>
<td>An exceptional example of landscape design of the Age of the Enlightenment—the 18th century.</td>
<td>(ii) (iv)</td>
</tr>
<tr>
<td>Aranjuez Cultural Landscape</td>
<td>Spanish</td>
<td>Property area = 2047.56 ha. Buffer area = 16604.56 ha.</td>
<td>2001</td>
<td>An entity of complex relationships: nature and human activity, sinuous watercourses and geometric landscape design, the rural and the urban, forest landscape and delicately modulated architecture.</td>
<td>(ii) (iv)</td>
</tr>
<tr>
<td>Royal Botanic Gardens, Kew</td>
<td>United Kingdom</td>
<td>Property area = 132 ha. Buffer area = 350 ha.</td>
<td>2003</td>
<td>Illustrates significant periods in the art of gardens from the 18th to the 20th centuries.</td>
<td>(ii) (iii) (iv)</td>
</tr>
<tr>
<td>Muskau Park / Park Mużakowski</td>
<td>Germany</td>
<td>Property area = 348 ha. Buffer area = 1204.65 ha.</td>
<td>2004</td>
<td>Utilizes local plants to enhance the inherent qualities of the existing landscape and pioneers new approaches to landscape design.</td>
<td>(i) (iv)</td>
</tr>
</tbody>
</table>
The Chinese gardens discussed in this paper, which are royal gardens and official gardens, have their functions of the gardens, the Mountain Resort and its Outlying Temples in Chengde, Beijing City. This is similar to the "residence front and backyard" concept in traditional Chinese architecture, which make gardens the political center of feudal society and examples of Chinese royal culture. In modern times, by virtue of its suburban location close to Beijing, it has become a historical and leisure space for contemporary people to step into nature, express emotion and experience cultural belonging.

### 4.1.2 Comparisons with domestic garden-themed heritage sites

This article also compares the Three Hills and Five Gardens area with four garden heritage sites that are World Heritage listed in China. What is noteworthy is that one of the core gardens, the Summer Palace, has already been incorporated into the category of "Cultural Heritage" in 1998. Actually, according to the *Operational Guidelines*, "Cultural Landscape" was separated from "Cultural Heritage" in the time at which the first garden with a "Cultural Landscape", namely, the Garden Kingdom of Dessau-Wörlitz in Germany, proposed in 2000. Many sites of Chinese cultural heritage possess the unique feature of combining human activity and nature, and most that incorporated into "Cultural Heritage" in the early time also carry the feature of "Cultural Landscape". Therefore, the Chinese gardens discussed in this paper include both concepts of "Cultural Heritage" and "Cultural Landscape". In recent years, the increasingly important value of the area as a whole is gradually being recognized, which also reminds us that it is improper to consider each core garden separately.

In terms of the function of the gardens, the Mountain Resort and its Outlying Temples in Chengde, and the Three Hills and Five Gardens are both royal gardens. Meanwhile, the Classical Gardens of Suzhou are private gardens and the West Lake Cultural Landscape of Hangzhou is a public garden. So, compared with Suzhou Garden and Hangzhou West Lake, the Three Hills and Five Gardens have greater symbolic significance in political culture. As royal gardens, Chengde became a summer palace as a whole; however, the Three Hills and Five Gardens assumes various functions: the Garden of Tranquility and Pleasure and the Garden of Tranquility and Brightness are mainly responsible for providing agreeable mountain residences and conserving water. The Garden of Everlasting Spring is the residence for the Empress Dowager. The Garden of Perfect Brightness is the residence for the Emperor and has governance and recreational functions. The summer palace was a birthday gift for the Empress Dowager at the beginning, then became a site of residence and governance that took the place of the Garden of Perfect Brightness. Moreover, the functions of the five core gardens in the Three Hills and Five Gardens are different, and there are also some other royal gardens and official gardens.

As for its urban location, the Three Hills and Five Gardens area has a relationship with the Forbidden City. This is similar to the "residence front and backyard" concept in traditional Chinese architecture, which make gardens the political center of feudal society and examples of Chinese royal culture. In modern times, by virtue of its suburban location close to Beijing, it has become a historical and leisure space for contemporary people to step into nature, express emotion and experience cultural belonging.

### Table 2. Domestic heritage-themed gardens in the World Heritage list.

<table>
<thead>
<tr>
<th>Name</th>
<th>Scale</th>
<th>Inscribed time</th>
<th>Construction time</th>
<th>Heritage type</th>
<th>Heritage descriptions</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Persian Garden</td>
<td>Iran</td>
<td>Property area</td>
<td>2011</td>
<td>Exemplifies the diversity of Persian garden designs that adapted to different climatic conditions.</td>
<td>(i)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 716.35 ha.</td>
<td></td>
<td></td>
<td></td>
<td>(ii)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buffer area</td>
<td></td>
<td></td>
<td>garden designs that adapted to different climatic conditions.</td>
<td>(iii)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 9740.0.0 ha.</td>
<td></td>
<td></td>
<td></td>
<td>(iv)</td>
<td></td>
</tr>
<tr>
<td>Bergpark</td>
<td>Germany</td>
<td>Property area</td>
<td>2013</td>
<td>A remarkable testimony to the aesthetics of the Baroque and Romantic periods and an expression of the ideals of absolutist Monarchy.</td>
<td>(i)</td>
<td></td>
</tr>
<tr>
<td>Wilhelmshöhe</td>
<td></td>
<td>an area of 558.7 ha while buffer area is 2665.7 ha</td>
<td></td>
<td></td>
<td>(ii)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(iii)</td>
<td></td>
</tr>
<tr>
<td>Medici Villas and Gardens in Tuscany</td>
<td>Italy</td>
<td>Property area</td>
<td>2013</td>
<td>A dedication to leisure, art and knowledge between the 15th and 17th centuries, representing an innovative system of construction in harmony with nature.</td>
<td>(i)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 125.4 ha.</td>
<td></td>
<td></td>
<td></td>
<td>(ii)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buffer area</td>
<td></td>
<td></td>
<td></td>
<td>(iii)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 3539.08 ha.</td>
<td></td>
<td></td>
<td></td>
<td>(iv)</td>
<td></td>
</tr>
<tr>
<td>Singapore Botanic Gardens</td>
<td>Singapore</td>
<td>Property area</td>
<td>2015</td>
<td>An important centre for science, research and plant conservation, notably in connection with the cultivation of rubber plantations.</td>
<td>(i)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 49 ha.</td>
<td></td>
<td></td>
<td></td>
<td>(ii)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buffer area</td>
<td></td>
<td></td>
<td></td>
<td>(iii)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 137 ha.</td>
<td></td>
<td></td>
<td></td>
<td>(iv)</td>
<td></td>
</tr>
</tbody>
</table>
### 4.2 Evaluation of the heritage value of the Three Hills and Five Gardens

According to the Operational Guidelines, the criteria for World Heritage listed sites include having outstanding universal value and integrity and/or authenticity, with appropriate protection and management that ensures their conservation of heritage. Referring to the evaluation criteria, the area of the Three Hills and Five Gardens meets criteria i, ii, iii, iv, and vi for an assessment of Outstanding Universal Value.

**Criterion i:** *Represent a masterpiece of human creative genius*. The Three Hills and Five gardens area is a model of planning and utilizing land at a large scale. The area combine features of gardens from south and north China, and represents the highest achievement of art and technology for Chinese classical gardens.

**Criterion ii:** *Exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design*. The Three Hills and Five Gardens area embodies the concepts of Chinese traditional culture. The names of scenic spots are mostly derived from Confucianism, showing that the rulers of the Qing Dynasty inherited and carried forward orthodox culture. Meanwhile, religious constructions account for almost one-third of the buildings in the gardens, including Buddhist monasteries, temples and pagodas. These express a hope for national unification and create a mixed area of Manchu (Mongol) and Han ethnicity. Besides, the Garden of Perfect Brightness is representative of the integration of Chinese and international garden art.

**Criterion iii:** *Bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared*. The Three Hills and Five Gardens area has a rich variety and exhibits a unique form of culture and art. The Garden of Tranquility and Pleasure mainly takes advantage of the natural environment with little artificial modification, the Summer Palace and the Garden of Tranquility and Brightness exhibit combinations of humanity and nature, and the Garden of Perfect Brightness is mainly an artificial landscape. They reflect the Chinese traditional spirit called “heaven-man unity”, and also reflect the freehand brushwork used in traditional Chinese paintings during the Tang and Song Dynasties for more than seven centuries. The Three Hills and Five Gardens area presents Chinese royal gardens as a kind of cultural art in the world. This area also manifests the Chinese agricultural system, and the layout of various service facilities embodies the social hierarchy that served governors during the feudal period.

**Criterion iv:** *Be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history*. The Three Hills and Five Gardens area also illustrates the traditional Chinese philosophy of recreating natural landscapes in

| Mountain Resort and Its Outlying Temples, Chengde | Property area = 611.2 ha | 1994 | 1703-17922 | Cultural | A vast complex of administrative and ceremonial buildings such as palaces. A rare historic vestige of the final stage of feudal society in China. |
| Classic Gardens of Suzhou | Property area = 11.922 ha, Buffer area = 26.839 ha | 1997 | 11th-19th centuries | Cultural | Illustrates the idea of recreating natural landscapes in miniature and reflects the profound metaphysical importance of natural beauty in Chinese culture. |
| Summer Palace, an Imperial Garden in Beijing | Property area = 297 ha, Buffer area = 5595 ha | 1998 | Founded in 1750, destroyed in 1860 and restored in 1886 | Cultural | The natural landscape of hills and open water is combined with artificial features to form a harmonious ensemble of outstanding aesthetic value. |
| West Lake Cultural Landscape of Hangzhou | Property area = 3322.88 ha, Buffer area = 7270.31 ha | 2011 | Has existed since the 9th century (Tang Dynasty) | Cultural Landscape | A testimony to the cultural tradition of an idealised fusion of humans and nature, which has also influenced garden design in China, Japan and Korea. |
miniature and reflecting the profound metaphysical importance of natural beauty. The area not only shows the maturity of garden techniques used in late Chinese feudal society, but also reflects the development standard of artifacts, culture, and techniques at that time, projecting specific material and spiritual forms of society. Besides, the Garden of Perfect Brightness was introduced to the world by missionaries, opened the first window to the world through which people could recognize Chinese gardening art. As such, it occupies an important position in gardening history.

Criterion vi: Be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria). The Three Hills and Five Gardens retains a lot of precious historical material such as paintings and literature. As a miniature and direct reflection of the royal culture of the Qing dynasty, this area bears much historical duty and educational significance.

4.3 Authenticity and Integrity

4.3.1 Authenticity

The key component elements—cultural connotation, Jiangnan artistic conception and urban-mountain forest thought are preserved in the Three Hills and Five Gardens, which were formed during the Qing Dynasty. From the perspective of material and texture, the architecture, stone inscriptions, horizontal inscribed board, tablet inscriptions and other immovable historical sites in the Three Hills and Five Gardens are preserved. These have become a material expression of multi-national unification and represent the achievements of traditional architecture and classical garden art. At present, the overall West Hill background of the Western Suburb Garden, and the typical landscape outlines such as Longevity Hill and the Tower of the Fragrant Buddha are basically the same as those recorded during the Qing Dynasty. The urban outline is within a scope that is controllable under the background of Beijing’s urban development.

Above all, the authenticity of the Three Hills and Five Gardens can still be demonstrated. The landscape patterns, visual relationships, the water utility in the landscape’s construction, and reflects of politics, aesthetics and culture are sustainably preserved, and conservation and management rules guarantee its authenticity to some extent.

4.3.2 Integrity

The heritage elements in the Three Hills and Five Gardens area are still integrated. The major planning design concepts of the heritage relics and the natural landscape morphology transmit the history of the Qing Dynasty. The landscape environment, architecture and garden decorations are basically preserved. In addition, many historical data, pictures and literature records describe the area’s historical development since the Qing Dynasty.

The Three Hills and Five Gardens area is large enough to embody features of heritage value. It contains five major mountains (Fragrance Hill, Jade Spring Hill, Longevity Hill, Table Mountain and Baiwang Mountain), three types of water systems (springs at Jade Spring Hill and Wanquan Village; rivers: Long River, Qing River, Wanquan River, and North & South Han Rivers; lakes: Kunming Lake, Gaoshui Lake, Yangshui Lake and Fu Lakes) and forests interspersed with villages. Although there have been many changes made in modern water systems and rice fields, and many villages are on the verge of destruction, the physical form has not completely disappeared. Therefore, it still embodies heritage value characteristics.

The Three Hills and Five Gardens area is influenced by Beijing’s urban development to some extent, but there are protection measures in place. Policy documents include: theBeijing Second Batch of Defined Protection Scope of 120 Culture Relic Protection Sites, Description of Four Boundaries of Construction Control Zone, Provisions of Strictly Controlling Construction Engineering in The Summer Palace and the Garden of Perfect Brightness, and Beijing Planning of Conservation of Historic Cultural Cities. All these are devoted to guaranteeing the landscape and ecological completeness of the area.

5 CONCLUSIONS AND RECOMMENDATIONS

The Three Hills and Five Gardens area of Beijing’s western suburbs is a representative of Chinese royal gardens and is a complex of natural and cultural landscapes. However, we must admit that the development of Beijing city has an influence on the area by disrupting the overall landscape pattern and isolating the gardens. To reinforce the potential heritage value of the area, we can take the following
strategies. Firstly, we should strengthen regional integration by avoiding garden fragmentation and guarantee linking relationships between different gardens, such as visual passage corridors and waterways. Secondly, we should diversify protection methods. The area contains gardens, farmlands and buildings. Considering the different attributes, values and statuses of these elements, it is unwise to apply existing provisions or simply adopt a single management method. Measures should be adjusted due to local conditions. Thirdly, we should emphasize spiritual cultural values by not only protecting regional tangible entities, but also by strengthening intangible traditional concepts, cultural consciousness and brand publicity, so as to raise the social status of this area.

Notes:
① Presently, there is no explicit official definition of the area. Based on urban landmarks, Liu, J. and Hu, L. pointed out that the scope of the area is as follows: Yongfeng Road-North Malianwa Road is the northern boundary; West Shangdi Road-subway Line 13 in Beijing-Shuangqing Road is the eastern boundary; Chengfu Road-Zhongguancun Avenue-South Haidian Road-Suzhou Road-Changchungqiao Road-Yuanda Road-North West Fourth Ring Road-North Wucun Road-Minzhuang Road form the southern boundary; the south wall of Round City arms drill field and the east-west extension cord of the southern boundary of the Garden of Tranquility and Pleasure is the western boundary; the western foothills are the northwestern limit.
② Qianlong (1735-1795), an emperor in Qing Dynasty.

View Borrowing is a traditional method for Chinese garden construction that we intentionally make the scenery outside the garden be seen in the garden. In this way we can make the scenery richer and broader.

6 REFERENCES
NEW SITE PLANNING AND DESIGN METHODOLOGY: MODELLING URBAN MORPHOLOGIES TO IMPROVE AIR POLLUTION DISPERSION FOR BETTER DESIGN PERFORMANCE OF RESIDENTIAL OPEN SPACE IN BEIJING

YU, JUNYA  
The University of Melbourne, junyay113@email.com

WALLISS, JILLIAN  
The University of Melbourne, jwalliss@unimelb.edu.au

1 ABSTRACT

Numerous researchers highlight the public health implications of long-term exposure to air pollution and investigate the influence of existing urban morphologies on air movement through Computational Fluids Dynamics (CFD) modelling. However, few researches explore the possibility of designing new urban morphologies and the associated open space which can positively influence on air pollution dispersion so as to improve landscape performance. This study aimed to explore this gap. Surrounded by office buildings and industrial sites in a highly polluted district in Beijing, a new residential development site presented a great opportunity to apply a research-driven design methodology that explores the role of digital techniques (CFD) and computational and real-time data in bridging the gap between scientific knowledge and design speculation. The study carried out CFD modelling of conventional and new urban morphologies to identify an optimised building configuration that positively influence on air pollution dispersion in the associated open space, and then to develop a series of microclimate adaptive design strategies that minimize residents’ exposure to pollution in this open space. Through this methodology, we demonstrated the possibility of modifying wind speed and wind direction as a valuable strategy to reduce the effect of air pollution by the massing and siting of residential building blocks and topographic strategies. Then the detailed design of external spaces was developed with the ambition to maximise the usability of open space during low air pollution periods, and to encourage responsive micro-atmospheric behaviours through the combined effects of landform manipulation, spatial and material design.

1.1 Keywords
landscape, design, pollution, performance, China
2 INTRODUCTION: THE INFLUENTIAL FACTORS OF AIR POLLUTION IN BEIJING

The documentary 'Under the Dome' by the Chinese journalist Jing Chai significantly raised public awareness of the extent of China’s air pollution, especially in the capital city Beijing. Numerous researchers (Esch, 2015; Excell, 2015; Walton et al., 2015; Bolund & Hunhammar, 1999) highlight the dangers of long-term exposure to air pollution which can lead to respiratory and cardiac diseases, and even premature death. For example the great London Smog of 1952 is believed to have resulted in approximately 12,000 deaths due to ‘a delayed effect’ (Bell, Davis, & Fletcher, 2004). Even though the Clean Air Act has been adopted since 1956 (Excell, 2015), ‘London’s air pollution still affects human health’ (Bell, Davis, & Fletcher, 2004). This demonstrates that any remediation of China’s pollution issue will be a long-term process. Consequently, many generations of Chinese people will continue to suffer from the delayed health effects of pollution, even with the successful application of pollution limiting economic and environmental reforms, policies and regulations.

The extreme pollution levels experienced in Beijing during the winter of 2015 attracted extensive media attention from across the world. According to the Chinese Ministry of Environmental Protection Data Centre (Liu, 2013), Beijing is one of the most polluted of China’s thirty one provinces and municipalities. The reasons behind this high level of pollution are complicated, ranging from poor supervision and enforcement of environmental regulations from vehicles and factories, heavy reliance on coal for energy and rapid population growth resulting in a tremendous increase in energy consumption (Li, Feng & Li, 2015). All of these factors lie outside the influence of design. However, wind is acknowledged as a major contributing factor in air pollution dispersion, transmission and diffusion. A recent report by Peking University (2015) highlighted Shijiazhuang and Tianjin as neighbourhoods which produced high levels of air pollution due to heavy industries such as steel manufacture. Due to wind movement, these emissions contribute to high air pollution levels in Beijing city. This factor, combined with the mountain ranges surrounding Beijing, which run from north to south west, act to trap pollutants in the city. Conditions are particularly severe when the southerly winds prevail (Zhang & Sang 2004; Jianzhong et al., 2014).

Wind direction however is not the only factor to consider – wind speed is of equal importance. Research recommends that wind speed be maintained within a range of 5.4-10.8 m/s for optimum dispersal of air pollution. Further Zhang et al. (2012) and Liu & Bian (2007) comment on wind speeds dual impact on air pollution levels. Within this recommended range of 5.4-10.8 m/s, the wind speed promotes diffusion and dispersion of air pollutants as it gets higher; while over 10.8 m/s, the increased wind speed can aggravate the concentration of Inhalable particulate matter (PM10, particulate matter 10 micrometers or less in diameter) so as to increase Air Pollution Index (API, a quantitative measure that describes ambient air quality). The index is obtained by combining figures for various air pollutants into a single measurement (UN, 1997). Also, if lower than 5.4m/s, the decreased wind speed is unlikely to promote dispersion of air pollutants which can accumulate over time.

In addition to this, the influence of urban morphologies on air pollution levels also presented a great opportunity to engage. From the perspective of urban planning and urban design, this means exploring how built form can influence residents’ exposure to pollution. Building layout (massing and siting) is recognized as one of the major ways in which designers can contribute to minimizing air pollution levels due to its impact on surrounding wind fields. For instance, a 2014 study (Yuan, Ng & Norford) examined the role of Hong Kong’s high, dense urban morphologies on air pollutant dispersion and highlighted the importance of maintaining an active air flow to improve the dispersion of air pollutants in high density cities. Similarly research by Ng (2009) demonstrated how uniform, dense urban high-rise buildings with limited open space between buildings resulted in stagnate air movement which causes accumulation of air pollution at the pedestrian level. In a further study Ng et al. (2011) found that low porosity can limit air flow velocity which acts to retard the dispersion of air pollutants. Collectively this research reveals to planners and designers the importance of considering air pollution dispersal as an influential factor when considering building layout in dense urban contexts such as China.

Influencing wind direction and speed can therefore be an immediate and valuable strategy for designers to use to minimise the effect of air pollution levels on residents. Despite this potential, many urban focused research studies tend to limit their enquiries to the relationship between air pollution levels and existing urban forms, in particular on traffic related emissions on streets or, alternatively, the statistical correlation between meteorological conditions and air pollution levels. Few published studies engage with the design of new urban morphologies and how the density, height and layout of buildings and associated open spaces might positively influence residents’ exposure to pollution. It is therefore important for
designers to consider how incremental changes might influence pollution exposure. This paper presents a two-phase research-driven design methodology which investigates the influence of conventional and new built form on air pollution exposure in the design a new residential development block in Daxing District, Beijing. The first phase tests urban morphological configurations (heights and siting orientation) using local data and CFD modelling. The second phase, shifts scale to explore the possibilities of influencing atmospheric conditions in the detail design of the resulting open space, considering topographic manipulation, programmatic and spatial relationships and materiality.

3 METHODS: TWO-PHASE STRATEGY

3.1 Phase one: Designing of possible conventional and new urban morphologies for CFD modelling to identify the optimised building configuration and microatmospheric conditions in its associated open space

A 14 hectare vacant block in the Daxing District was selected as the site for exploration. The study began with the consideration of conventional urban design patterns (adopting Chinese standards), which were then varied over the course of the explorations to achieve the desired wind effects. Importantly the site topography was accurately established, obtained from the ASTER Global Digital Elevation Model (2016). According to the Standards China (MCPRC, 2002), the site could accommodate a maximum of 3000-5000 households or a population of 10000-15000. The maximum net density of residential buildings is defined as 35% for lower-rise (1-3 levels), 28% for multi-story (4-6 levels), 25% for mid-rise (7-9 levels) or 20% for high-rise (≥10 levels) buildings over the total development land (MCPRC, 2002).

In this study, 3, 6, 9, 15 and 21 levels were tested. In addition, the density of conventional building layout was constrained by spacing requirements which ensure lower level buildings receive adequate solar exposure in accordance with Chinese standards (Standards Beijing, 2007; Standards China, 2014). Furthermore, the conventional building layout was divided into four common urban siting configurations - including row, perimeter, point and a combination of these three. As shown in Figure 1, the combination of these different building heights and standard siting configurations produced 14 different options. These formed the starting point for testing the relationships between urban forms and local wind data using CFD simulations in ArcGIS 10.3. Importantly the influence of the surrounding existing buildings was also considered as part of the simulation models.
Figure 1. (a) Conventional building configuration models (2016). (b) CFD simulation input parameters: conventional building layout, building height and existing surrounding buildings (2016). Diagram by the author J. Yu.

Testing began with the prevailing wind of the District, with local data providing hourly mean wind velocity and directions in the Daxing District from 1951 to 2014. This data revealed that the prevailing winds originated from the north, north-northwest and south-southwest with the corresponding wind velocity ranging from 0.3 m/s to 5.4 m/s. Testing comprised of two stages. The first stage (Figure 2a) explored the performance of the 14 variations of the conventional building configurations, discussed earlier. This analysis provided an understanding of the behavioural relationships between building height and configuration, density, wind speed and direction with the ambition of encouraging the northern wind within the parameter of 4-5 m/s and minimising the southerly wind. The 3, 6 and 9-levels building patterns were tested as representatives of lower-rise, multi-story, mid-rise buildings configurations. This preliminary study revealed
that none of the conventional building layouts adequately increased the northern wind speed, nor satisfactorily reduced the south-southwest wind at pedestrian level.

<table>
<thead>
<tr>
<th>Wind</th>
<th>CFD on Conventional Building Layouts</th>
<th>CFD on Further Developed Building Configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>5.4m/s</td>
<td>N</td>
</tr>
<tr>
<td>NNW</td>
<td>5.4m/s</td>
<td>NNW</td>
</tr>
<tr>
<td>SSW</td>
<td>3.3m/s</td>
<td>SSW</td>
</tr>
</tbody>
</table>

Figure 2. (a) Stage one CFD modelling with conventional building configurations (2016). (b) Stage two CFD modelling with new building configurations (2016). (Colour changes from blue to red presented calm wind to high wind speed.) (c) The best building configuration and the generated micro-atmospheric conditions in the associated open space (2016). Diagram by the author J. Yu.
The next stage (Figure 2b) examined the potential of the higher buildings (15 to 21 levels) to produce better outcomes, using the same input of wind parameters. In the case of the 21-storey buildings, as expected the wind velocity increased substantially. However, this building height also produced problematic conditions such as amplifying wind speeds larger than 10.8 m/s in some sections of the site and increasing negative southerly winds. As discussed earlier, research (Peking University, 2015; Zhou et al., 2014) indicates that wind velocity higher than 6 m/s (inclusive) can negatively activate sand dust found at ground level. Therefore, the 21-story buildings were regarded as the maximum threshold for building levels. Equipped with this knowledge, the same building configuration was tested with a lowering of building height on the south-western edge to 18 and 15 levels to explore the potential to reduce the wind velocity to the desired wind scale 4-5 m/s.

Simulations confirmed that a combination of 15 and 21-level buildings (Figure 2c) offered the best possible configuration to maximise the positive impacts of the northerly winds to disperse air pollutants whilst minimising south south-west wind at pedestrian level on the site. Documentation of this simulation process is featured in Figure 2, along with a diagram of the favoured siting configuration which also highlights areas which have the highest potential for air pollutant accumulation. This configuration established the foundation for exploring more detailed site design strategies for open space which also aimed to minimise pollution exposure.

3.2 Phase two: Micro-climate adaptive design response of the associated open space through landform manipulation, spatial and material design associated with local residents' activity patterns

This next phase shifted from processes of simulation and modelling to examine in more detail how different groups occupy open space in daily life. This review found that senior Chinese people who place value on their physical wellbeing are frequent users of parks and residential open space. Further, the need for parents to work in the city means that many seniors take care of their grandchildren, often taking them to exercise and play in the parks and open space mostly located within 1.2 kilometres of their residential blocks (Fu & Zhao, 2009). This combination of the elderly and the young also represent the most sensitive and vulnerable members of society in regards to air pollution exposure (Campbell, Halliday, & Cresci, 2014). This knowledge further highlights how important it is for landscape architects to consider air quality when designing open space in the Chinese city. But what can be achieved at the scale of detailed site design?

While it is impossible for a designer to reduce the quantity of air pollution, it is possible to minimize the exposure to poor air quality by considering the relationship between the time (daily and yearly) that people use open space and fluctuating pollution levels. For example, a pollution level study by Wang (2014) compared daily average levels of air pollutants such as PM2.5, and concluded that even though the average daily air pollution levels are the highest in winter, the lowest daytime air pollution levels are also experienced in winter, and not summer. Consequently, winter mornings from 8-11am offer residents the least exposure to PM2.5 across the year. From a design perspective, this knowledge presents an opportunity to maximise the usability and performance of open space in winter mornings as a strategy for limiting resident's exposure to pollution.

This observation formed the starting point for developing a series of atmospherically responsive landscape strategies, premised on increasing the performance of external spaces, especially during winter mornings, (informed by an understanding of seasonal and daily pollution fluctuations). These strategies were developed through the combination of landform manipulation, spatial design and material exploration.
Building on the preferred site configuration from Phase one, the next strategic move was to explore how the manipulation of landform across the external spaces could influence the behaviour of winds to maximise the dispersal of air pollutants while also establishing viable activity space, especially during the winter months. Drawing on the wind field analysis generated during Phase one and a detailed sun shade analysis of the preferred siting configuration, the first design move was to propose a major landform manipulation to maximise winter morning sun exposure and ensure a dynamic spatial experience. As shown in Figure 3, the insertion of a large hill increased morning sun exposure and was also valuable in redirecting cold winter winds. This topographic form also responds to research which highlights how topographic features can increase wind speed at the pedestrian level on the leeward slope. (Mason, Wood, & Fletcher, 2010).

In a further topographic move, pollutant concentrated areas located close to building facades (identified in Phase One) were sunk to trap air pollutants. As will be discussed in the following section, the establishment of these zones presented the opportunity to explore the potential of technological and material innovation evident in architectural design to address pollution more directly.
Figure 4. Spatial Design Strategy: typical landform with sunken ground surface to enable turbulence for air pollutants (2016). Diagram by the author J. Yu.

An increasing number of architectural projects have begun to explore the potentials of architectural facades and skins to filter air pollutants and trap solar energy. The design of Manuel Gea González Hospital in Mexico City, for instance, has applied smog-absorbing technology, powered by renewable energy, into the building facade to reduce air pollutants (Zimmer, 2013). Drawing on these precedents, our scheme proposed that the facades of buildings exposed to the pollution bringing southerly winds be designed with an air filtering facade. Importantly, a sunken topographic space immediately adjacent to the facade helps contain these pollutants and channel them along the face of the facade, as shown in Figure 4. Other spatial strategies included strategically programming car parking in poorer performing outdoor conditions, while in shaded areas of the site which experience more optimal wind conditions, heating would be introduced (especially during winter mornings), powered by renewable energy from solar collecting technology.
Figure 5. (a) Materials arrangement across the site (2016). (b) The performance of open space in winter and the selection of dominant evergreen (2016). (c) The performance of open space in summer and winter and the selection of dominant deciduous (2016). Diagram by the author J. Yu.

With the first two strategies establishing the overall framework for the open space, a further layer of performance was developed through the careful consideration of materiality—including the role of living systems. As has been documented by many researchers (Janhäll, 2015; Wang et al., 2015), vegetation can play an important role in deposition and dispersion of air pollutants. Wang et al. (2015) highlights 10 common evergreen trees which have the capacity to absorb air pollutants in Beijing, with *Platycladus orientalis, Pinus tabuliformis, Taxus chinensis, Juniperus chinensis* proven to be the most effective species. Working with these four species, evergreen trees were introduced tactically into the design to redirect winds and reduce wind velocity in activity and shaded space. As deciduous trees, such as *Koelreuteria paniculata* and *Robinia pseudoacacia* can also effectively retain pollutants (Wang et al., 2015), these species were used in areas such as the large hill to maintain maximum sun exposure in winter and provide shade in summer. The
combined effect of the planting, consideration of site relationships and program and the broader topographic manipulations establish a considered atmospheric condition for the external spaces. A series of pathways were then laid into this new landscape which, as much as possible, aligned people’s daily activity routes with cleaner areas of the site.

4 CONCLUSIONS AND FUTURE STUDY

In this study, we hope to highlight the value and the methodology of reconsidering conventional design process to engage with meteorological conditions in the future planning and design of open space. This methodology highlights the potential of computational tools and real-time data in developing performance driven design responsive to address contemporary issues including pollution and climate change. Through integrating the CFD modelling with research of the relationships between building layout, topography, vegetation, materiality and dynamic atmospheric conditions, planners and designers can develop a greater understanding of the performance of open space, considered at the scales of the residential district and detail design. In addition, this study intended to bridge the gap of scientific research and real world design process. For instance, working with the knowledge from research conclusions that winter mornings presented the lowest pollution readings of any time of year and the relationships between residents’ activity pattern and air pollution, the external spaces then can be designed to maximise their usability and reduce residents’ exposure to air pollution during winter mornings to mitigate the urban extreme events.

In this study, we utilised ArcGIS 10.3 to carry out CFD modelling as a mean of understanding the the relationship between conventional and new residential blocks and the invisible and influential atmospheric conditions. The testing results can be potentially validated by either collecting and monitoring real-time data or conducting physical modelling tests in real world in the future. Although the validity of the CFD modelling remains as a question for future verification, it is still considered as a new unexplored territory for planners and designers to be aware of the importance of understanding atmospheric conditions such as pollution and winds in contemporary cities. This extends their comprehension of the invisible behaviours and their influences on the performance of external spaces. Through CFD simulations, this study tested the relationship between the prevailing winds and the residential blocks. The results presented the possibility of modifying building configurations to influence wind distributions, and the potential to identify the best option for maintaining the most desirable wind speeds and direction for encouraging pollution dispersal as a new methodology in urban planning and design process to mitigate the modern atmospheric events of air pollution and climate change for open space. The best building configuration provided the best performance for its associated open space to be further designed with landform, spatial and materials strategies to reduce residents’ exposure to the most polluted areas so as to improve the performance of the residential open space.

This paper is not offering a replicatable approach for every site, but more a methodology for structuring a research-driven design investigation which responds to the particular dilemmas of a site. As more engagement with digital techniques in CFD modelling, this methodology can be further explored from larger scale urban planning to detailed scale of site design to better mitigate urban environmental issues in future planning and design process and to also potentially bridge the gap between scientific research and real world projects.

5 ACKNOWLEDGEMENTS

The authors would like to express their thanks to the visiting professor Wenqi Lin for providing local historical wind data (1951-2014) in Daxing district of Beijing while he was at the University of Melbourne on his sabbatical leave from Tsinghua University in 2016.

6 REFERENCES


LANDSCAPE PLANNING
AND ECOLOGY

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EFFECTS OF LINPAN SIZE AND TREE DISTRIBUTION ON WINTER MICROCLIMATE OF THE LINPAN SETTLEMENTS IN CHENGDU PLAIN, CHINA

ZONG, HUA  
Department of Landscape and Architecture, Southwest Jiaotong University, huangjiqutian@aliyun.com.cn

PU, DE-HUA  
Department of Landscape and Architecture, Southwest Jiaotong University, 34270332@qq.com

1 ABSTRACT
Linpan settlement (abbreviation Linpan) is the most important and traditional rural settlement and the main agroforestry ecosystem in Chengdu Plain. It shows a comfortable seasonal microclimate, which matches local residents' preferences for thousands years. However, in the past two decades, urbanization has accelerated the disappearance of Linpan. The purpose of this study is to identify the winter microclimate variation in Linpan, find out the relationship among the microclimate parameters, and explore the impacts of Linpan size and tree distribution (surrounding, central, unilateral, and scattered) on winter microclimate. Microclimate parameters (i.e., air temperature, light intensity, wind speed, relative humidity, and so on) were separately measured in the 12 Linpan samples from December to February in 2015 and 2016. The results showed the air and soil temperatures of Linpan were positively influenced by Linpan size, but the air temperature difference exhibited a strong negative correlation with Linpan size. The relative humidity exhibited a positive correlation with Linpan size. Tree distribution patterns differed remarkably with respect to the winter microclimate. Light intensity and wind speed were strongly affected by the tree distribution pattern. Scattered patterns showed the optimal temperature preservation and windproof effects than other patterns in winter. Among the four parameters, air temperature supplied a strongly effect on relative humidity. While, only a significant negative correlation between air temperature and wind speed in winter was observed, which suggested that wind protection is the crucial factor in maintaining temperatures of Linpan in winter.

1.1 Keywords  
Linpan size; Tree distribution ; Winter; Microclimate parameters
2 INTRODUCTION

Linpan settlement (abbreviation Linpan) is a typical and important rural settlement pattern and a agroforestry ecosystem spreading in southwest China, and most of them scatter in Chengdu Plain, which is composed of farmers’ houses with a large number of trees around, water and land (Fig. 1a). Linpan is the sub-village settlement and the elementary unit of the village within the scattered locations. It is also known as a beautiful and unique rural landscape in China. Meanwhile, it is an important part of the local ecological system. The vegetation around the house improves the Linpan microclimate, which makes a major contribution to the saving of energy inside the buildings. In addition, Linpan not only inherits Chinese traditional farming culture, but also is an important carrier of regional history and rural landscape. In 2010, the number of Linpan in Chengdu Plain was more than 140,000 with a total area of 67679.87ha (Fig. 1b), and its density had been estimated at 15 per km2 (Xu 2010). The population living in Linpan was 4.49 million, accounting for 77.09% of the total rural population in Chengdu Plain (Chengdu institute of planning & design, 2008).

Nevertheless, with the trend toward urban and rural integration in response to China’s urbanization, new rural settlements have sprung up in China since 2003 (Yuan et al, 2016). This has had a huge impact on Linpan, which have changed significantly with respect to quantity and structure. On the one hand, more and more Linpan are disappearing each year. On the other hand, traditional Linpan is becoming hollow because of residents have to move to the new settlements. For example, there were more than 11000 Linpan in Pi county in 2003, but this number decreased sharply to less than 8000 in 2007. Moreover, the rate of decrease continued to accelerate. Since 2007, the ecology and landscape value of Linpan has been recognized by researchers. However, only a few researches have been reported it to date. These studies have almost exclusively focused on policy issues related to Linpan protection (Yang 2011, Sun 2011, Zhou 2012, Ye et al., 2013, Wang et al., 2016), investigations of the plant community in Linpan (Yang 2009, Xu 2010, Lu 2012), and Linpan reconstruction after the earthquake of 2008 (Hu 2009).

Figure 1a. Tradition Linpan (in the red circles) in Chengdu Plain (base images courtesy of internet http://cq.qq.com/a/20071219/000342_9.htm, modified by author).

Nevertheless, with the trend toward urban and rural integration in response to China’s urbanization, new rural settlements have sprung up in China since 2003 (Yuan et al, 2016). This has had a huge impact on Linpan, which have changed significantly with respect to quantity and structure. On the one hand, more and more Linpan are disappearing each year. On the other hand, traditional Linpan is becoming hollow because of residents have to move to the new settlements. For example, there were more than 11000 Linpan in Pi county in 2003, but this number decreased sharply to less than 8000 in 2007. Moreover, the rate of decrease continued to accelerate. Since 2007, the ecology and landscape value of Linpan has been recognized by researchers. However, only a few researches have been reported it to date. These studies have almost exclusively focused on policy issues related to Linpan protection (Yang 2011, Sun 2011, Zhou 2012, Ye et al., 2013, Wang et al., 2016), investigations of the plant community in Linpan (Yang 2009, Xu 2010, Lu 2012), and Linpan reconstruction after the earthquake of 2008 (Hu 2009).
Though many residents have to move away from the Linpan, however, investigations have shown lots of them desire the Linpan environment, especially the comfortable microclimate (Yang 2011, Sun 2011, Zhou 2012). A comfortable microclimate is usually the foundation of well-loved and well-used outdoor places (Brown 2010). Accordingly, people tend to live in places where the microclimatic conditions match their preferences (Katzschner and Thorsson 2009). Regrettably, the costs of Linpan microclimate have been ignored so far. In traditional Linpan, the vegetation area represented more than half of the total area and did not require management. Plants are always considered as a key factor controlling microclimate parameters (Chen et al., 1999). There are many reports of plant influences on microclimates. Most of them have focused on the cooling effect in summer or in arid regions (Didham and Lawton 1999, Dimoudi and Nikolopoulou 2003, Sirodov et al., 2009, Bowler et al., 2010, Oliveira et al., 2011, Behera et al., 2012). Only a little attention has been given to variability in winter. For example, Kawashima (1990) pointed out in the more vegetated places of the suburbs, the higher surface temperatures were observed during the night time than urban area in winter. Sugawara et al (2006) and Hamada and Ohta (2010) indicated the urban area was cooler than the green area in winter. However, these researches only focused on the temperature parameter and ignored other factors. Furthermore, we did not find any interrelated reports about the rural area.

In this study, the microclimate of 12 traditional Linpan with the similar tree canopy coverage were investigated in Sandaoyan town of the Chengdu Plain. In the district, there are more than 600 traditional Linpan and these have acquired relatively complete protection. It is cold and rainy in the Chengdu Plain in winter, which is considered the worst season with respect to the comfort of residents. Analyses of the extreme climate improved our understanding of the ecological mechanisms of Linpan. Thus, this exploratory study had the following goals: (a) to characterize the typical microclimate variation of Linpan in winter based on main microclimate parameters (light intensity, relative humidity, wind speed and air temperature), (b) to analyze the influence of Linpan size and tree distribution patterns on winter microclimate, and (C) to give some suggestions to promote a comfortable microclimate in new rural settlements of China.

3 SAMPLE SELECTION AND STUDY AREA
The 12 Linpan settlements were located in Sandaoyan town (30°52’14”N, 103°54’49”E), Pi county (30°48’38.46”N 103°53’14.13”E), Chengdu city, Sichuan province, China, and ranged in size from 2000 m² to 10000 m² (Fig. 1c). In winter, the average temperature was 6°C, precipitation was 5–15 mm/month, wind speed was 0.7 m/s, and relative humidity was 65%–75%. To prevent interference, samples with similar outdoor environments were selected. Moreover, the tree canopy coverage rates for all samples were around
60%. According to the horizontal position of trees, samples were divided into four distribution patterns (Fig. 2). The details of the samples (arranged from small to large) are shown in Table 1.

<table>
<thead>
<tr>
<th>Linpan number</th>
<th>Size (m²)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2301</td>
<td>Tree species: <em>Sophora japonica</em> L., <em>Sinocalamus affinis</em>g, and <em>Pterocarya stenoptera</em> C. Tree distribution: surrounding</td>
</tr>
<tr>
<td>2</td>
<td>3048</td>
<td>Tree species: <em>Metasequoia</em>, <em>Sinocalamus affinis</em>g and <em>Pterocarya stenoptera</em> C. Tree distribution: surrounding</td>
</tr>
<tr>
<td>3</td>
<td>3796</td>
<td>Tree species: <em>Pterocarya stenoptera</em> C and <em>Camptotheca acuminata</em>. Tree distribution: central</td>
</tr>
<tr>
<td>4</td>
<td>4234</td>
<td>Tree species: <em>Cinnamomum camphora</em> L. and <em>Pterocarya stenoptera</em>. Tree distribution: unilateral</td>
</tr>
<tr>
<td>5</td>
<td>4704</td>
<td>Tree species: <em>Metasequoia glyptostroboides</em> Hu, <em>Sinocalamus affinis</em>g, and <em>Cinnamomum camphora</em> L. Tree distribution: surrounding</td>
</tr>
<tr>
<td>6</td>
<td>4929</td>
<td>Tree species: <em>Metasequoia glyptostroboides</em> Hu, and <em>Cinnamomum camphora</em> L. Tree distribution: unilateral</td>
</tr>
<tr>
<td>7</td>
<td>5125</td>
<td>Tree species: <em>Pterocarya stenoptera</em> and <em>Sinocalamus affinis</em>g. Tree distribution: scatter</td>
</tr>
<tr>
<td>8</td>
<td>5268</td>
<td>Tree species: <em>Pterocarya stenoptera</em> and <em>Eucalyptus robusta</em> S. Tree distribution: central</td>
</tr>
<tr>
<td>9</td>
<td>5784</td>
<td>Tree species: <em>Pterocarya stenoptera</em> and <em>Cinnamomum camphora</em> L. Tree distribution: central</td>
</tr>
<tr>
<td>10</td>
<td>5848</td>
<td>Tree species: <em>Sinocalamus affinis</em>g and <em>Pterocarya stenoptera</em>. Tree distribution: scatter</td>
</tr>
<tr>
<td>11</td>
<td>6243</td>
<td>Tree species: <em>Pterocarya stenoptera</em>, <em>Firmiana platanifolia</em>, and <em>Camptotheca acuminata</em>. Tree distribution: scatter</td>
</tr>
<tr>
<td>12</td>
<td>7678</td>
<td>Tree species: <em>Camptotheca acuminata</em>, <em>Sinocalamus affinis</em>g, and <em>Cinnamomum camphora</em> L. Tree distribution: unilateral</td>
</tr>
</tbody>
</table>
Figure 1c. The location of the Linpan samples (purple area) in Sandaoyan town, Pi county, Chengdu Plain (base map courtesy of Pi County Planning and Construction Bureau, modified by author).

<table>
<thead>
<tr>
<th>Plan</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
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<tr>
<td><img src="image7" alt="Plan Image" /></td>
<td><img src="image8" alt="Elevation Image" /></td>
</tr>
</tbody>
</table>

Surrounding

Central

Unilateral
4 MATERIAL & METHODS

4.1 Instruments and measurement methods
The measurements were carried out at interval 3 days from December to February in 2015 and 2016. Measurements were obtained from 08:00 to 18:00. The outside (abbreviation o), edge (e), and center (c) of each Linpan were measured at the same time. Parameters were recorded at 1-minute intervals. The portable Kestrel 4000 instrument (NK, Boothwyn, PA, USA) was used to record wind speed, air temperature, and relative humidity. The portable Light Scout instrument (Spectrum, Middleton, WI, USA) was used to estimate light intensity. These instruments were installed horizontally at 1.5 m above ground level. Soil temperature and moisture data were collected using the Em5b mini-loggers (Decagon Devices, Inc., Pullman, WA, USA) and Field Scout TDR 300 Soil Moisture Meter (Spectrum Technologies, Aurora, Illinois, USA) under 10 cm from the ground level.

4.2 Data analysis methods
Survey results were presented as mean±standard deviation (SD), and the pairwise differences in parameters among three points at every location were calculated as follows: air temperature difference (abbreviation ΔT), ΔT1 = To – Te, ΔT2 = Te – Tc, ΔT3 = To – Tc. All data were statistically analyzed using Duncan’s multiple range tests implemented in SPSS (ver.11.0). Origin 8.0 was used to analyze correlations and draw charts.

5 RESULTS AND DISCUSSION

5.1 Analysis air temperature in Linpan areas in winter
Air temperature (abbreviation T) has been described as the most important microclimatic factor for human comfort, followed by humidity, wind speed, and so on (Moonen et al., 2012, Fonseca, 2013; Tyrovolas et al., 2014). There Chengdu Plain in winter is cold, windy, rainy and less sunny (Feng, 2004; Yu et al., 2009). Temperature preservation is not only recognized as the most important factors for the comfort of residents, but also for maintaining plant survival during the winter. As shown in Fig. 3a, the winter T in Linpan samples No. 1–6 (size, <5 × 103 m2) regularly showed a decreasing trend from outside to inside (To > Te > Tc). However, from sample No. 7 (size, >5 × 103 m2), Te and Tc increased, and even an opposite trend (Tc and Te > To) was observed in some samples, which showed the center T of the larger Linpans were higher than the smaller ones. Subsequently, samples were divided into five size ranges (<3.5 × 103, 3.5–4.5 × 103, 4.5–5.5 × 103, 5.5–6.5 × 103, and >6.5 × 103 m2). As shown in Fig. 3b, the three groups of ΔT in five size ranges became smaller with size increased. The maximum (1.6°C) and minimum (-0.4 °C) ΔT were both observed between outside and inside of Linpan. Further correlation analysis confirmed ΔT had a strong negative correlation with size, particularly ΔT3 (0.8640). It was indicated air temperature, especially the central T of Linpan, was substantially affected by Linpan size. We also observed 5.5 × 103 m2 was the lower limit of the area at which the air temperature inside exceeded outside. We speculate that when a critical size threshold of Linpan was reached, T inside might exceed the outside T. This phenomena also demonstrated that Linpan has the ability of keeping warmer in the winter daytime, and the bigger Linpan could provide a better temperature comfort for the residents than the small ones. This effect was similar to the keeping warm effects of urban green space in winter (Sugawara et al., 2006, Hamada and Ohta, 2010).
but different from suburban green area which showed a warming effects only during the night in winter (Kawashima, 1990). It is also worth discussing whether our critical size could be applied to other regions. In addition, with increasing size, the increase in temperature slowed and eventually stabilized. Similar patterns were reported in other green spaces in summer (Oliveira et al., 2011). Thus, we inferred there should be an upper limit of the Linpan size for temperature preservation in winter. Regretfully, owing to the limited samples in this study, we did not find out the upper limit.

The role of plants in moderating the temperature has recently been explored all over the world (Wong and Yu 2005). Especially the distribution of plants may be an important intermediary between patterns of human settlement and regional climate spatial variability (Jenerette et al., 2007). Moreover, under a changing microclimate, plants often have to react to altered environmental conditions (Opedal et al., 2013). As shown in Figure 3c, the $\Delta T$ was strongly affected by the tree distribution. Among the four patterns, the surrounding pattern presented the highest $\Delta T_3$, suggesting it gave the best cooling effect, but the worst temperature preservation effect in winter. The scattered pattern exhibited the lowest $\Delta T_3$ (0) and a negative $\Delta T_2$ (-0.1), which indicated it was optimal for temperature preservation in winter.

Figure 3. (a) Air temperature in Linpan samples in winter, (b) Correlations between air temperature difference and Linpan size, and (c) Relationship between tree distribution patterns and air temperature difference.

5.2 Analysis of light intensity at Linpan areas in winter

Light intensity is usually recognized as the main heat source for green space (Jordan 1969, Hardiman et al., 2013). In our works, a clearly decreasing trend of the light intensity (abbreviation $L$) from the outside to inside in the 12 Linpan samples was described in Fig. 4a. As Linpan size increased, $\Delta L_1$ increased slowly, but $\Delta L_2$ and $\Delta L_3$ both went from low to high to low (Fig. 4b and 4c). The correlation indexes confirmed there was lack of a relationship between Linpan size and light intensity (all correlations were less than 0.1, data not shown). We observed that evergreen trees are the dominant species in Linpan, which canopy is commonly higher than 12 m, extending well above the houses. As one of the chief determinants of the microhabitat, growth restrictions and survival of understory plants (Mroz et al., 1999,
Jennings et al., 1999), the evergreen canopy in Linpan restricts the light intensity in winter. Considering the light intensity with respect to the tree distribution pattern (Fig. 4c), the lowest ΔL3 was observed for the surrounding pattern, and its value was significantly different from other patterns. Without shade from trees in the center of Linpan, the surrounding pattern provided the most sunshine to the central houses. In contrast, the central patterns got the shelter from sunshine in the center. The scattered pattern showed the lowest ΔL2, indicating uniform shade from trees. Based on this analysis, the main factor affecting light intensity was the horizontal tree density, instead of the Linpan size.

![Graph a: Variation in light intensity among the 12 samples](image)

![Graph b: Variation in the light intensity difference among the 12 samples](image)

![Graph c: Influence of tree distribution and size on the light intensity difference](image)

**Figure 4.** (a) Variation in light intensity among the 12 samples, (b) Variation in the light intensity difference among the 12 samples, and (c) Influence of tree distribution and size ($\times 10^3$ m$^2$) on the light intensity difference.

5.3 Analysis on wind speed at Linpan areas in winter

In winter, cold wind consistently blows across Linpan without shelter. McPherson (1988) indicated vegetation around houses enhanced winter energy saving by reducing the velocity of air over buildings ('wind break'). Similarly with our results, trees in Linpan showed an important ability to prevent cold wind. Fig.5a and 5b showed winter wind speed in the 12 Linpan samples decreased as the following order: Wo > We > Wc. The wind speed in the center was obviously slower than that at other positions, and a static or breeze situation was observed in the center of the Linpan. It was confirmed the plants in Linpan functioned in wind prevention. The maximum of $\Delta W3$ (Wo – Wc) was 1.5 m/s in Linpan sample 11(Fig. 5b). However, there was no obvious correlation between wind speed and Linpan size (data not shown). In contrast, the tree distribution pattern strongly influenced on wind speed. The scattered pattern (Fig. 5c) resulted in the best wind reduction, while the worst one was the unilateral pattern. We observed in scatter pattern, a coherent bushes and grasses under trees spread all over the Linpan. Accordingly, it was inferred that scattered trees were beneficial to create the abundant and consistent understory. Furthermore, a dense, consistent, and uniform plant community played an important role in wind protection. As indicated by Zeng (2010), abundant vertical structure of forests (e.g., species composition and configuration) also strengthens the resistance of individual tree stands to wind damage. Wind speed is also an important factor in plant
transpiration (McNaughton and Jarvis 1983, Dixon and Grace 1984, Kume et al., 2015). Our results below also indicated the scattered pattern was also optimal for increasing humidity in winter.

Figure 5. (a) Variation in wind speed among the 12 Linpan samples, (b) Variation in wind speed difference among the 12 samples, and (c) The effect of the Linpan size (×10^3 m^2) and tree distribution on wind speed difference in Linpan.

5.4 Analysis on the relative humidity of Linpan in winter

Relative humidity are also influenced by plants via wind prevention, transpiration, and storm water damage. In winter, there was a high relative humidity (65%–75%) in the Chengdu Plain. As summarized in Fig. 6a, ΔH1 (Ho–He) and ΔH3 (Ho–Hc) were nearly negative, indicating that the relative humidities at the edge and central positions were higher than that at the outside position. However, the variance of relative humidity remained at more or less 4%. According to the data presented in Fig 6b, the relative humidity increased slightly as the Linpan size increased, which revealed that under the same tree canopy coverage, a bigger size was associated with a higher relative humidity. In addition, the scattered pattern exhibited the lowest ΔH3 (negative). It suggested that scatter pattern was the best pattern to improve humidity in winter. This result might be attributed to several factors. First, the richness and vertical structure under scattered trees could yield a higher leaf area index and higher transpiration intensity. Second, owing to the remarkable effect on wind prevention, air condition of Linpan center was nearly static, which was beneficial to maintain the humidity. Third, the highest interior temperatures associated with the scattered pattern resulted in a high transpiration rate in winter. Of course, plant evapotranspiration also consumes energy to cool circumstance (Grimmond and Oke 1991, Shashua-Bar and Hoffman 2000). However, because of the weaker evapotranspiration in winter, Linpan plants showed a stronger influence on wind protection than cooling in winter.
5.5 Correlation among the microclimate parameters

As well known, the interrelations of the microclimate parameters are complex (Nikolopoulou & Steemers, 2003). Such as the temperature of green spaces is usually determined by interactions among light, wind, and other factors. Furthermore, the role and importance of various factors vary widely depending on environment conditions, and there are complex interactive effects of factors (McPherson et al. 1997, Chen et al., 1999, Hamada and Ohta, 2010). To clarify the interrelationship among the microclimate parameters, Pearson correlation analysis was undertaken to compare their relative significance (Table 2). It was clearly showed relative humidity was separately strongly positively (0.872) and negatively (-0.741) effected by air temperature and wind speed, but there were non-linear correlation. In contrast, the air temperature showed a significant negative correlation (-0.903*) with wind speed. Combining these data, we confirmed wind speed was the critical determinant of temperature and humidity in Linpan at winter. This result was different from previous comments which suggested light intensity could be the key factor influencing air temperature of open green space (Deng et al., 2015; Kong et al., 2016). Our founding explained why the scatter pattern yielded the less light, due to its best windproof effect, it was still got the optimal capacity for temperature preservation in winter.

Table 2 The Pearson correlation analysis among the microclimate parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Air temperature</th>
<th>Light intensity</th>
<th>Wind speed</th>
<th>Relative humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air temperature</td>
<td>—</td>
<td>0.008</td>
<td>-0.903*</td>
<td>0.872</td>
</tr>
</tbody>
</table>

Figure 6. (a) Variation in the relative humidity difference among the 12 sample and (b) Influences of Linpan size (×10³ m²) and tree distribution on relative humidity difference in the samples.
CONCLUSIONS

We investigated and analyzed the winter variations of the main microclimate parameters of Linpan in Chengdu Plain. Moreover, the correlations among the microclimate parameters, Linpan size and tree distribution were discussed. The new interpretations obtained in this study were as follows:

The light intensity and wind speed decreased from the outside to inside of Linpan, but were not correlated with Linpan size. They were strongly effected by the tree distribution pattern.

The relative humidity and temperature (air and soil) increased from outside to inside of Linpan. They also showed a gradual increase as Linpan size increased. A significantly negative correlation were only found between air temperature difference and Lipan size. When a critical size threshold of Linpan (5.5 x 103 m²) was reached, the inside temperature of Linpan could exceed the outside temperature. However, the increase in temperature eventually slows and stable levels were maintained.

Among the four microclimate parameters, wind speed, instead of light intensity in winter was the key factor controlling Linpan interior temperature and humidity. Thus, windproof was the most important way to create a comfort Linpan microclimate in winter.

The scattered pattern showed the optimal temperature preservation in winter, because of its predominant effects on windproof and maintenance of humidity. This pattern was suggested to be used for the new rural reconstruction in Chengdu Plain.

PROSPECT

Urbanization is a component of global change (Chen et al, 2013). At this stage of China urbanization, urban–rural development have grown vigorously in Chengdu Plain in the past ten years. There are 2887 villages in Chengdu Plain, and 2101 of them have completed or are in progress for new settlements reconstruction (Long et al., 2009, Long et al., 2011). However, as a new research field, the methods and experiences of rural environment design usually copies urban greening, which ignores the rural climate, rustic texture, traditional custom and residents’ preferences, and mostly focuses on the landscape aesthetics (Ding and Ma, 2010). Compare with the new rural settlements, the microclimate in traditional Linpan not only highly matched residents’ needs, but also do not need to be managed. It is worth further studying and exploring. Future searches will further understand the seasonal microclimate variation, ecological mechanism, the effects of different greening rates and plant communities on Linpan microclimate. We hope this research can be used for the protection traditional Linpan, the new rural reconstruction and landscape design in the future.

ACKNOWLEDGMENTS

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GHATS ON THE GANGA IN VARANASI, INDIA: A SUSTAINABLE APPROACH TO HERITAGE CONSERVATION

SINHA, AMITA
University of Illinois at Urbana Champaign, sinha2@illinois.edu

1 ABSTRACT
At Varanasi in India, where the Ganga reverses its flow, the 84 ghats (steps and landings) in a 6.8 km stretch are an iconic image of the city. Their built fabric evolved over 800 years from self-organized systems of worship and pilgrimage. The cultural landscape is complex in its layering and detail, and was resilient in its recovery from natural disasters as well as cultural upheavals. This can be interpreted as constituted by situated events, natural—flooding, silting, and changing flow of the Ganga—and cultural—ritual activities and performances in diurnal and seasonal rhythms tied to the Ganga. The riverfront is a complex ecosystem evolving from spatial practices responding to natural phenomena and its cycles that reflect the Hindu understanding of cosmic order. The ecosystem is stressed by over use and unprecedented levels of pollution in the Ganga, posing a challenge to the idea of the river as an archetypal symbol of purity and to the continuity of spatial practices. For sustainable conservation of the ghats, design and management strategies that will ensure a healthy and resilient cultural landscape should be based upon a systems approach. Patrick Geddes’ town planning reports in early twentieth century India are a useful precedent in connecting traditional cultural practices with ecological planning. In the proposed framework, the symbolic meanings of nature in traditional beliefs and practices are augmented with utilitarian functions in local energy cycles linking sun, flora, and fauna that will address air and water pollution and increase the capacity of the landscape to recover from flood events.

1.1 Keywords
cultural landscape, heritage, spatial practices, purity and pollution, sustainable conservation
2 INTRODUCTION

At Varanasi, the spiritual capital of India, the holy River Ganga takes a northward turn, describing a crescent sweep of ghats (steps and landings), over which rise the impressive temple spires and palace towers of historic Varanasi (Figure 1). The ghats, having evolved over the last eight centuries into the spiritual center of Hinduism, have recently been the cynosure of attention. Their ill-maintenance, encroachments, solid waste management problems, and increasing pressures caused by three million visitors annually is jeopardizing their iconic image and resulting in loss of many cultural traditions. Although urban infrastructure—sanitation, solid waste management, water supply—in Varanasi has been upgraded and measures have been taken to reduce the pollution in Ganga through schemes launched by the Government of India, the efforts so far have failed to address the issues at the ghats. The top-down, engineering approach is not sensitive to cultural traditions, mythologies, and the local ecology, putting into question the long-term social and environmental sustainability of the on-going projects. A new approach based upon the idea of the ghats as an eco-cultural system will be more effective in engaging local communities in making the landscape healthy and resilient.

3 VIEW OF NATURE

The cultural landscape of the Ganga Riverfront reflects the ancient Hindu world-view in which the occurrence of natural phenomena is celebrated as manifestation of rta or cosmic order. Rta, derived from the Sanskrit root of verb r meaning to go or to move, is believed to underlie the movement of celestial and terrestrial phenomena, of solstices and equinoxes, of flowing rivers and vegetal growth, and the cycle of seasons. The diurnal and seasonal rhythms of natural phenomena express this eternal order that governs human life as well. The traditional belief is that participation in rhythms of nature brings harmony and happiness and reaffirms the universal order. Time is conceived as cyclical as in the birth and death of all living entities that are part of nature. It is celebrated in festivals tied to seasons and harvests, and in life cycle rituals. These cultural practices are spatial in that they produce the landscape through human interactions with the natural phenomena (Sinha 2015, 43).

Figure 1. Skyline of Varanasi Ghats.
On the banks of Ganga in Varanasi, the sun and the river are central to spatial practices and are worshipped as transcendent divine entities made immanent through their material form and physical presence. As symbols of natural archetypes of fire and water, they are sources of energy that create and sustain all life. Ganga, deriving from the Sanskrit verb ‘gam’ meaning ‘to go’, is the prime symbol of purity in her capacity to cleanse and purify through her flow. She is liquid shakti (energy) as Shiva’s consort and life sustaining as the mother’s milk, known as Ganga Ma (Eck 2015, 240). Her descent to earth nurtures millions living in the plains of Northern India. As a divine goddess and a flowing river that purifies all that it touches, the Ganga’s spiritual and phenomenal forms are mutually constituted. The sun, worshipped as aditya, generates life as a source of light and heat. Its movement in the sky known as uttarayana and dakshinayana, beginning with the winter and summer solstices, is an expression of rta, bringing forth the seasons. Similarly, the moon’s waxing and waning, symbolic of death and renewal, is the basis of the lunar calendar in which the month is divided into auspicious (shukla-paksh) and inauspicious (krishna-paksh) halves.

At the ghats, time, space, and cultural practices come together in commemorating divine nature and engaging with its material forms. Ganga liberates one from the cycle of death and rebirth when cremation occurs on her banks. Circadian rhythms are affirmed in daily worship of the sun at dawn in the ritual namaskar and in the evening aarti (waving of lamps) to Ganga. Shrines to aditya, the sun-god on the western bank were located to align with the sun’s position in the sky, marking yantras (triangles formed of visual axes), thereby inscribing a certain order in the landscape (Singh 1994). Most of these shrines are now lost, but a few remain and their tanks are used for bathing on the auspicious occasion of Makar Sankranti (January 14) when the sun begins its northward journey. Festivals such as Ganga Dusshera, Mahashivaratri Kartik Purnima, and Deva Deepavali are celebrated in accordance with the lunar calendar, when devotees take a dip in the holy waters and the ghats are lit with lamps (Eck 1982, 253). They commemorate the descent of Ganga, Shiva whose matted locks break her fall, the fortnight of the annual visit of ancestors to earth, and lila (deeds) of Vishnu avatars, Ram and Narsingh.

4 CHALLENGES

The built fabric of the ghats—its steps, landings, historic palaces, temples, and shrines—was shaped by cultural practices based upon the value assigned to being in harmony with natural rhythms and belief in purity of Ganga. The riverfront landscape evolved as a complex ecosystem in which culture and nature are in a symbiotic relationship (Ramakrishnan 2003). Human activities are synchronized with the dynamic natural phenomena, both affirming the transcendent cosmic order. The ancient settlement was situated on the west bank on the Rajghat plateau at the confluence of Ganga and Varanasi. Behind the high ridge were lowland water bodies amidst forests that gradually disappeared as the city expanded southwards (Singh 1955, 15; Eck 1982, 48). Small settlements around inland lakes gave way to the sprawling city and the riverbank was transformed over time from a natural wooded area dotted with ashrams (hermitages) to the heavily built-up urban edge today used for the cremation of 32,000 corpses every year and with 35 drains and sewers emptying untreated wastewater and untreated sewage (Naskar 2014). Biological oxygen demand (BOD) levels in the river are over 40 mg/l in Varanasi when they should be 2 mg/l or less.

The ghats being the public commons of the city are intensively used for recreation and myriad other activities—washing clothes and buffaloes, open air defecation, transporting goods, and discharge of sullage. The riverfront is severely stressed today with the core beliefs and practices beginning to lose their validity. As pollution mounts in the river, the Ganga’s centrality in Hindu imagination as the ultimate symbol of purity is weakening. Cultural practices valorizing Ganga’s divinity are themselves generating waste that contributes to the local point source pollution (Conaway 2015). There is a disconnect between ideology and reality, and a mismatch between the concepts of Ganga as pure (shuddha) and clean (swatcha). Priests at the ghats believe that Ganga will always be pure even though not clean, leading to lack of religious mobilization in state efforts to clean Ganga (Alley 1998). Rituals paying homage to the powers of the Ganga have become spectacles and are in danger of losing their meaning as beliefs are challenged by all too visible evidence of widespread environmental pollution. Diesel boats plying on the river with low-grade engines and incomplete combustion of fuel, contribute to air pollution (Singh 2016). Many inland water bodies have been filled up and have become dumping grounds for waste leading to groundwater contamination. The Ganga in Varanasi, far from nourishing life, is a source of water-borne enteric disease for those who bathe in it and drink its waters.
Efforts to control pollution in the Ganga have been unsuccessful in part because of the top down approach in wastewater infrastructure projects constructed under the aegis of the Ganga Action Plan launched in 1986. Alley (2016) points out that sewage pumping stations and sewage treatment plants do not function to their full capacity because of intermittent electric supply and the state monopoly has led to corrupt practices that make the system even more inefficient. The more recent Namame Ganga Scheme announced in 2014 has recommended bio-remediation and in-situ treatment of waste water flowing through the open drains in addition to new sewage and effluent treatment plants. This would require considerably less energy and has the potential to involve local communities. A combination of decentralized, bottom-up and top-down, central approaches may have a higher rate of success in tackling what is proving to be an intractable problem.

5 METHODS
Heritage conservation in South Asia has been largely a state enterprise and has continued the colonial legacy in preserving monumental buildings (Sinha 2017, 2). New government initiatives such as HRIDAY and PRASAD on sacred and historic cities focus on developing their infrastructure. Neither effort considers the cultural landscape that sustains tangible and intangible forms of heritage and is a product of a culture’s relationship with nature. Patrick Geddes’ bio-centric approach as demonstrated in his planning reports for cities in India in early 20th century is a useful precedent to consider in developing an alternative framework for urban heritage conservation. While Geddes’ report on Varanasi can no longer be traced, his work in other Indian cities exemplifies the importance of decentralization, civic responsibility, and collaborative planning (Tyrwhitt 1947). As his letters to friends show, Geddes understood that nature is sacred in Varanasi and creation of new life follows from destruction (Lannoy 1999, 600). In his diagnostic survey of historic cities, proposals for conservative surgery of dilapidated structures, and improving sanitation through sewage gardening, Geddes emphasized renewal and placed human needs above all (Khan 2011). He believed that planning for individual and societal development should occur by applying cultural insights to ecological niches.

A century later, the Geddesian approach is valid for planning the Ganga Riverfront in Varanasi. The cultural heritage embodied by the ghats is at grave risk when the core belief in Ganga’s purity cannot be sustained and traditional practices lose their meaning. The complex layering of historic and vernacular built forms, spatial practices tied to seasonal and circadian rhythms, and stresses caused by pollution resulting from mechanized traffic and activities of millions of people make it imperative that conservation goes beyond historic structures and engineering projects, and address issues holistically in a system-based approach. In systems thinking, landscapes are inter-connected webs of spaces, events, and flows of energy and sustainability is ‘the quality of not being harmful to the environment or depleting natural resource, and thereby supporting long term ecological balance’ (www.dictionary.com).

For a sustainable approach towards cleaning Ganga and ensuring a healthy and resilient riverfront, the spiritual and phenomenal aspects of nature need to coalesce in conceiving planning and management strategies. The chasm between Ganga’s divinity and her material properties should be bridged such that her transcendent powers are perceived to be immanent in her earthly flow. Similarly, sacred symbolism and utilitarian values of sun, flora, and fauna should be integrated in developing strategies for managing the complex eco-cultural system of the ghats. The following set of design strategies were developed based on mappings of flows of animals and people, cultural practices, waste, flooding, and sun and shade on the ghats.iii The mappings were developed from REAP (Rapid Ethnographic Assessment Procedure) at the ghats using multiple research tools—observations, interviews, and visual documentation. The mappings spatialized and interpreted the data, enabling understandings of complex inter-relationships between cultural practices and landscapes processes. They provided the framework for developing design strategies for preserving cultural heritage and promoting environmental health of the riverfront.

6 SUN
The sun is worshipped daily and during festivals especially during the festival ‘Loraka Chauth’ ‘Lorark’, the ‘trembling sun’ is venerated at the shrine and kund close to Assi Ghat (Singh and Rana 2006, 109). This ghat, at the confluence of Ganga and Assi Nala is an auspicious site for bathing, especially on Makar Sankranti when the sun sets on its northward journey, Uttarayan. However, its energy remains untapped. In January and June, the coolest and warmest months respectively, between 85% to 92% of the
ghats receive sunshine between 9 am-2 pm. Solar energy can be harvested from this abundant sunshine in solar panels mounted in the vacant site south of the Ghat where the riverfront is not actively used. Given the erratic supply from the grid in Varanasi, this renewable energy can be an alternative source of electricity to be used in powering boat engines, in charging stations for mobile devices, and lighting the ghats (Figure 2).

The solar lighting system will increase safety and accessibility as the ghats are presently unevenly lit. Bollard lighting on the pilgrim trail, spot lighting on heritage buildings and signage, and evacuation lighting during emergencies, can be installed at low cost. The ghats support many small vendors who do brisk business by selling tea and snacks. They rely on biomass fuels such as coal or wood for cooking which contributes to air pollution and is harmful to the health of those cooking. Solar energy harnessed by sun ovens is clean and inexpensive and can be used for cooking in small restaurants and food stalls. Their parabolic shape, shiny surfaces, and adjustability allow harvesting the maximum amount of sunshine at any given time of the day. Sun ovens can also be mounted on mobile carts thus increasing the mobility of vendors.

Figure 2. Solar energy cycle.

7

FLORA

Vegetation is sacred in Hinduism because of its associations with powerful gods and goddesses. The bel tree is symbolic of Varanasi’s ruling deity Shiva and numerous shrines containing shiva lingas are found under bel and other trees such as pipal and neem. The densely built-up southern part of the ghats has a few tree-shrines; the tree cover becomes denser near the confluence of Varana and Ganga where seasonal farming occurs on the river embankment. The flood plain soils on the east bank support seasonal farming as well. Among flowers, lotus of the Nymphaeaceae family occupies a very special position in the culture. Its emergence from the waters signifies the birth of cosmos itself. As the seat of gods and goddesses,
particularly Vishnu’s consort Lakshmi, it is a symbol of stability as well the dynamic life force, *shakti*, that caused form to emerge out of watery chaos (Sinha 2006, 40). Marigold flowers are extensively used in ritual worship. The symbolic meanings of plants rest upon their material attributes, in particular their curative and remediating powers; it is this aspect that can be harnessed for addressing air and water pollution on the ghats. The utility of vegetation can extend beyond its shade giving property and as a source of food (cereals, vegetables, fruits) to its ability to filter pollutants and use treated waste as fertilizer.

Untreated sewage from the city is the major source of pollution with the two major drains, Nagwa and Khirkhi, located at the southern and northern ends of the ghats, emptying untreated sewage into the river. In addition, domestic wastewater from the old city is carried to the river in surface drains (*nalis*) on the ghats. A large amount of solid waste is generated at the ghats and by the adjoining urban neighborhoods. The shoreline at the popular ghats is littered with rubbish and it is not uncommon to stumble into rotting piles of ritual offerings (Figure 3). Local point source pollution stems from flower offerings, food scraps, plastic bags, clay pots, lumber from old boats, washing of clothes and bodies, animal waste, ash from cremations, charred human flesh, and animal carcasses. Non-point-source pollution from industrial effluents and agriculture adds to the overall contamination levels, causing the biological oxygen demand (BOD) to increase by more than 500% in the Ganga after she passes through Varanasi.

![Figure 3. Waste mapping at Dashashwamedh Ghat.](image)

Phytotechnology—i.e., a plant based system for remediation—is natural, uses solar energy, and is low cost (Kennen and Kirkwood 2015, 7). Free water surface constructed wetlands are effective in wastewater treatment, easy to operate, and can be maintained by local communities as shown by their performance in historic Warangal (Jayakumar and Dandigi 2002). They can complement the industrial STPs that are resource intensive in terms of energy use, space, and engineering skills. For example, where Assi Nala empties into the Ganga, phytoremediation will be useful in treating wastewater and sullage carried by the stream. The old streambed of Assi Nala that was channelized to build Ravidas Ghat is proposed to be restored and widened to construct rain gardens. This will enhance the water retention ability of the Nala and
prevent flooding during monsoons. Plants in the rain gardens will absorb pollutants and filter waste. Another major pollutant at Manikarnika and Harishchandra Ghats is ash generated from cremations, about 1.8-2.7 kilograms per body, and scattered directly into the Ganga. These ashes can be collected in biodegradable urns to be planted on the alluvial flood plain of the east bank. The urns will have a top layer of soil containing seeds, which after germination will penetrate and use the ashes in the lower layer as a fertilizer. The recycling of ashes in the memorial grove will not only be environment friendly but also a powerful symbolic gesture.

At Manikarnika Ghat, popularly known as the ‘burning ghat’ because of its perpetual cremation pyres, the air is always thick with smoke and cinder from the burning logs with temperatures reaching 60 degrees Celsius in the scorching June sun, and the surrounding buildings are covered with soot. The dominant wind direction is from west to east, spreading smoke, ashes, and dust to the Ganga. Shade trees such as neem, pipal, and banyan will improve the microclimate. Small gardens can be planted at ghat edges, especially where silt deposits after the monsoons and is difficult to remove. Local organic waste such as leaves, flower and food offerings, and clay pots that are strewn on the steps can be collected and treated in compost tumblers to fertilize the silt gardens here and at other ghats. The proposed compost program for transforming waste into a productive growing medium requires trash receptacles, compost bins and tumblers to be located at strategic points along the ghat stretch.

The landscape of the unbuilt east bank is contingent upon the river flow and its shifting patterns, its convex shape unstable as the river meanders and streamlines diverge. Since the flood plains of the concave (western built edge) and convex edges are inter-related on the bend of a river, it is likely that increasing sedimentation will impact the ghats (Choudhary et al 1996). Sand should be dredged from the shoreline and deposited further inland in the low-lying areas where the memorial grove can be planted. Constructed wetlands planted with grasses in low-lying areas, interspersed with higher sand mounds, will filter the agricultural waste from upland farming. The intermediate level with rich alluvial deposits will be for seasonal farming that is already occurring with watermelon and bitter gourd. The highest level, accessible even during the monsoons, is planned as maidans for public use (Figure 4).
Figure 4. Site Plan for a healthy and resilient landscape.

8 FAUNA

Bovines are very much a part of the ghat scene, ambling up and down the steps, resting on landings, eating out of garbage, munching marigold offerings, and bathing in the Ganga. Their ubiquity in public spaces and a lack of restriction on their movements are based upon the respect accorded to the cow in Hindu culture. The cow is revered as mother or ‘gau-mata’ and is given protection, her slaughter a grave sin in Hinduism. She is a symbol of earth in its generosity and support of all living beings, and of wealth and prosperity. She is associated with Krishna and ascribed divinity in her form as ‘Kamadhenu’, the cow of plenty who gives all asked for. Her milk and milk products are used in many sacred rituals and her dung is used as fuel, fertilizer, and disinfectant. Nandi bull, the vehicle of Shiva, is visibly present in sculptured stone at the threshold of shrines and temples. Decorated cows are often paraded around and the chant
'gau hatya pap hai' (killing cows is a sin) can be frequently heard at the conclusion of a ritual ceremony on the ghats.

The ‘zoogeography’ or study of cattle movement (Hui 2015) on the five ghats revealed dung piles in lanes and stepped landings, adding to other biodegradable forms of waste. The roaming cattle and goats at the cremation sites on Manikarnika Ghat disturb the solemnity of funerals, and at the other two crowded ghats—Dashashwamedh and Panchganga—add to congestion. At Assi and Raj ghats, buffaloes are found in large numbers, resting and bathing in the river. The widespread presence of cattle means that their dung is produced in large enough quantity for it to be treated as a resource. Vandana Shiva (2002) describes the cow as a keystone species for sustainable agro-ecosystems and performing a critical function by converting organic matter into nutrients for plants. The symbolic status of the sacred cow in Hindu society is derived from her utility as an economic resource.

At the ghats, animal dung, instead of flowing into the Ganga, can be systematically collected and used to generate biogas and fertilize gardens. At Assi Ghat, a milk cooperative society is proposed in the adjoining maidan. Here the roaming buffaloes can be gathered in a buffalo farm, fed flower offerings from rituals occurring all over the ghats, and their dung collected in the biodigester. Anaerobic digestion will treat the manure to produce biogas that can be used for cooking milk-based sweets, in great demand as prasad (offerings) to the gods in Varanasi temples and shrines. At Adi-Keshav Ghat, a gau-shala (cattle shed) is part of a proposed ashram next to the Adi-Keshav Temple where panchkroshi pilgrims stop before completing the final leg of their journey. Cows will be an integral part of the ashram life, their milk, and curd and ghee made from it used in ritual ceremonies. Their dung as well as other organic waste collected from Raj Ghat will be treated to produce biogas and the digestate will be used as fertilizer in the community gardens planted on the embankment to grow fresh vegetables for the ashram (Figure 5).
CONCLUSION

Ganga’s pollution is a grave threat to her centrality in Hindu thought as a symbol of purity. The reduction in local point source pollution is necessary to sustain rituals tied with holy waters that are a cornerstone of cultural heritage of Ganga and her ghats. The resilience of this cultural landscape has been proved time and again; however, climate change and unprecedented levels of pollution may cause irreparable damage to this legacy. The sustenance of heritage for future generations is tied to planning policies and design interventions that can be effectively implemented using local resources and energy. The complex eco-system of the ghats had evolved from self-sustaining cycle of human activities integrated with natural rhythms; it is unbalanced and stressed today as its carrying capacity has been exceeded many

Figure 5. Proposed energy cycle at Adi Keshav Ghat.
times over. Although the public spaces of the Ganga Riverfront are a civic responsibility, the government has been ineffective in filling in the vacuum left by the loss of royal patronage in independent India. Top-down planning practiced so far should be complemented with the bottom-up approach as a new and more effective way to deal with the challenges in keeping Ganga clean and preserving the cultural heritage of the ghats. The design strategies were presented to stakeholders—Municipality, Public Works and Town Planning Departments, local NGOs and concerned citizens—as a framework open to adjustment to ground realities and input from local communities in the course of site specific implementation.

The banks of the Ganga should be protected from any further development that is not ecologically sustainable, which means designing with water, sun, flora, and fauna. This would create new cycles of energy production and consumption and of waste transformed and recycled, all embedded within the age-old cycle of spatial practices tied with natural rhythms. This approach is in keeping with the Geddes’ framework of bio-centric planning in which urban settlements are parts of regional ecology and where community development is a function of working with traditional practices that are in harmony with natural processes. On the Ghats in Varanasi where nature is worshipped based upon the powers of Ganga to create and sustain life harnessing the energy of sun, it is important that the transcendent status of nature deities and their earthly physical forms are not considered separate, and their symbolic and utilitarian values be combined in planning for a healthy and resilient landscape.

10 REFERENCES


All figures courtesy of Department of Landscape Architecture, University of Illinois at Urbana Champaign

ENDNOTES

i Rta Ritu: An exhibition on Cosmic Order and Cycle of Seasons. Indira Gandhi National Centre for the Arts, New Delhi, January 4--March 30, 1996.

ii HRIDAY (Heritage city development and augmentation yojana) scheme is for heritage cities and comes under the Ministry of Urban Development while PRASAD (National mission on pilgrimage rejuvenation and spiritual augmentation drive) is focused on pilgrim cities and implemented by the Ministry of Tourism. Varanasi is covered by both schemes.

iii In two-week long site workshops in Varanasi (January 2014 and 2016) conducted with B.N. College of Architecture, Pune, India, the ghats were studied extensively by undergraduate and graduate students in Landscape Architecture and Architecture. The project reports *Ghats of Varanasi on the Ganga in India: The Cultural Landscape Reclaimed* (2014) and *Envisioning a Resilient Cultural Landscape: Ghats on the Ganga, Varanasi, India* (2016) summarizing design studio work at University of Illinois at Urbana Champaign, USA campus can be accessed at: http://landarch.illinois.edu/india-projects

iv This project was developed by Reina Patel in the Grand Challenge Learning Course for Freshmen (GCL 129) taught by Amita Sinha at University of Illinois at Urbana Champaign in Spring 2016.
THE CONSTRUCTION OF “NATURE TO THE CITY LANDSCAPE CORRIDOR” OF YANG VILLAGE

MU, TINGING
Beijing Forestry University, 363723429@qq.com

LI, CHI
Beijing Forestry University, 376656318@qq.com

WU, PEIYANG
Beijing Forestry University, 270710342@qq.com

1 ABSTRACT
Urban fringe villages are located in the border areas between nature and cities, where natural landscape and urban landscape strongly clashes, resulting in fragmentation and contradiction in the village landscape. Based on the case study of Yang village, this paper puts forward a method of “constructing landscape corridors” to improve the landscape of urban fringe villages. Yang village is located in the fringe of Haidian District, Beijing. In order to integrate the landscape of natural and city better here, a south-to-north and nature-to-city landscape corridor is established, introducing the concept of ‘landscape corridor’ in the reconstruction of Yang Village landscape. The corridor connects three existing separated landscape areas and takes charge of corresponding landscape functions. 1. Mountain tourism corridor, an important mountain trail, connects a series of rest and viewing platforms; 2. Agricultural sightseeing corridor, an important viewing channel, connects a number of picking gardens, sightseeing nurseries and horticultural schools; 3. Community transformation corridor connects the central green of a number of communities, emerging contiguous green open space. Yang village’s landscape corridor will not only improve the village environment, but also promot the integration of natural landscape and urban landscape, providing experience for the landscape reconstruction of urban fringe villages.

1.1 Keywords
Urban fringe area, Yang Village, landscape corridor, landscape reconstruction
2 INTRODUCTION

According to the description of Article 1 in the Urban and Rural Planning Law, the urban fringe area is the forefront of "coordinating the layout of urban and rural space" and is the most critical area for "improving the living environment". Along with the rapid development of economy and society and the rapid expansion of urban and rural construction, the urban-rural transition zone is also the most sensitive and vulnerable area in urban and rural construction (Wu Liangyong 1999). It is the zone where the industrial structure, population structure and spatial structure gradually change from urban characteristics to rural, with the urban and rural landscape characteristics. The human activities in this region are more complicated than other areas, the landscape pattern is more specific, and landscape ecological problems are more prominent. And it is the 'focal point' of the landscape ecological construction to rural and urban. This paper, taking Yang village as an example, quoted the concept of "landscape corridor" in the urban landscape reconstruction of urban fringe, and then contacted the relatively independent landscape elements through establishing corridor, and also provided corridor to the material and energy flow for natural and urban.

2.1 Characteristics of Rural Landscape in Urban Fringe

(1) Diversity and complexity of landscape types
Different from the urban landscape dominated by artificial landscape, the rural landscape of the urban fringe has three types of landscape: natural landscape, semi-natural landscape and artificial landscape (Liu Liming 2006). It has commercial streets, residential area, industry area, mineral area and road for artificial landscapes, forest and rivers for natural landscape, and farmland, orchard and grass for semi-natural landscape.

(2) Diversification of landscape function
The function of rural landscape of urban fringe is diversity. It not only provides vegetables, fruits, eggs and other agricultural products to citizens and local residents, but also provides places for them to contact with nature, experience agriculture and enjoy tourism, leisure or recreation, and it also has function in building ecological barriers for the city, adjusting climate, water conservation, wind prevention and sand fixation, beautifying the environment and so on.

(3) Poor stability of landscape
In recent years, due to the rapid urbanization of the countryside, a large amount of arable land has been occupied, and the irrational use of rural resources and neglect of the protection for ecological environment result in the disappearance of local characteristics around the traditional area, followed by increasingly prominent problems of resources and environment, such as damage of natural and semi-natural landscape, lack of continuity, destruction of ecological balance; unreasonable planning of rural landscape, landscape fragmentation, lower accessibility; extensive use of rural landscape resources, land waste, a threatened ecological security and a reduction of aesthetic value and so on. Taking the urban fringe of exurban Beijing for example, some secondary forests are preserved only in the western and northern mountains, however, because of the increasing land development and traffic construction activities in the suburbs, some rural landscape ecology around Beijing has deteriorated.

2.2 Taking ‘landscape corridor’ into the remodeling of urban fringe rural landscape

The concept of the landscape corridor comes from landscape ecology, referring to the line or strip elements that are different from the surrounding landscape matrix (Forman 1986). The construction of the landscape corridor solves the environmental problems such as landscape fragmentation caused by strong human activities. And it has following effects:

(1) Ecological effects
The establishment of the landscape corridor, connects the original broken landscape elements in series, and builds a holistic landscape pattern, and enhances the stability and continuity of the surrounding ecology. Through this stable ecological pattern, establishes a good ecological corridor for animals and plants, and improves the level of regional ecosystem.

(2) Industrial effects
The landscape corridor relies on the regional advantages of the area as well as the traffic conditions, and becomes the link of various industries in the region. Relying on the landscape corridor, various industries will be connected together to form a complete industrial chain and a linkage of three industries to promote regional economic development.

(3) Cultural effects
Landscape Corridors can effectively protect the local characteristics of historical and cultural relics, enhance the quality of local life, awake cultural awareness, and bring unique humanistic experience for local residents and foreign tourists. Through the construction of landscape corridor, displaying and continuing the characteristics of cultural, developing regional historical and cultural value, artistic value and scientific value, and stimulating the regional vitality.

It is of great significance to the sustainable development of villages, by introducing landscape corridors in landscape remodeling based on the characteristics of the rural landscape in urban fringe area. Landscape corridors connect different types of landscape in series, and rebuild the landscape pattern from broken to complete, assume the dual function of urban landscape and rural landscape, and then realize the transition from nature to city. Based on the case study of Yang village, this paper proposes to construct the landscape corridor in urban fringe villages, which is for connecting the urban landscape and the natural landscape, and improve the living environment of the village.

3  RESEARCH BACKGROUND & CURRENT SITUATION

3.1  Location and Village Overview

Yang village is located in Wen Quan town on the edge of Haidian District, the north side of it is the active Zhongguancun innovation demonstration area, the south side is the stretching beautiful Western mountains, the west is close to the Bai village, and the east is near the Black Dragon Lake (see Figure 1). It is a typical city fringe village. The village has an area of 424 hectares, with 1173 people, including 472 agricultural persons and 691 non-agricultural persons. The Beijing-Miyun diversion canal is to the north of the village, which is on the different sides with the Haidian central city.

Figure 1. Location map of Yang village.

In the upper planning, Yang village is close to the R & D service center and high-tech industry cluster, known as "two cities and two zones", in the north of the Beijing, which has the requirement of industrial development. Meanwhile, Yang village is located in Beijing\'s second green interval area, with important ecological protection function. In the Western Mountain tourism planning, the positioning of Yang village area is a tourist resort. There are three types of land use in the planning area: residential land, agriculture and forestry land, forest land. Therefore, in the future, under the Yang village landscape construction, we should consider about the different types of land between the transition and connection, and assume the function of industry, ecology, tourism.

3.2  Landscape status and problems

Because Yang village is located in the edge of the city, the landscape is also reflected in the characteristics of the urban fringe landscape, such as the variety of landscape types and the fragmentation of landscape pattern. According to the different landscape styles, Yang village is divided into three areas:
the urban landscape in the northern area, the central style in the central area, mountain landscape style in the southern area. There are the Beijing-Miyun diversion canal ribbon green land and other small green space in the north area which is dominated by artificial landscape. The farmland and picking gardens are mixed in the central area which shows a semi-natural landscape. The southern area, with a large area of natural woodland, shows a good natural landscape style.

Figure 2. The landscape status of Yang village.

<table>
<thead>
<tr>
<th>Landscape area</th>
<th>Landscape type</th>
<th>Landscape components</th>
<th>description of current landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern area</td>
<td>Artificial landscape</td>
<td>Beijing-Miyun diversion canal ribbon green land, Community Green Space, Idle green space</td>
<td>Dull form, low utilization rate.</td>
</tr>
<tr>
<td>Central area</td>
<td>Semi-natural landscape</td>
<td>Farmland, Picking garden, Spa Resort Club, Drainage ditch</td>
<td>The idle and dull landscape. Spontaneous formation, decentralized distribution, lack of planning. Ecology is destroyed.</td>
</tr>
<tr>
<td>Southern area</td>
<td>Natural landscape</td>
<td>Natural woodland</td>
<td>Good landscape, ecologically sensitive.</td>
</tr>
</tbody>
</table>

Through the above analysis, here are the landscape problems of Yang village:
From the ecology aspects, the landscape of Yang village is fractured seriously. The artificial landscape, natural landscape and non-natural landscape have obvious boundaries and lack connection. Lack of planning with the various types of landscape resulting a dull form and poor quality of landscape. For instance there is a large number of urban construction sites in the northern area, but the number of green spaces is very small and there is a lack of green space. In the meanwhile, the ecosystem is under different degrees of damage due to the invasion of human activities in the central and southern areas.

From the industry aspects, relying on the farmland and picking gardens in the central area, the village began to develop secondary and tertiary industries, such as food processing and agriculture tourism,
besides traditional agriculture. However these industries lack rational planning that land resources and landscape resources have not been well utilized. The central and southern areas have a good ecological base and should develop urban agriculture and mountain tourism on the basis of not destroying the landscape security pattern. From the cultural aspects, with the continuous invasion of urban construction, Yang village has gradually lost the traditional landscape style and the cultural landscape. The landscape in the northern area is completely urbanized and is impossible to see the old village scene. Yang village is located in the Wen Quan area, once had a rich spa resources and culture, the hot spring resort in the central area is the only reservation.

It can be seen that Yang village is the transition zone between nature and the city according to the geographical environment, However, the situation is that the village activities caused the fragmentation between city and natural, as well as that a large number of urban construction destroyed the original continuous landscape interface of the western mountain.

4 THE CONSTRUCTION OF “NATURE TO THE CITY LANDSCAPE CORRIDOR”

4.1 Construction strategy

The concept of landscape corridor was introduced into the landscape remodeling. The three aspects of strategies of ecology, industry and culture were used to integrate fragmented landscape pattern and then construct the landscape corridor throughout north to, from the natural area to the city area. Yang village will be built into a friendly environment, complete and perfect, multi-cultural, vibrant areas.

![Figure 3. Landscape corridor construction strategy map.](image)

(1) Improving the ecological landscape pattern

Firstly, improving the quality of the existing green space and perfected landscape node. Then increasing the green area and connecting the southern mountain landscape and the northern city landscape, through the corridor, to connect the broken landscape elements. A complete pattern of ecological security and ecological green space was construct, with rich plant communities and varied species diversity (Yan Talasite 2010). Strengthen the construction of ecological systems and the protection of ecologically sensitive areas, in such a way as to effectively control the use of ecological land; enhance the level of ecological services, strengthen ecological conservation, ecological restoration and ecological construction; build a complete landscape nodes, green corridors and ecological area.

(2) Building characteristic industries
Based on the current situation of the industrial basement and resource distribution, a corridor system integrating agricultural products planting, fruits picking, sightseeing and tourism is built based on the idea of the balanced development of primary, secondary and tertiary industries. Modern service industry is developed based on modern agriculture, and the brand of agriculture tourism, mountain tourism and community horticulture is constructed (Li Kairan 2010). We will build a new community of self-sufficiency and provide industry and tourism for the city relying on the corridor construction. Among them, the development of community gardening was in the north, the development of urban agriculture was in the middle, and the development of mountain tourism was in the south. Building a number of special projects to improve the core competitiveness of the industry. The construction of a number of characteristic projects is to enhance the core competitiveness of the industry, and change the single agricultural production activities to the cultural activities that attract the public experience, then make the cultural industry developed together with the agricultural industry.

(3) Stitching village traditional memory

The village culture is integrated into the corridor construction to create a cultural and activities band for the villagers. Integrating existing natural resources and cultural resources into people’s lives through festival & special event planning to make the village more popular and sustainable. By carrying forward the traditional culture heritage of the village, to enhance regional attraction and promote the development of regional spiritual civilization (Zhu Qiang & Yu Kongjian 2005).

![Aerial view of Yang village.](image)

### 4.2 Overall arrangement

Integrating the demand of environmental remediation, industrial structure upgrading, community vitality, tourism development and other aspects, to sort out and integrate all kinds of resources. In the zonal space, the zoning blocks are used to make clear the key planning measures, so as to carry out the protection and construction of different degrees, and to form the corridor structure of “point, line and surface”. A main corridor on the distribution of three distinctive landscape area, along the layout of the three service cores.

Main corridor: starting from the southern mountains, the central agricultural area series, to reach the northern urban landscape area. It is the main line of the development of the village space, and the main line of tourism, communicating green space, tourist attractions and service areas. Three scenic areas from south north as follows: mountain tourism, agricultural sightseeing area, community transformation zone.
4.3 District construction

Figure 5. Sectional plan of Yang village.

(1) Community transformation area
Community transformation zone is the area of population aggregation Yang, but also the most full-bodied breath of life. According to the current situation, without changing the layout of the village and the life style of residents, carding and integration status of dispersed roadside greenbelt, green belt construction runs from north to south, connecting South and north area of natural landscape Beijing Water Diversion Canal green space protection, construction of continuous open space network within the community, the southern natural landscape into the city. At the same time, in the center of the community to build Central Park and horticultural base, the combination of leisure, horticultural education, horticultural production, promote the site of the internal three-dimensional industrial chain cycle. Relying on the corridor open system, to carry out the activities of the villagers, and promote cultural exchanges, the construction of the community into a self-sufficient industrial community. At the same time, the landscape corridor of the community reconstruction area is also the passageway from the city to the natural landscape area of the village.

(2) Agricultural sightseeing area
The agricultural sightseeing area is the transition zone of urban landscape and natural landscape, and the urban agriculture is carried out by the advantage of current resources. Integrating the current
industry to arrange picking orchards, sightseeing nurseries and horticultural schools. This area will be a new type of agricultural area which integrates cultivation, tourism, production and education. The landscape corridor is an important sightseeing passageway in this area. It connects various scenic spots and tourist service centers in series.

(3) Mountain tourist area
Mountain tourist area is the most natural scenery area of Yang village, through the construction of landscape corridor will be on the south side of the village and Western mountains link ecological corridor system, carry out the mountain tourism projects in the premise of protecting the ecological security pattern of the. Protect the existing natural forest vegetation, improve and repair the ecological pattern, and effectively play its ecological service function. Landscape corridor is also the main route, along the corridors of the construction of bicycle lanes and forest recreation trails, a series of mountain tourism projects, to create a healthy lifestyle.

5 LESSONS LEARNED
"Farewell to the roar of the machine, people need clean water, fresh air and good outdoor space. (Zhang Hao 2015) "The vibrant urban fringe area needs to strengthen the construction of the landscape corridor, not only can improve the regional ecological environment, but also can connect the city with villages, while taking the role of similar leisure green space to meet people's demand for green, attracting the public to the edge of the area to play, entertainment. It is an effective way to ease the old city space carrying capacity. At present, the urban fringe area is favored by its suburbs' original environment and low development cost. However, the urban fringe is the sensitive area of urbanization. The landscape structure is complex, fragile and rich in interface, and is most susceptible to disturbance. In this paper, taking Yang village as an example, through the three levels of the ecological, cultural, industrial, constructing a landscape corridor from the nature area to the city area, connecting the three broken landscape area, enhancing industrial advantages, and creating characteristic village. The construction of landscape corridor can ensure the continuity and integrity of the natural landscape in the urban fringe area, and make the corridor of the edge area connected with each other to form a network.

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FEASIBILITY STUDY ON NEAR NATURE CONTROL OF WATERFRONT RESTORATION IN THE PEARL RIVER ESTUARY AREA

ZHOU, DIYA
Beijing Forestry University (Beijing 100083), diyacheuk@bjfu.edu.cn

ZHU, JIANNING
Beijing Forestry University (Beijing 100083), blzjn@vip.sina.com

1 ABSTRACT
The Pearl River estuary is one of the typical coastal wetland types in Southern China, which has significant value in both ecological and economic aspects. Over the past 30 years, large numbers of river bank hardening projects, such as reclamation, river levee and wharf, have directly changed the hydrodynamic environment characteristics of the Pearl River estuary area, which has led to a chain of ecological environment deterioration problems. The crucial concept of near natural control is to reconstruct the environmental basement near the original or natural state in the damaged area by artificial means, so as to gradually restore the sustainable ecosystem and create a rich local landscape. This paper focuses on the near natural control spatial restoration of the hard engineering waterfront with low ecological function in the Pearl River estuary area. Based on the realistic regional hydrological characteristics of the Pearl River estuary area, we design a series of spatial waterfront modes according to the conditions and the needs of different surrounding land use. These spatial modes are constructed by waterfront slope reconstruction, soil matrix improvement, mangrove and associated plant community replanting, and other ecological engineering methods of varieties for spatial units. On the basis of meeting the functional requirements such as irrigation, freight transport and flood control, this research assesses whether near nature control is a feasible way to restore the natural material and energy flow of the Pearl River estuary waterfront effectively, and gradually restore the diversity of its ecosystem.

1.1 Keywords
landscape planning, near nature control, waterfront restoration, pearl river estuary, hydrological characteristics
2 INTRODUCTION

At Guangdong in southeast China, the Pearl River is an extensive river system with rich natural resource that take a significant role in hydropower, shipping, irrigation and so on. For thousands of years, under the period alternately movement between light water and salt water, soil with variety biological resources accumulates at the area where the Pearl River flows into South China Sea, forms the rich estuary delta.

Located in the south central part of Guangdong Province, the Pearl River estuary is a complex tidal delta (22°02′~23°8′N, 112°35′~113°57′E) which size in about 160km in North-South and 120km in East-West (Zhang Sheng-cai, 1994). According to the form of the water, the spatial form of the Pearl River estuary can be divided into two zones—the river network zone and the estuary bay zone (Figure 1). The convergence of the runoff from the three rivers (Xi jiang, Beijiang, Dongjiang), and the tide form the South China Sea, makes the Pearl River estuary one of the most complex river estuaries in the world (in hydrological activities).

Under the combined effect of Subtropical oceanic monsoon climatic conditions, the estuarine ecosystem was formed with water as its core and varies in biological diversity. As the interface between land and water, the waterfront is the most intense area of land and ocean interaction in the region of the estuary. Sediments and nutrients transported by the large river continue to accumulate in this area, and form large-scale tidal flats with great biological diversity.

As for economic and social development, the tidal flat is a great potential land use resource. People in the estuary region often use the means of reclamation to transform these perennial or non-periodically flooded wetlands into usable land. The Pearl River estuary area has a long history of reclamation. Continuous reclamation provides space for agriculture, industry and urban construction.

In the period of agricultural society, the major land use form of the waterfront space in the Pearl River estuary was farming. Restricted by the level of productivity development, it would take about 10 to 15 years for people to transform the tidal flats into cultivated land by reclamation (Xian Jian-ming and Wang Li-wa, 2005). After entering the period of industrial society development, the construction of waterfront in the Pearl River estuary area became mainly focused on industry, urban construction, and port traffic.

In the last three decades of reform, construction of water conservancy projects, such as the construction of sluices, rivers and embankments, port terminals, and so on, has been maintained at a high level. The coastline and entrances (also, mouth) are advancing rapidly to the sea, and have changed greatly in shape (Li Ying, et al., 2008) (Figure 1). Since the reform, urban construction in the Pearl River Delta has developed rapidly. Magnanimous and high intensity waterfront construction has seriously threatened the natural ecological environment of the estuary. However, the process of urbanization has had dire biological effects, and the ecological environment is in need of urgent repair. To coordinate the contradiction between human social development and environmental carrying capacity, waterfront construction in the Pearl River estuary region, the center of economic development, needs to introduce a new pattern of spatial organization.
3 INADEQUATCES & PROBLEMS
The river and with the surrounding floodplain is an ecosystem. In natural conditions, water quality is maintained by flow. The flow of the water washes the sediment of the shore and the bottom of the river, and the riverbed is relatively stable under the condition of natural erosion and deposition. Overall, the scouring and silting interaction between soil and water, and the interaction between animals and plants, provide a balance in the natural river. The river landscape presents an obvious lateral and vertical continuity.

Because of the strong influence of human activities and its accumulation in recent decades, the characteristics of the riverbed evolution and the spatial distribution and correlation of the runoff and tidal dynamics in the Pearl River Estuary area have changed sharply compared to the previous natural state.

The hardening of the waterfront blocks the interaction between the river water and the soil. This formed the vertical section which led to an intensive rapid reclamation that changed the shape of the river bank sharply. This hardening also led to the variation of water and sediment distribution, leading to the alienation of the geographical environment (Yun Cai-xing, 2010). As a result of its geographic and the climatic condition, the Pearl River estuary area suffers a great many natural disasters such as flood, drought saltwater intrusion and storm (mainly typhoon). Among them, the biggest natural disturbance factors are flood and storm.

In the time scale of ten years to several hundred years, the effects of human disturbance like waterfront reclamation, urban and port development in the Pearl River estuary area has been running neck and neck with natural disturbance. The influence of natural disturbance on the estuary area has been exacerbated by the interference of human disturbance. The following section describes, in depth, the major ecological and environmental problems in the region.

3.1 Ecological resource degradation
The reclamation, fill Bay Bridge construction, and other projects continue to occupy a large area of wetland resources and significantly reduce the availability of the waterfront wetland. Mangrove resources are rapidly shrinking (Zhan Guo-qiang, 2008 and simplification of species is aggravated and amplified.

3.2 Aggravated water pollution caused by increased rain pollution hazards
At this stage, due to the dense population and booming in economy, large amounts of domestic
sewage and industrial waste water drain into the estuary water body without proper disposal. Also caused by urbanization, impervious areas have increased rapidly which has led to the change of surface hydrological processes change. Abundant rainfall gathers pollutants on the impervious surface (like roof and pavement), which is turned into contaminated runoff flow by the hard-engineering waterfront into the river.

3.3 Increased risk of flooding
In recent years, the frequency of extraordinary flooding in the Pearl River estuary area has grown. Located at the edge between the river and the sea, the Pearl River estuary area plays a significant role in the flood drainage of the Pearl River Basin (Chen Wen-long, et al., 2014). Affected by the strong influence of human activities and its accumulation, the regulation capacity of flood discharge in the lateral branch channel of the Pearl River estuary has been weakened, as well as the reduction of flood storage space. More and more flood runoff is also flowing into the main channel (Yun Cai-xing, 2010).

From a spatial point of view, river bed deformation of the split entrances in the lower part of the estuary area (estuary bay zone) have not changed much. Under the impact of tidal lockup, the flood transportation from river to sea is still blocked, but the return period of the flood is basically unchanged. The flooding from upper river, together with the tide from estuary bay, have formed a two-way extrusion at the upper part of the estuary area (river network zone), and this has caused the water level to rise abnormally high. The return period of flooding has shortened significantly, and this has increased the threat of flooding (Yun Cai-xing, 2010).

3.4 Salt tide disaster intensified
In recent years, saline water intrusion in the Pearl River estuary area has become more frequent, longer in duration, shows a wider range of effects, has increased intensity, and tends to be more serious. Severe salinity intrusion occurred in the years between 1998-1999, 2003-2004, 2004-2005, and 2005-2006. Increased salinity intrusion frequency resulted in the degradation of wetland types. An increase in tidal flat soil salt content can affect or even destroy the growth of reeds and other various wetland vegetation (Guo Zheng-ren, Yuan Li-rong, 2012).

4 NEAR NATURE CONTROL
The concept of “near natural control” was first proposed by Alwin Seifert, a German landscape architect. In the 1950s, the school of near natural river management engineering was formally established in Germany, and proposed that the river regulation should be consistent with the principle of plant and life. By the 1980s, the European engineering field began to reflect the construction concept of a water conservancy project, and realized that river management should not only conform to the principle of engineering design, but also be in accord with the principles of ecology. In 1990s, the river ecological control projects in Europe proved to be successes, and this brought out a series of theory and technology on ecological river control engineering.

In 1991, Japan began to promote a river construction method that focused on creating waterfront environments with habitat variety increases; this was called Multi-Natural River Construction. By recovering soil and planting vegetation, this construction method effectively promoted the infiltration of groundwater and a virtuous cycle of water system. After nearly a century of research and practice, the concept of near nature control has been widely accepted by the field of water conservancy and has been numerous applied in middle and small size river restoration projects in suburbs or cities (Wu Dan-zi, 2015). However, due to the complexity of hydrology and socio-economic infrastructure constraints, research and practice of ecological landscape restoration planning on near nature control in large size river is still in the initial stage.

Near nature control, is a systematic engineering theory that comprised modern hydraulic engineering, landscape ecology, environmental science, biological science, aesthetics and other disciplines together as a theoretical support. On the premise of protecting the living environment of the river system and creating a harmonious natural landscape, as well as ensuring the safety of flood control and full consideration of the ecological effect. The aim of near nature control is to transform hard-impermeable waterfront spaces into a soft-permeable spaces of which three systems (water system, soil system and bio system) mutually interact in balance.

In essence, near nature river control is an artificial river construction method based on the simulation of natural river characteristics (Table 1). The crucial concept of near natural control is to reconstruct the
environmental base near the original or natural state of the damaged area by artificial means, so as to gradually restore the sustainable ecosystem and create a rich local characteristics landscape. Restoration of natural the soil and water interaction process contributes to the success of environmental base reconstruction.

Table 1. Comparison of natural and artificial river.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Nature River</th>
<th>Artificial River</th>
</tr>
</thead>
<tbody>
<tr>
<td>High water quality</td>
<td>improve water quality</td>
<td></td>
</tr>
<tr>
<td>Water body circulation</td>
<td>artificial measures</td>
<td></td>
</tr>
<tr>
<td>Water corridor effect take place</td>
<td>levee withdrew</td>
<td></td>
</tr>
<tr>
<td>water-soil interaction</td>
<td>vertical anti-seepage</td>
<td></td>
</tr>
<tr>
<td>Rich animal and plant resources</td>
<td>artificial community construction</td>
<td></td>
</tr>
</tbody>
</table>

In ecological river landscape planning at the basin scale, the major guiding principle is to realize the natural circulation of water; this has become a global approach. Therefore, the relationship between the river and the groundwater must first be improved, in order to create a complimentary relationship (Figure 2). Specific measures include:

(a) River channel adjustment.

(b) Dig a deep channel in the upstream to reduce the bed height and increase the interaction of the water and soil by excavating a braided channel.

(c) In the middle reaches of the river, determine the width of the river according to the flood flow, then set the dam at both sides. The river then flows along the artificial channel by the continuous self-adjustment, and the adapted river bed is formed to create a more natural river.

(d) In the downstream, take parts of the farmland as a flood-relief area to avoid a flood disaster.

The Pearl River estuary area restoration is a large complex social system of engineering projects involving many disciplines. Due to high population density and the high land utilization rate, numerous organizations are involved. It is unrealistic to develop a basin-scale near nature control plan that fully restores the natural ecological state back to the time before the high intensive construction.

The border interface of land and water, compared to the river base, is an easier space to be used and transformed. Here the scenery changes are more intuitive. Also, the change in the riparian morphology directly affects the activities of the water and sediment within the river, and therefore influence the operation of the whole river ecosystem. Accordingly, combined with bank construction opportunities, the realistic regional hydrological characteristics, and the practical application needs, the reconstruction of the waterfront space on the concept of near natural control is a feasible method to restore the ecological environment quality of the Pearl River estuary area.

Figure 2. Water oriented near mature control approach.
5 STRATEGY

According to region environmental problems and development needs, like flood control and channel construction, the spatial structure of the near nature control model of the waterfront in the Pear River estuary area consists three basic levels—Level 1: Decontamination and interception; Level 2: Retard and retention; and Level 3: Purify and salt solution (Figure 3).

Figure 3 Spatial structure of natural waterfront in the Pearl River Estuary.

As a transitional space unit, according to the different surrounding land use, our research focuses on two major types of waterfront spatial units.

5.1 Urban Interface

Shoal and tidal flats would be restored by the means of earthwork. On this basis, the river drainage ditches, slope-detention ponds and swamps would be designed to form the three defense lines to ensure the quality of the estuarine waters and provide maintenance to the river corridor ecosystem (Figure 4).

Figure 4 Urban Interface Model.
5.2 **Agriculture and forestry interface**

Agriculture and forestry interfaces include: conform to the texture of the farmland and woodland, plant moderately so as to modified the skyline. Modify the planting intensity, in order to gradually reduce the intensity of crop planting towards the river. Draw back the original levee, and form soft-permeable grass revetment with serious shoal wetland which slopes directly into water. Set up a ditch along the road sides as well as replant the swamp between the shoals and mangroves in order to intercept runoff containing pesticides (Figure 5).

![Figure 5 Agriculture and Forestry Interface Model.](image)

6 **MEASURES**

The main measures involved in the above space units are as follows:

6.1 **Waterfront slope reconstruction**

The major goal of this measure is to simulate the river profile under natural condition, to increase the capacity to absorb floodwater and tidal salts. Simultaneously, the contact surface between the soil and water would be increased to allow the formation of natural material circulation. On the other hand, by the reconstruction of slopes, a series of sub water environments with different water depths can be set up, providing habitat for different plants. By utilizing the variation of water flows, a series of submerged spaces could tentatively be development into recreation open space for people to have a more intuitive feeling of the ebb and flow of river, and more obvious touch with its natural beauty.

6.2 **Soil matrix improvement**

Large amounts of discarded soil from urban subway construction provides the possibility to improve the saline alkali soil. Inland soils which are rich in fresh water nutrient substances could be used to improve the soil salinity, and slow down the impact of the salt tide in the groundwater. At the same time, a natural gap of these soils can enrich the hydrological process of the waterfront.

6.3 **Mangrove and associated plant communities replanting**

Large, stable mangrove and associated plant communities have performed great functions in preventing wind erosion, temperature adjustment and purifying the environment. They provide a magnificence value for the provision of food and habitat for terrestrial and aquatic organisms. Also, the mangrove and its associated communities has the ecological effects of decomposing salt. Restoration of mangrove vegetation along the Pearl River estuary area can slow down the erosion of groundwater by salt tide.

7 **REFLECTION**

The design of spatial units in this paper is based on the general problems of the whole basin of the Pearl River estuary on the macro level. It’s more like a hypothesized model depends on the case study of
near nature control. The Pearl River estuary is a complex estuary which hydrological characteristics with changes in different reaches on the meso level. In this paper, as lack of data and the design of waterfront spatial models did not provide numerical data. The suitability of the method is still on practicing. In future research, we hope to continue to study this issue, hoping to develop a more specific and adaptable landscape spatial models for different sections of the Pearl River estuary on the concept of near nature control.

8 REFERENCE
PEOPLE-ENVIRONMENT RELATIONSHIPS

Edited by Deni Ruggeri & Ole Sleipness
PEOPLE’S USE OF URBAN SMALL PARKS: A CASE STUDY OF HAIĐIAN, BEIJING, CHINA

LUO, CHANG
Beijing Forestry University, llc555118@gmail.com

ROEHR, DANIEL
University of British Columbia, droehr@sala.ubc.ca

1 ABSTRACT
Green spaces play an important role in urban life. In dense cities, large new urban park projects are gradually reducing, and small green spaces such as pocket parks are likely to become more important. However, previous studies on small urban green spaces were usually carried out in the developed countries. Relatively, there’s still little research on the use of urban small green spaces in rapidly urbanizing cities in developing countries. Due to the different cultural background, population structure and social structure, the analysis of previous studies on small urban green spaces does not necessarily apply to China.

The case study region was in Haidian District, Beijing. Non-participant observation of local visitors was used to collect qualitative and quantitative data of the visitors in 9 small urban green spaces. These green spaces in the study area have been classified into three different categories based on the Location Based Service (LBS) data from smartphone users. The results of this study demonstrate that people’s use of small urban green spaces may relate to the categories based on the LBS data above. Also, the visitor’s gender and age could be the factors that influence the use of these spaces.

1.1 Keywords
small urban green space, location based service, non-participant observation, green space use, Chinese cities
2 INTRODUCTION

Currently, the urban population accounts for more than half of the world’s population. The number is expected to increase, especially in Africa and Asia where the urban population will double between 2000 and 2030 (UNFPA, 2007). China, as a developing country and a major emerging economy of the world, has been urbanizing at a rapid speed during the past three decades (Zhang et al., 2013). It was reported that there would be 18 million migrants from rural areas pouring into cities every year (UNFPA, 2007). Large numbers of migrants workers from the rural areas moved to big cities for working opportunities, leading to the further densification of urban areas. Therefore, it caused the decline in per capita space and as well as the decrease of per capita urban green space.

As public places in cities, urban green spaces are associated with a wide variety of perceptions, preferences and demands of urban residents (Janse and Konijnendijk, 2007). First of all, urban green spaces provide many social and recreational functions for citizens, which make urban green spaces a valuable public resource (Kaplan and Kaplan, 1989). Also, green spaces play an important role in social services and city sustainability (Chiesura, 2004). Functioning as habitat for various species in urban areas, urban green spaces provide a positive influence on the preservation of the urban biodiversity and help to enhance the urban ecosystem (Tzoulas et al., 2007, Carbó-Ramírez and Zuria, 2011). Secondly, it has been suggested that green spaces have a benefit for both physical and psychological health (Kaplan, 2001). The World Health Organization (WHO) has demonstrated that urban green spaces are thought to have made contributions to health (WHO, 2006). It was demonstrated that the pressure of individuals could be effectively reduced by visiting urban green spaces (Granh and Stigsdotter, 2010, Jiang et al., 2014, Stigsdotter and Granh, 2011, van den Berg et al., 2010). In general, people living in areas that lack green space maybe more vulnerable to the negative impacts of stressful life events (Kaplan and Kaplan, 1989). The WHO, therefore, encouraged local governments to improve the policies and regulations of urban green spaces (WHO, 2006).

However, expanding the number of large urban parks is challenging in densely built-up areas, especially for cities of developing countries undergoing rapid urbanization. Therefore small green spaces of urban areas tend to become increasingly important. According to previous studies, as the supplement to urban green spaces, small urban parks could fill peoples’ need of open spaces in dense urban areas (Nordh and Østby, 2013). There have been studies investigating people’s use and concerns about factors and components of small urban spaces (Whyte, 1980, Nordh et al., 2009). It has been demonstrated that the users of small urban green spaces tend to visit the spaces with natural components, and social activities are likely to take place in these spaces (Whyte, 1980, Granh and Stigsdotter, 2010). In addition, several studies found that small urban parks could provide a potential for psychological restoration (Nordh et al., 2009).

The previous studies, however, have mainly been on the spaces in industrialized nations (Whyte, 1980, Chiesura, 2004, Karin K. Peschardt, 2012, Nordh et al., 2011, Nordh et al., 2009, Peschardt and Stigsdotter, 2013, Nordh and Østby, 2013). But the use and preference of urban small green spaces in rapidly urbanizing cities of developing countries have rarely been studied. The analysis of previous studies does not necessarily apply to China (Austin Williams, 2014, Taplin et al., 2002). In this study, we have focused on the use of small urban green spaces in Beijing, China and try to show the potential value of small urban green spaces. These green spaces in the study area have been classified into three different categories based on the Location Based Service (LBS) data from smartphone users.

3 METHODS

Due to the current political regime of China, decision-making of urban green spaces has long been controlled by the government (Shan, 2012). Thereby, the planning, construction and management of green spaces mainly rely on the planning and construction sectors. Since the 1950s, China has mainly followed the Standards for Urban Greening space of the Soviet Union. Until 2002, the National Standard for Classification of Urban Green Space has been carried out (Jia, 2001). Recently, the policy makers have been increasingly recognizing the shortages of the current classification system. Also, landscape architects, city planners, and green space managers are becoming more curious about when a small urban green space is built, and how it is used. However, the definition and the size of a small urban green space are likely to be different in previous studies (Karin K. Peschardt, 2012, Peschardt and Stigsdotter, 2013, Nordh and Østby, 2013, Nordh et al., 2009). To avoid confusion, the definition of the small urban green space in this study refers to the related national standards of China and the previous studies. It has been defined as
a green space that has a maximum size of 1 ha (Zhu, 1995, MOHURD, 2002), and at least some vegetation and accessible green space.

3.1 Sampling

The case study region was the city center of Haidian District, Beijing. Haidian lies towards the northwestern part of the urban core. It is one of the most urbanized and dense areas of the Beijing City. Based on the definition mentioned above, all the small urban green spaces in Haidian were identified (See Figure 1). This was achieved using the remote sensing images of Haidian and a list of urban green spaces provided by the City of Beijing (Beijing, 2004). The currently empty lots or vegetation buffer areas, greenways, and sports areas that were designed for certain activities are not the focus of this study.

Figure 1. Location of study area in Beijing City (left) and location of study cases in Haidian (right).

Green spaces in the study area have been classified into three different categories based on the LBS data from mobile devices users. LBS data are the geographically-oriented data and information services to users across mobile telecommunication networks, pinpointing the location on the move (Jiang and Yao, 2006). In our study, the LBS data were all originally derived from Baidu Heatmap, which was an open access resource. The data were captured from application clients of Baidu users who allowed the software to obtain their location. We used the real-time LBS data of Haidian District from Baidu Heatmap on December 23rd, 2015, which was a typical work day (Baidu, 2015). The heat map has demonstrated the real-time population density per 100 square meters of Haidian District. The data at four different time points in a day have been captured, which were 10:00, 14:00, 18:00 and 20:00, illustrating that the population density has been changing with time (see Figure 2). Different population density, from less than 10 per 100 square meters to more than 60 per 100 square meters, has been reflected by different colours on the map. Although the LBS data rely on smartphone users, which could have its limitation on the variety of people that could use the small urban parks. Because the main group of smart phone users was the young and the middle-aged people living in cities. However, it was reported that there were 620 million mobile map users in China, and 29.4% of that was the Baidu users (Group, 2016). It makes the LBS data from Baidu a valuable resource for this study.
Figure 2. Real-time Heat map of Haidian district (from Baidu Heatmap).

We defined these areas based on their changing tendency of population density and divided the nine small urban green spaces into three categories based on their characteristics and locations. The small urban parks in our study area are categorized into the following three categories: ‘Workplace’, ‘Residential’ and ‘Mixed-use’. The small parks located in workplaces, where companies and corporations were gathering, were defined as ‘Workplace’ green spaces (See Table 1). These spaces have tended to be crowded areas (more than 40 people per 100 square meters) during the working hours (from 10:00 to 18:00) and became empty areas (less than 10 people per 100 square meters) after work (after 20:00), which was due to people returning home from work. The small parks of residential areas were categorized into the ‘Residential’
category. These areas had a higher population density in the night than that during day time. The number declined from more than 40 per 100 square meters to less than 10 per 100 square meters during the commuting hours. Small parks of the ‘Mixed-use’ category were the spaces located in the mixed-use regions that blend residential, commercial, or institutional uses, where their population densities remained stable in a day. In the study, three small urban parks were chosen from each category.

Table 1. Categories of the nine small urban parks (figures and photos by 1st author).

<table>
<thead>
<tr>
<th>Site Plan</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Zhongguancun Plaza</td>
<td></td>
</tr>
<tr>
<td>Area: 7701 m²</td>
<td></td>
</tr>
<tr>
<td>Category: Workplace</td>
<td></td>
</tr>
<tr>
<td>Name: Western Automobile Centre</td>
<td></td>
</tr>
<tr>
<td>Area: 8975 m²</td>
<td></td>
</tr>
<tr>
<td>Category: Workplace</td>
<td></td>
</tr>
</tbody>
</table>
Name: Jianxiang Bridge
Area: 8259 m²
Category: Workplace

Name: Maolinju
Area: 7720 m²
Category: Residential

Name: Zhichun Park
Area: 5292 m²
Category: Residential
Name: Shuangyushu Park
Area: 9191 m²
Category: Residential

Name: Xiaoniwan Community
Area: 3226 m²
Category: Mixed-use

Name: Sitong Centre
Area: 1056 m²
Category: Mixed-use
3.2 Data collection

Questionnaire and interview methods are usually used to collect quantitative and qualitative data in the studies of urban green spaces (Tzoulas and James, 2010, O’reilly, 2005, Robson, 1993). However, the observation methods used in this study were the unobtrusive methods that do not require the researcher to intrude in the research context. This may reduce the biases that result from the intrusion and interaction of the researcher with participants. Hence, the Non-participant observation method was used in this study which included the unstructured observation and the structured observation (Robson, 1993, Tzoulas and James, 2010, Whyte, 1980).

The study comprised the unstructured observation and the structured observation. During the unstructured observation, these identified small green spaces were visited randomly at different times of a day (between 10:00 and 20:00) to survey the types of visitors’ activities that took place in small urban parks of Haidian. The nine small urban parks were visited in a week in October 2015. The qualitative data collected through the unstructured observation were recorded and sorted as groups (See Table 2). The activities taking place during the observations were summarized and grouped into three categories: ‘Functional’, ‘Recreation’ and ‘Sport’. The ‘Functional’ category contained the purposeful activities like walking to work or shopping. These activities usually took place in small parks that closely connected to a main road or spaces with a relatively high population density. The ‘Recreation’ category included chatting, strolling, walking the dog, etc. And the activities that were categorized into ‘Sport’ included a variety of exercises, such as skate boarding, jogging, diabolo and fitness dance.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional</td>
<td>Walking to work, walking to or from the shops, picking children, having lunch</td>
</tr>
<tr>
<td>Recreation</td>
<td>Chatting, strolling, walking the dog, Relaxing, Family outing, playing cards/chess/mahjong, singing Chinese opera</td>
</tr>
<tr>
<td>Sport</td>
<td>Using outdoor exercise facilities, doing exercises, cycling, skate boarding, jogging, diabolo, fitness dance, playing basketball</td>
</tr>
</tbody>
</table>

Through the structured observations, various activities taking place in the small urban parks were captured. The qualitative and quantitative data of the visitors in 9 small urban green spaces were collected during the structured observations.

The observer selected an observation point with a clear view of the entire place in each green space and set up cameras there to film and record all activities taking place in the spaces during observation.
hours. All data were collected during the November to December of 2015. These small urban parks were visited four times a week, and each park was visited for one hour. The four visits took place at different times of the day, from 10:00 to 20:00.

4 RESULTS

During the observation hours, 1410 observations were made in the study areas, and of these 56.9% were male and 43.1% were female. The sex ratio was broadly in line with that of Beijing City, which is 51.2% male and 48.8% female (Statistics, 2016), and the age of people observed in the study was estimated, depending on their physical appearance (See Table 3). People in the age group of 19 to 39 years old visited the small urban parks most frequently (44.8%). Teenagers (2.2%) and children (4.3%) were the least observed in these small parks, which could be because the observation was taking place during school hours.

Table 3. Gender and age of people observed in the small urban green spaces.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>802</td>
<td>56.9</td>
</tr>
<tr>
<td>Female</td>
<td>608</td>
<td>43.1</td>
</tr>
<tr>
<td>Sum</td>
<td>1410</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \leq 10 ) years old</td>
<td>61</td>
<td>4.3</td>
</tr>
<tr>
<td>11-18 years old</td>
<td>31</td>
<td>2.2</td>
</tr>
<tr>
<td>19-39 years old</td>
<td>631</td>
<td>44.8</td>
</tr>
<tr>
<td>40-59 years old</td>
<td>350</td>
<td>24.8</td>
</tr>
<tr>
<td>( \geq 60 ) years old</td>
<td>337</td>
<td>23.9</td>
</tr>
<tr>
<td>Sum</td>
<td>1410</td>
<td>100.0</td>
</tr>
</tbody>
</table>

As the result of the observation, 60.6% of the activities were the functional activities such as using the park as the path to the nearby shops or office buildings (See Table 4). The rate of functional activities may reflect that people were using the small urban parks as traffic spaces. There were six types of recreational activities observed in the parks (36.9%). The most frequent recreational activities observed were strolling (12.0%), playing cards/chess/mahjong (8.7%) and standing or sitting to relax (6.7%). Six types of sport were observed in the spaces. However, these sports activities only took 2.5% of all activities, and one of them was only observed once (Diabolo). The most frequent types of sport observed were cycling (0.9%). This may be indicative of people’s lack of exercise.

Table 4. Activities observed in the small urban parks.

<table>
<thead>
<tr>
<th>Functional (%)</th>
<th>Recreation(%)</th>
<th>Sport(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>N=1410</td>
<td></td>
</tr>
<tr>
<td>Picking children</td>
<td>5.3</td>
<td>Chatting 6.2</td>
</tr>
<tr>
<td>Walking to/ from shopping</td>
<td>17.6</td>
<td>Strolling 12.0</td>
</tr>
<tr>
<td>Walking to work</td>
<td>37.7</td>
<td>Walking the dog 2.2</td>
</tr>
</tbody>
</table>
Visitors’ use of the small urban parks differs according to their age (See Table 5 and Table 6). The working people, mostly between 19 and 59 years old, were usually the functional users. Their activities were mainly functional activities like walking to workplaces or nearby shops. These could take place during the whole observation hours. Teenager and children were mostly observed after school (between 16:00 and 20:00). The seniors mainly use the small urban parks for recreational and social purposes. Some certain recreational activities, playing cards/chess/mahjong, for instance, were only carried out in the age group over 60 years old. Also, these activities could be randomly observed during the observation hours. It may be because the retired people had plenty of time to use the green spaces.

Table 5. Age * Activity-type Crosstab.

<table>
<thead>
<tr>
<th>Age</th>
<th>Activity</th>
<th>Functional</th>
<th>Recreation</th>
<th>Sport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Count</td>
<td>51</td>
<td>13</td>
<td>4</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>75.0%</td>
<td>19.1%</td>
<td>5.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td>11-18</td>
<td>Count</td>
<td>20</td>
<td>6</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>66.7%</td>
<td>20.0%</td>
<td>13.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>19-39</td>
<td>Count</td>
<td>515</td>
<td>107</td>
<td>8</td>
<td>630</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>81.7%</td>
<td>17.0%</td>
<td>1.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>40-59</td>
<td>Count</td>
<td>194</td>
<td>153</td>
<td>4</td>
<td>351</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>55.3%</td>
<td>43.6%</td>
<td>1.1%</td>
<td>100.0%</td>
</tr>
<tr>
<td>≥60</td>
<td>Count</td>
<td>79</td>
<td>239</td>
<td>13</td>
<td>331</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>23.9%</td>
<td>72.2%</td>
<td>3.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>859</td>
<td>518</td>
<td>33</td>
<td>1410</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>60.9%</td>
<td>36.7%</td>
<td>2.3%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 6. Crosstab Chi-square Tests.

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>344.379a</td>
<td>8</td>
<td>.000</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>346.971</td>
<td>8</td>
<td>.000</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>189.910</td>
<td>1</td>
<td>.000</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>1410</td>
<td></td>
<td>2 cells (13.3%) have expected count less than 5. The minimum expected count is .70.</td>
</tr>
</tbody>
</table>

The results have demonstrated that the small urban parks did not only provide recreational and social uses but also served as the functional spaces. However, due to the size issue of these spaces, the types of recreational activity were not as much as that taking place in large parks. Also, some types of sport were restricted by the scale of the site.

This study used the non-participant observation methods to investigate how people use the small urban green spaces. In general, there were more functional activities than recreational activities observed...
in the study area. These results are in line with the results from the studies of large scale green spaces (Tzoulas and James, 2010, Zhang et al., 2013). However, some specific functional activities like walking were the mostly observed activity. Although there were more types of recreational activities and sport were recorded, most of them were observed less frequently. It was observed that the working people in the age group 19-59 mainly used the small parks as the path to the workplace or another certain destination. These functional types of activities mostly took place in the small urban parks of the 'workplaces' and 'mixed-use' category during working hours (between 10:00 and 18:00). It could be a reasonable explanation for this that the small green spaces in these areas were usually surrounded by office buildings, or located in commercial areas. The users of these parks were mostly working people on their way to workplaces, surrounding shops or returning home.

Recreational activities like strolling are often the most common activity in urban green spaces or woodlands (Ward Thompson et al., 2005, Zhang et al., 2013). Strolling was the most frequently observed recreational activity in this study, indicating that there was a similar result with large scale urban green space. Also, the other important reasons for visiting the small green spaces were socializing, rest and relaxing, which seems to be in line with the results from previous studies (Karin K. Peschardt, 2012, Chiesura, 2004, Nordh and Østby, 2013). However, some recreational activities in previous studies, like reading/writing or sunbathing, were rarely observed in green spaces of China (Nordh and Østby, 2013, Zhang et al., 2013). Instead, some certain recreational activities like playing cards/ chess/ mahjong were rarely found in urban green spaces outside China (Karin K. Peschardt, 2012, Tzoulas and James, 2010, Stigsdotter and Grahn, 2011, Nordh and Østby, 2013, Refshauge et al., 2015, Whyte, 1980). These types of recreational activities mainly took place in ‘residential’ and ‘mixed-use’ small urban park during all observation hours.

In our study, only 2.5% of the people used the spaces for sport. It seems to be a minority in the three types of activities. The ratio is much lower than the results from the studies on green spaces in the developed countries (Karin K. Peschardt, 2012, Tzoulas and James, 2010, Stigsdotter and Grahn, 2011). This may indicate the lack of sport and exercise among Chinese people.

5 DISCUSSION AND CONCLUSION

Therefore, landscape architects should pay attention to the landscape components in different types of small urban green space to meet people’s various needs. For instance, landscape architects should provide easily accessible walking paths and entrances to the green spaces, as well as spaces for relaxing in small parks located in workplaces (Lottrup et al., 2013), while outdoor facilities for children and seniors should be provided in small residential parks. It is indicated that landscape architects should meet the different requirements of users from different age groups.

In this study, nine small urban parks in the core area of Haidian District were investigated based on the LBS data provided by Baidu. The LBS data was derived from mobile devices (mainly smartphones) users who were the application clients of Baidu users allowing the software to obtain their location. Thereby, the results of the study rely on the data from smartphone users, which could put a limit on the variety of the users. As the main group of smart phone device users, the young and the middle-aged people living in cities provided the primary LBS data sources, while users of smart phone devices were less ubiquitous among the seniors, children, or migrant workers. However, with the widespread use of smart phone devices, the large number of Baidu users still makes the LBS data valuable. Despite the limitations of the LBS data, the study demonstrates that people’s activities in small urban green spaces are related to the categories based on the LBS data. Also, the visitor’s gender and age could be the influencing factors. Through observing the behaviors of the visitors, the results of the case study reveal how people use different types of the small urban parks in a Chinese city. However, they may not be able to reveal the reasons why people visited small urban parks and the relations between visitors’ specific characteristics and their activities. To fill the gaps in this area, further studies in the future would be the investigation of relationships between the specific characteristics of different focus groups and uses of small urban parks.

6 REFERENCES


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THE ROLE OF WATER-BASED IMAGEABILITY IN CLIMATE ADAPTATION: PROMOTING UPSTREAM WATER RETENTION THROUGH WATER-BASED PLACE IDENTITY

RISING, HOPE HUI
Landscape Architecture Program, School of Design and Construction, Washington State University, PO Box 642220, Pullman, WA 99164-2220, hope.rising@wsu.edu

1 ABSTRACT
Many downstream areas have used urban design to implement controlled flooding for climate adaptation. It is more cost-effective, however, to mitigate downstream flooding through upstream water retention. To investigate the potential of water-based place attachment in encouraging upstream water retention, water-based place attachment was operationalized into water-based place identity and dependence. Cognitive mapping and photovoice recall questions were used to interview 60 participants sampled from eight water cities. These questions measured waterscape mappability and identifiability as contributors to water-based place identity. Water-based place dependence was derived from interview questions concerning waterscapes’ capacities to help reduce stress and to facilitate spatial orientation. Water-based place attachment was measured by the extent to which participants would miss waterscapes if they were to leave the city. Mediation analyses showed that the significant relationship between watershed location and water-based place attachment became insignificant due to the mediating effects of aquaphilic urbanism. Aquaphilic urbanism was proposed as a higher-order construct of waterscapes’ mappability, identifiability, stress-reducing effect, and potential to facilitate spatial orientation. When water-based place attachment was derived from water-based place identity, it significantly increased people’s openness toward water-coherent urbanism. Openness toward water-coherent urbanism was measured by interview questions concerning public support for storing public stormwater runoff, infiltrating public stormwater runoff, water transportation, and waterways. The findings suggest that, while upstream areas are likely to have lower water densities, making waterscapes mappable and identifiable helps generate public support for upstream water retention, which in turn makes flood mitigation downstream more cost-effective.

1.1 Keywords
Climate adaptation, place attachment, imageability, water retention, waterscape, mappability, identifiability
2 INTRODUCTION

Cultural geographer Yi Fu Tuan (1974, p. 93) popularized topophilia as a term describing our “affective ties with the material environment.” Ogunseitan (2005) revealed that topophilia was significantly attributed to the restorative effects of water features, flowers, and spatial familiarity. Although non-water natural features—hills, mountains, rocks, trees, and forests—were included in the experiment, they did not have a significant effect on topophilia. This micro-study suggests that love of nature, which Wilson (1984) refers to as biophilia, may be largely attributed to aquaphilia, which I define as people’s love of water. Design may help evoke topophilia if water is integrated in a way that increases an environment’s spatial familiarity and restorative effect.

While no empirical study investigated how design affects water’s influence on place attachment, a macro-study discovered that a higher density of water amenity was significantly associated with a higher population growth in the presence of other favorable amenity-related and socioeconomic variables as controls (Deller, Tsai, Marcouiller, & English, 2001). The findings suggest that water-based place attachment may be stronger in downstream cities because their watershed locations tend to be related to higher water densities.

Although it is more cost-effective to mitigate downstream flooding by capturing runoff in upstream areas (Hartmann, 2010), most long-detention facilities have been proposed for downstream locations due to a more urgent need to provide emergency flood management in downstream areas. These projects increase the amount of water surface in downstream areas with high water densities already, contributing to population growth in the areas most susceptible to the impacts of climate change.

Place attachment mediates societal responses to climate adaptation and encourages pro-environmental behaviors (Vaske, & Kobrin, 2001). It is speculated that biophilia, or our instinctual affinity for nature, is a likely mechanism underpinning greening behaviors (Kaplan, 1995; Kellert, 1995). Stedman and Ingalls (2013, p. 137) discovered that the intersection of biophilia and topophilia instigated “collective attempts to restore nature in places that serve as loci of attachment.” Water-based place attachment, i.e., the contribution of aquaphilia to topophilia, may help encourage water retention or “blue-greening” behaviors in upstream cities as loci of attachment.

This study substantiated water-based place attachment as a potential mechanism through which aquaphilic urbanism helps mainstream water-coherent urbanism in upstream cities to make them more attractive migration destinations. Water-coherent urbanism here refers to an urban design approach that promotes water retention. Aquaphilic urbanism alludes to a water-centric, place-making approach that evokes aquaphilia. This study qualified aquaphilic urbanism as a water-based sense of place that contributes to environmental identifiability and mappability, as well as stress reduction and spatial orientation.

3 BACKGROUND

3.1 Cognitive aspect from the aesthetic aspect of aquaphilic urbanism

Kaplan (1984) described sense of place as the extent the aesthetic aspect of a place influences its legibility as a cognitive map and make environmental features identifiable. He further defines a topophilic sense of place as what makes it easy to attach oneself to a novel place because the place seems familiar. Using identifiability as one of the measures for spatial familiarity, Ogunseitan’s (2005) micro-level study substantiated the influences of aesthetics on spatial familiarity as a significant contributor to topophilia. At the city-level, Lynch (1960) speculated that the aesthetic coherence of the urban environment tends to enhance people’s emotional bonding with a city by making it easy for people to form a coherent cognitive image of it. Lynch (1960) also postulated that water-centric cities, such as Venice and the Dutch polder cities, are imageable environments, and that polder cities tend to have a unifying structure connecting identifiable parts.

In an imageability study conducted with visitors and residents in three Dutch water cities, De Jonge (1962) observed greater detail in sketch maps drawn at closer proximity to bodies of water. Water-based elements may serve as higher-order spatial anchors that help organize spatial information (Golledge, 1992; Milgram & Jodelet, 1976). Spatial anchors are among the first features recalled from participants’ cognitive maps (Osmond, 1963). These spatial anchors help form a coherent image of the environment to facilitate wayfinding. Golledge (1992) stated that spatial anchors contribute to spatial familiarity, which he defines as the ability to identify and locate features, in addition to relating them to other features, in a cognitive map. This study adopted water-based mappability and identifiability as variables for measuring the cognitive
outcome from the aesthetic aspect of aquaphilic urbanism. Mappability and identifiability seem to correspond to two components of imageability proposed by Lynch (1960): structure and identity. Structure is similar to the mappability-based legibility, and identity is akin to the identifiability of environmental features, as described in Kaplan’s (1984) functional view of aesthetics.

3.2 Behavioral outcome from the functional aspect of aquaphilic urbanism

From the perspective of spatial behavior, Kaplan (1984) associates topophilic sense of place as the degree to which a place’s physical configuration facilitates spatial orientation and provides psychological comfort. With stress reduction as a measure for restorative experience, psychological comfort contributes to topophilia (Ogunseitan, 2005). Using the environment to adjust the physiological self is a form of environmental self-regulation (Korpela, Hartig, Kaiser, & Fuhrer, 2001) that leads to topophilia (Korpela, 1989). Potentially, stress reduction may improve spatial performance, including orientation and navigation, because stress impairs spatial working memory and learning (Diamond, Fleschner, Ingersoll, & Rose, 1996). The behavioral outcome from the functional aspect of aquaphilic urbanism was thus measured by the degree to which water facilitates spatial orientation and stress reduction to aid spatial behavior.

3.3 Tripartite theory of place attachment

The tripartite theory of place attachment suggests that place attachment can be operationalized into place identity and place dependence (Scannell & Gifford, 2010). Jorgensen and Stedman (2001, 2006) validated the tripartite model by conceiving of place identity, place dependence, and place attachment as the cognitive, behavioral, and emotional dimensions of people’s attitudes towards place (Figure 1).

![Figure 1. The tripartite model of attachment.](image)

3.4 Tripartite theory of water-based place attachment

Water-based place dimensions were generated from the tripartite model of place attachment to investigate the effects of designing water into the public realm based on place-based attitudes. Using a wayfinding perspective, this research conceptualized water-based place identity, place dependence, and place attachment as people’s cognitive, behavioral, and emotional attitudes toward aquaphilic urbanism due to their interactions with environmental features. As shown in Figure 2, this study characterized aquaphilic urbanism with water-based place identity and dependence as the cognitive and behavioral outcomes from its aesthetic and functional aspects. This study proposed to measure water-based place identity and dependence with the contributions of waterscapes to people’s spatial cognition (through water-based mappability and identifiability) and spatial behavior (through water-based stress reduction and spatial orientation). Water-based place attachment was modeled as the emotional outcome from both the aesthetic and functional aspects of aquaphilic urbanism and the cause of people’s openness toward water-coherent urbanism.

3.5 Aquaphilic urbanism as a higher-order construct

Two-way interactions have been found between place identity and place dependence as interrelated constructs (Jorgensen & Stedman, 2001, 2006). Figure 2 shows that aquaphilic urbanism is likely a higher-order construct of water-based place identity and dependence, with water-based place attachment as its outcome. However, Nicholls and Cazenave (2010) pointed out that the interaction is one-way, with place dependence influencing place identity. On the other hand, spatial cognition researchers found that the identifiability and imageability of a place lead to familiarity, influencing spatial behavior (Brunyé et al., 2009). The findings of this study suggest that the one-way influence originates from place identity toward place dependence instead. The direction of the interactions among these place-based dimensions will not be investigated within the scope of this paper. This paper is primarily concerned with
how to design with water to evoke aquaphilia and how to mainstream water-coherent urbanism with aquphilic urbanism.

Figure 2. Interrelationships of constructs and variables.

4 STUDY OBJECTIVES AND HYPOTHESES

4.1 Water-based place attachment as a potential catalyst
One objective of this study was to identify possible catalysts for encouraging water retention in upstream cities. This research tested the extent to which water-based place attachment influences the relationships between the functional and aesthetic aspects of aquaphilic urbanism and people’s openness toward water-coherent urbanism as a pro-environmental behavior.

4.2 Aquaphilic urbanism as a potential intervening factor
The other objective of this study is to identify the mechanism through which aquaphilic urbanism helps intervene in the positive feedback loop between watershed location (a low- or high-water city) and water-based place attachment. The first step was to test the significance of the relationship between watershed location and water-based place attachment. This test helped confirm whether the model had sufficient ecological validity to represent the self-perpetual migration trend towards downstream cities or cities with higher water densities. The second step was to test whether aquaphilic urbanism nullifies this significant relationship that captures the migration trend as a ground reality.

Mediation analysis is an appropriate method for testing these working hypotheses because it requires a significant linear relationship between an independent and a dependent variable. Additionally, the method is used for testing whether this significant relationship becomes insignificant with the addition of a mediator that can fully explain it (MacKinnon, Fairchild, & Fritz, 2007).

5 METHODS

5.1 Measuring water-based mappability with cognitive mapping recall protocol
Cognitive mapping was employed to measure water-based mappability because it had been used to investigate the extent that water spatially anchors people’s cognitive maps (Rasmussen, 1931; Southworth, Cranz, Lindsay, & Morhayim, 2012). Certain socioeconomic and age groups had difficulty drawing accurate sketch maps of a large-scale environment, although they were able to navigate the environment (Clayton & Woodyard, 1981; Hart, 1981). Instead of acquiring sketch maps, a survey-administered, cognitive mapping protocol was used as a prompt to obtain the recall sequence of water-based features. These recall sequences determined the extent that these waterscapes were spatial anchors.
contributing to water-based mappability. The recall sequence was used to create a weighted measure to account for the gradient of spatial saliency it reflected.

5.2 Measuring water-based identifiability with photovoice recall protocol

To capture an eye-level perspective of spatial memory and supplement sketch maps and verbal interviews, Lynch used photograph recognition. The photographs were preselected by investigators and may not have been as ecologically or cognitively valid as those obtained from photovoice. Photovoice is an effective place-research method engaging participants to express their impressions of an environment by taking photographic images (Ruggeri, 2014; Wang & Burris, 1997). To increase the ecological validity of this study, photovoice was used to investigate water-based place identifiability. A photovoice recall protocol was employed because it was not possible for the interviewer to travel with all participants to take five pictures around the city. Furthermore, in the absence of an interviewer, participants might be inclined to take photographs of salient features they have easy access to. Only a few would travel to specific locations to capture the most memorable pictures of an entire city. During the photovoice recall protocol, participants were guided to recall five pictures and articulate the content of each recalled photograph. Then, they were asked to locate the observer’s position and viewing angle on a city map. Like the cognitive mapping recall protocol, the recall sequence from the photovoice recall protocol was used to generate a weighted measure. This data coding scheme assumed that the scenes that emerged earlier had a higher level of saliency in spatial cognition.

5.3 Measuring water-based place attachment with emotional recall protocol

Emotional bonding with spatial features influences their saliency in cognitive maps (Brunyé et al., 2009). Water-based place attachment was measured by the weighted score generated from a recall question concerning people’s emotional bond with waterscapes. Proximity-seeking is associated with emotional bonding with a locus of attachment (Douglas, Kearney, & Leatherman, 2000). The emotional recall protocol probed environmental features and locations evoking proximity-seeking.

5.4 Measuring water-based stress reduction with a structured question

A structured interview question was used to both measure water’s contributions to stress regulation and determine people’s ability to self-orient in a water-centric environment. Although physiological instruments can be used to provide an objective assessment of stress reduction, self-reporting measures using questionnaires are useful substitutes (Masood, Ahmed, Jongyong Choi, & Gutierrez-Osuna, 2012). This study intended to measure the aggregated effects of many place-based experiences within a city. This study did not employ physiological instruments for measuring stress because they were costly.

5.5 Measuring water-based spatial orientation with a structured question

Objective measurements of spatial abilities have been effectively predicted by inexpensive, self-report measures (Hegarty, Richardson, Montello, Lovelace, & Subbiah, 2002). Self-reports of sense of direction reflect spatial orientation ability (Kozlowski & Bryant, 1977). They are also more highly correlated with the measures of spatial knowledge acquired from direct environmental experience than with those from secondary sources, such as maps, videos, and virtual environments (Hegarty et al., 2002). In this study, a structured question on sense of direction was used to provide a self-reported measure for spatial orientation.

6 DATA COLLECTION

6.1 Selection of water cities

Many water cities have been considered comparable to Venice (MacLean, 2011; Raplee, 2010). I chose six as study sites based on their similarity in precipitation pattern and geographical proximity to minimize the cost of sampling. The six cities were Amsterdam and Giethoorn in the Netherlands, Ghent and Bruges in Belgium, and Berlin and Hamburg in Germany. Only Amsterdam and Hamburg are downstream cities with nearby harbors. The other four are upstream water cities. Rotterdam and Almere were added to the selection of study sites because they are two of the fastest-growing polder cities in the Netherlands with easily accessible harbors. The final list of study sites comprised four downstream water cities and four upstream water cities. This selection of water cities allowed for some level of variability in the amounts and types of water features. All eight water cities have canals. The four downstream water
cities have a water density greater than 10% due to the presence of larger water bodies, such as harbors and lakes. The water density for the upstream cities is less than 10%. Water densities were calculated by dividing the total surface of water in each city by its total area. The eight cities were coded as 1 or 2 based on whether they have low or high water densities, creating the grouping variable of high- or low-water city.

6.2 Recruitment of field participants

A simple and obvious sampling frame for residents and tourists does not exist, as tourists enter and exit the cities constantly and typically do not have permanent local addresses. Instead, randomly sequenced sampling sites recruited participants, creating an approximation of a random sample derived from a theoretical sampling frame. This theoretical sampling frame assumes that it is possible to include all residents and tourists in all eight cities during the sampling time frame. A randomized order was used to sequence the eight cities. Each city’s nine sampling sites always included major entry points (such as airports, intercity train stations, and bus stations), city halls, and tourist bureaus, as well as various hotels, cafés, ethnic stores, and universities. These sites were chosen to sample a representative mix of residents and visitors, high- and low-income populations, environmental design experts and non-experts, and immigrants and visitors from various countries of origin. Each sampling site was sampled for five hours, for a total of 45 hours for each water city. Spending equal time in each sampling site and city helps reduce sampling bias.

6.3 Expert interviews and reviews

To formulate four questions for measuring openness toward water-coherent urbanism, the investigator conducted two open-ended, expert interviews with a Landscape Architecture faculty member from a Dutch university and a Dutch consultant with an international non-profit organization specializing in Urban Planning and Design. Six faculty members in Landscape Architecture, Architecture, Urban Planning, and Sociology from an American university reviewed the four questions before they were deployed for field interviews. The first two items asked participants to provide ratings related to several possible urban design solutions for storing and infiltrating public stormwater runoff. The last two items prompted participants to rate the likelihood of urban design features to promote travel by water and waterways in the urban environment. The ratings were generated based on “very,” “somewhat,” and “not” as response categories equally spaced along a three-point Likert scale. These answers generated the score of 3, 2, or 1, respectively. Each measure was based on the average score of all response ratings. These questions are presented in Table 1.

Table 1. Interview items and coding for aquaphilic urbanism measures.

<table>
<thead>
<tr>
<th>Variable: openness toward storing runoffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Flood-prone cities are considering the following ways to address flooding issues in the public spaces. How likely would you support storing 90% of the stormwater from public roads and properties during storms by...</td>
</tr>
<tr>
<td>a. converting auto lanes to 1m deep canals with bike paths. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>b. deepening existing canals from 1m to 3m. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>c. lowering the grounds of plazas and playgrounds. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>d. retrofitting plazas to float on top of water. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>e. retrofitting underground parking for storage. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>f. building big underground pipes for storage. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>g. Please specify or explain why you did not support any of the above solutions:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable: openness toward infiltrating runoffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. How likely would you support returning 90% of the stormwater from public roads and properties after storms by...</td>
</tr>
<tr>
<td>a. converting auto lanes to creeks with bike paths. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>b. converting parking lots into parks. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>c. converting plazas into parks. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>d. making roads porous. □ Very (3) □ Somewhat (2) □ Not (1)</td>
</tr>
<tr>
<td>g. Please specify or explain why you did not support any of the above solutions: __________</td>
</tr>
</tbody>
</table>

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Variable: openness toward water transportation

3. How likely would you travel by water more...
   a. if you had an amphibious car? □ Very (3) □ Somewhat (2) □ Not (1)
   b. if water were near your home? □ Very (3) □ Somewhat (2) □ Not (1)
   c. if water were near where you typically go? □ Very (3) □ Somewhat (2) □ Not (1)
   d. if you could take your bicycle along? □ Very (3) □ Somewhat (2) □ Not (1)
   e. if the water network were expanded? □ Very (3) □ Somewhat (2) □ Not (1)
   f. if water movement generated energy? □ Very (3) □ Somewhat (2) □ Not (1)
   g. if it improved water quality? □ Very (3) □ Somewhat (2) □ Not (1)
   h. if there were more security docking? □ Very (3) □ Somewhat (2) □ Not (1)
   i. if it improved your wellbeing? □ Very (3) □ Somewhat (2) □ Not (1)
   j. if flood evacuation were likely in your area? □ Very (3) □ Somewhat (2) □ Not (1)
   k. if there were no fuel cost? □ Very (3) □ Somewhat (2) □ Not (1)
   l. if it reduced climate change impacts? □ Very (3) □ Somewhat (2) □ Not (1)
   m. if it decreased sea level rise? □ Very (3) □ Somewhat (2) □ Not (1)
   n. if it reduced risks of flooding in your city? □ Very (3) □ Somewhat (2) □ Not (1)
   o. if it reduced risks of flooding in other cities? □ Very (3) □ Somewhat (2) □ Not (1)

Variable: openness toward canals and creeks

4. Would you like to see more canals or creeks...
   a. supported floating parks? □ Very (3) □ Somewhat (2) □ Not (1)
   b. supported floating greenhouses? □ Very (3) □ Somewhat (2) □ Not (1)
   c. generated renewable energy? □ Very (3) □ Somewhat (2) □ Not (1)
   d. supplied clean water? □ Very (3) □ Somewhat (2) □ Not (1)
   e. reduced floods? □ Very (3) □ Somewhat (2) □ Not (1)
   f. supported water transportation? □ Very (3) □ Somewhat (2) □ Not (1)
   g. improved water quality? □ Very (3) □ Somewhat (2) □ Not (1)
   h. supported floating bicycle paths? □ Very (3) □ Somewhat (2) □ Not (1)
   i. supported floating traffic lanes? □ Very (3) □ Somewhat (2) □ Not (1)
   j. supported boathouses □ Very (3) □ Somewhat (2) □ Not (1)
   k. reduced heat in urban areas? □ Very (3) □ Somewhat (2) □ Not (1)
   l. if it reduced climate change impacts □ Very (3) □ Somewhat (2) □ Not (1)
   m. if it decreased sea level rise? □ Very (3) □ Somewhat (2) □ Not (1)
   n. provided water during droughts □ Very (3) □ Somewhat (2) □ Not (1)
   o. supported vegetation? □ Very (3) □ Somewhat (2) □ Not (1)
   a. were necessary for distributing water? □ Very (3) □ Somewhat (2) □ Not (1)
   b. were necessary for distributing energy? □ Very (3) □ Somewhat (2) □ Not (1)
   c. were necessary for distributing food? □ Very (3) □ Somewhat (2) □ Not (1)
   d. supported wildlife? □ Very (3) □ Somewhat (2) □ Not (1)
   e. returned stormwater to the ground? □ Very (3) □ Somewhat (2) □ Not (1)
   f. supported floating parks? □ Very (3) □ Somewhat (2) □ Not (1)
   g. were more straight? □ Very (3) □ Somewhat (2) □ Not (1)
   h. were more meandering? □ Very (3) □ Somewhat (2) □ Not (1)
   i. needed energy to keep water in it? □ Very (3) □ Somewhat (2) □ Not (1)

Assume response categories are equally-spaced points along a Likert scale to generate scores as shown above in parentheses. Use the average score across all responses to create a variable measure.

6.4 Field interviews

Sixty participants from sampling sites in all eight cities were recruited for semi-structured interviews. As shown in Table 2, during each interview the investigator conducted cognitive mapping (item 1), photovoice (item 2), and emotional recall protocols (item 3). Item 1 prompted the participant to identify the first five features to emerge from a two-dimensional, top-down cognitive map of the city. Item 2 probed the first five photograph-like, eye-level cognitive images to surface from his or her spatial memory of the city. Item 3 generated the five elements that would be most missed if the participant had to leave the city the next day. I used these three recall protocols to assess water-based mappability, identifiability, and place
attachment. Two interview questions were used to measure water-based stress reduction (item 4) and water-based spatial orientation (item 5).

Table 2. Interview items and coding for aquaphilic urbanism measures.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Interview items for field participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>water-based mappabilitya</td>
<td>1. Cognitive mapping protocol: imagine you are drawing a map of the city. Please name or describe the five features or locations that come to mind first. Please do not consult a city map.</td>
</tr>
<tr>
<td>water-based identifiabilitya</td>
<td>2. Photovoice protocol: If you were to take 5 pictures of the city to describe it to someone who has never been there, what would you take pictures of?</td>
</tr>
<tr>
<td>water-based place attachmenta</td>
<td>3. Non-visual protocol: What are the 5 things you would miss about the physical environment if you had to leave the city tomorrow?</td>
</tr>
<tr>
<td>water-based stress reductionb</td>
<td>4. How much do the bodies of water in the city help you relax when you are stressed? □ Very much (3) □ Somewhat (2) □ Not at all (1)</td>
</tr>
<tr>
<td>water-based spatial orientationb</td>
<td>5. How much do you use the bodies of water in the city to orient yourself? □ Very much (3) □ Somewhat (2) □ Not at all (1)</td>
</tr>
</tbody>
</table>

a. Code each answer 1 or 0 based on whether it contains a target waterscape, assign a weight from 5 to 1 to account for the sequence of recall, and use a weighted average to create variable measures.

b. Assume response categories are equally-spaced points along a Likert scale to generate scores as shown above in parentheses.

7 DATA ANALYSIS

7.1 Coding for aquaphilic urbanism measures

For items 1, 2, and 3 in Table 2, we assigned a base score of 1 or 0 to each response depending on whether it contained water. We applied a weight of 5 to the base score for the first answer, 4 for the second, and so forth, to account for the significance of each water-based feature's recall sequence. As shown in the following formula, we took a weighted average from the sum of all five weighted base scores:

\[
\text{Weighted average} = \frac{(5 \times \text{first answer base score} + 4 \times \text{second answer base score} + 3 \times \text{third answer base score} + 2 \times \text{fourth answer base score} + 1 \times \text{fifth answer base score})}{5}
\]

This formula was used to derive the mappability, identifiability, and place attachment measures, respectively, for water-based features from the results of the cognitive mapping, photovoice, and emotional recall protocols in Table 2. For items 4 and 5 in Table 2, we used a three-point Likert scale to ordinate the score for water-based stress reduction and water-based spatial orientation.

7.2 Data reduction

Correlation analysis showed that several measures of aquaphilic urbanism and water-coherent urbanism were correlated. To reduce these measures to a smaller set of uncorrelated variables as components, we conducted an internal consistency reliability test (based on Cronbach’s alpha) and a principal component analysis (PCA) using the-eigenvalue-greater-than-one rule (Kaiser, 1960; McGraw & Wong, 1996). The PCA was also used to provide content validity for the measures of water-based place identity and place dependence by verifying whether these measures were reducible into their respective component constructs. Components are linear combinations of variables based on weights (eigenvectors) developed by an analysis (Jolliffe, 2002). Principal components represent most of the information in the original set of variables. The first principal component extracted captures as much of the variability in the data as possible. Each succeeding component accounts for as much of the remaining variability as possible. We used a correlation matrix to perform the PCA because the units of measurement of the individual measures differed.

7.3 Composite score for aquaphilic urbanism

According to 0.6 as the threshold for Cronbach’s alpha (Hume, Ball, & Salmon, 2006), the four measures for aquaphilic urbanism had an acceptable internal consistency reliability (\(\alpha = 0.71 > 0.6\)) and can
thus be condensed into fewer variables. With promax rotation and the-eigenvalue-greater-than-one rule (Kaiser, 1960), we used the PCA to extract two principal components to explain approximately 2.44 and 1.08 of the variable worth, or 60.88% and 27.01% of the four measures’ total variance, respectively. The loadings (simple correlations) between each of the four measures and either of these two components were either close to zero or much higher than the correlations between the same measures. Additionally, the residual correlations, or the differences between observed and reproduced correlations, were less than 0.3, indicating an absence of uncaptured strong correlations between residuals. Most residual correlations’ absolute values were less than 0.05, while the residual correlation between water-based identifiability and water-based mappability was less than 0.3. These relatively small residuals showed that the variances in the measures were well-captured by the component scores. The PCA outcome suggests that water-based place dependence, as the first principal component, parsimoniously represents water-based stress reduction and water-based spatial orientation, while water-based place identity, as the second principal component, effectively denotes water-based mappability and identifiability. The results supported the use of a composite score for aquaphilia urbanism as a variable for mediation analyses. To generate the variable in SPSS, we used the two component scores in the covariance matrix to weight these two principal components as the independent variables of a linear regression.

7.4 Composite score for openness toward water-coherent urbanism

The four measures for openness toward water-coherent urbanism also underwent data reduction because they had an adequate internal consistency reliability ($\alpha=0.86>0.6$). With 1 as the eigenvalue threshold, PCA extracted one component, which accounted for 3.02 of the variable worth and 60.31% of the total variance in the four measures. The loadings, or simple correlations, between each of the four measures and the component were greater than 0.3, and their residual correlations were less than 0.3. These findings indicate that the principal component score for participants’ openness toward water-based coherent urbanism effectively represents all four measures. The score was calculated by summing the weighted measures generated by multiplying each of the four measures with its corresponding coefficients as weights.

7.5 Mediation analysis

Franck (1984) highlighted the importance of studying the indirect effects of environment on behavior to address the criticism of environmental determinism as a dominant assumption in environment-behavior studies. To identify how public realm design mediated the seemingly environmentally deterministic relationship between watershed location and water-based place attachment, mediation analyses were conducted in SPSS Statistics 22 using a macro written by Preacher and Hayes (2008). Researchers typically use a mediation model to identify the underlying mechanism of an observed relationship between an independent variable and a dependent variable by including one or more mediators as explanatory variables (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). In the first set of mediation analyses, the mediating effect of aquaphilic urbanism on the relationship between watershed location and water-based place attachment was tested. The second set of mediation analyses was conducted to reveal the mechanisms underlying the relationship between water-based place attachment and people’s openness toward water-coherent urbanism.

8 RESULTS

8.1 Aquaphilic urbanism as a mediator of the effect of watershed location on water-based place attachment

Model A in Figure 3 shows that water-based place attachment seemed to be environmentally determined by watershed location measured by the grouping variable of a city’s water density. However, this significant indirect effect, or ostensible phenomenon of environmental determinism, was fully mediated by aquaphilic urbanism as a water-based sense of place evoking aquaphilia.
Figure 3. Mediation analysis results for aspects of aquaphilic urbanism as mediators on the relationship between watershed location or water density and water-based place attachment (**p<0.001; * p<0.05).

Such a sense of place encompasses water-based place identity (a composite construct of water-based mappability and identifiability) and water-based place dependence (a composite construct of water-based stress reduction and spatial orientation) ($\beta_a = 1.46, p_a<0.001; \beta_b = 0.33, p_b<0.001; \beta_c = 0.64, p_c<0.01; \beta_c' = 0.15, p_c' >0.05; R^2=0.34, F(2, 57)=14.96, p<0.001$). The results suggest that a watershed location with a higher level of water density does not always lead to a higher level of water-based place attachment due to the potential mediating effect of aquaphilic urbanism. In other words, upstream cities (with a lower water density than downstream cities) can evoke a greater level of aquaphilia by adopting aquaphilic urbanism.

### 8.2 Functional or aesthetic aspects of aquaphilic urbanism as adaptation motivators

Model A_1 in Figure 3 reveals that water-based place dependence fully mediated 29% of the contribution of watershed location (high- or low-water city) to aquaphilia ($\beta_a = 0.51, p_a<0.05; \beta_b = 0.41, p_b<0.001; \beta_c = 0.64, p_c<0.01; \beta_c' = 0.15, p_c' >0.05; R^2=0.29, F(2, 57)=11.75, p<0.001$). In model A_2, 23% of the influence of watershed location (high- or low-water city) on aquaphilia was fully mediated by water-based place identity ($\beta_a = 1.23, p_a<0.001; \beta_b = 0.41, p_b<0.01; \beta_c = 0.64, p_c<0.01; \beta_c' = 0.15, p_c' >0.05; R^2=0.23, F(2, 57)=8.37, p<0.001$). Compared to water-based place identity, the mediating effect of water-based place dependence was 6% higher. When both mediators were included in model A_3, they accounted for a total of 35% of the high- and low-water city's influence on aquaphilia ($\beta_a = 1.46, p_a<0.05; \beta_b = 0.35, p_b<0.01; \beta_a = 1.23, p_a<0.001; \beta_b = 0.29, p_b<0.05; \beta_c = 0.1, p_c<0.05; \beta_c' = 0.10, p_c' >0.05; R^2=0.35, F(2, 57)=9.89, p<0.001$). The combined effect of both mediators (35%) was only 6% higher than the mediating effect of water-based place dependence alone (29%). Like the CPA results, a comparison of all four models confirms that the functional and aesthetic aspects of aquaphilic urbanism are largely overlapping rather than mutually exclusive. Consequently, it is appropriate to investigate aquaphilic urbanism as a higher-order construct of both aspects.

### 8.3 Water-based place attachment as the function of aquaphilic urbanism for adaptation

In Figure 4, model B ($R^2=0.10, F(2, 57)=3.16, p<0.05$) indicates that a water city's watershed location did not influence public acceptance of water-coherent urbanism because being a high- or low-water city had no significant indirect or direct effect on people's openness toward water-coherent urbanism ($\beta_a = 0.31, p_a>0.05; \beta_c = 0.05, p_c >0.05$); however, model B's $a$ path indicates that high-water cities in downstream locations were more likely to embody aquaphilic urbanism than low-water cities further upstream ($\beta_a = 1.46,$ etc.)
p<0.001), and its b path shows that aquaphilic urbanism had a significant positive effect on openness toward water-coherent urbanism (βb = 0.18, p<0.05). Model C shows that the significant influence of aquaphilic urbanism on openness toward water-coherent urbanism was an indirect effect fully mediated by water-based place attachment (βa = 0.36, p<0.001; βb = 0.31, p<0.05; βc = 0.19, p<0.01; βc' = 0.08, p>0.05; R² = 0.17, F(2, 57) = 5.76, p<0.01). The findings of models A, B, and C suggest that water-coherent urbanism could be introduced to the mainstream for public acceptance through water-based place attachment as the product of aquaphilic urbanism.

**Figure 4. Mediation analysis results for exploring relationships among watershed locations, water-based place attachment, aquaphilic urbanism, and openness toward water-coherent urbanism (***p<0.001; ** p<0.01; * p<0.05).**

### 8.4 Water-based place attachment facilitates climate adaptation through water-based place identity

Figure 5 compares model C with models C1 and C2. Model C indicates that water-based place attachment fully mediated 17% of the indirect effect of aquaphilic urbanism on participants' openness toward water-coherent urbanism. Model C1 shows that water-based place attachment had no mediating effect when water-based place dependence replaced aquaphilic urbanism as the independent variable (βa = 0.47, p<0.001; βb = 0.39, p<0.01; βc = 0.17, p<0.05; βc' = 0.01, p>0.05; R² = 0.16, F(2, 57) = 5.44, p<0.01). In contrast, water-based place attachment mediated 20% of the effect of water-based place identity on participants' openness to water-coherent urbanism in model C2 (βa = 0.45, p<0.001; βb = 0.28, p<0.05; βc = 0.31, p<0.01; βc' = 0.20, p<0.05; R² = 0.20, F(2, 57) = 6.97, p<0.01) as opposed to 17% in model C with aquaphilic urbanism as the independent variable. In summary, functionally-derived water-based place attachment did not fully mediate the indirect impact of water-based place dependence on the participants' acceptance of water-coherent urbanism. In contrast, aesthetically-derived, water-based place attachment evidently fully mediated the indirect effect of water-based place identity on participants' openness toward water-coherent urbanism. The findings reveal that water-based place identity underpins the influence of water-based place attachment on people's openness toward water-coherent urbanism. Technocratic discourses around water retention alone are insufficient. The aesthetic influence of aquaphilic urbanism is essential for motivating public support for a more widespread application of water-coherent urbanism.

**Figure 5. Mediation analysis results for the mediating effect of water-based place attachment on the relationship between aspects of aquaphilic urbanism and openness toward water-coherent urbanism. (***p<0.001; ** p<0.01; * p<0.05).**
9 DISCUSSION

Water-based place identity and dependence are valid measures for the interrelated aesthetic and functional sub-aspects of aquaphilic urbanism (Model A3 in Figure 3). Aquaphilic urbanism was thus empirically substantiated as an urban design approach that integrates water to enhance waterscape salience in two-dimensional cognitive maps and eye-level cognitive images. In addition, this approach facilitates urbanites’ stress regulation and spatial orientation.

As shown by Model A in Figure 4, compared with upstream cities, downstream water cities with a greater proportion of water bodies are more likely to embody aquaphilic urbanism; however, aquaphilic urbanism can help defy this ostensible phenomenon of environmental determinism. Upstream cities with a low water density can be retrofitted with aquaphilic urbanism to potentially evoke more water-based place attachment, thus enhancing the appeal to individuals and businesses.

Water-based place dependence does not encourage more application of water-coherent urbanism through water-based place attachment (Model C1 in Figure 5). However, it mediates the indirect effect of watershed location on water-based place attachment more effectively than water-based place identity (Model A3 in Figure 3). Cities with little space or precipitation for large-scale water retention can still evoke water-based place attachment through smaller-scale waterscapes that facilitate stress reduction and spatial orientation. These local waterscapes may help drought-prone cities become more livable and more attractive tourist destinations. In addition, they can potentially contribute to the social coherence of cities by facilitating environmental adaptation for those most in need of stress reduction and spatial orientation assistance, including newcomers and other spatially-challenged populations. Future research should investigate how to design these waterscapes to better help with stress reduction and spatial orientation with less consumption of land and water. One possible approach is to quantify water surface areas and their impacts on stress reduction and spatial orientation.

The potential of water-based place attachment to help promote upstream retention depends mainly upon the aesthetic aspect of aquaphilic urbanism (Model C2 in Figure 5). Without considering how the configurations of waterscapes and water networks influence their spatial salience, technocratic discourses related to water retention for flood mitigation can be limited in generating public support for more water retention in the public realm. By making upstream water retention projects more mappable and identifiable, we can instigate an upward spiral for flood mitigation hydrologically and economically. These spatially salient water features will help generate more public demand and proactive financing to help promote upstream water retention. More aesthetically-driven water retention projects upstream then lead to support for more upstream water retention. This positive feedback creates self-perpetuating momentum for mainstreaming upstream water retention, making flood mitigation downstream more hydrologically feasible and cost-effective. Water retention has the potential to introduce economic benefits to upstream areas by increasing their land and property values. The largest increases (28%) in house prices have been attributed to the presence of a garden facing water or being connected to a sizable lake, with considerable increases (8-10%) for houses that overlook water (Luttik, 2000).

As a theoretical sampling frame did not exist, a quasi-random sampling approach was used to acquire the participant sample. This convenient sampling approach likely limited the extent to which the results could be generalized beyond the sample. A more rigorous sampling approach should be used to replicate this research design for a greater number of participants and cities to generalize beyond the sample. The degree to which watershed location or water density influences water-based place identity and dependence may need to be further clarified in future research. One possible focus is to target smaller sites, where the amounts of water and surface areas can be precisely quantified. This research direction could potentially determine whether water-based place identity is a construct likely to involve more water exposure than water-based place dependence. This comparison can help determine more nuanced design guidelines for maximizing the performance and minimizing the cost of aesthetically-driven water retention projects. For example, it would be helpful for place-makers to know the minimum water density and duration of water exposure needed to induce sufficient water-based place attachment to motivate public acceptance of water-coherent urbanism. Furthermore, future studies should investigate the effects of waterscape types on water-based mappability and identifiability to identify the most effective waterscape types for evoking water-based place attachment.
10 CONCLUSION

10.1 Proactive financing for more coherent upstream cities
The cost-prohibitive nature of massive flood-mitigation structures and the lack of substantial proactive funding for climate adaptation have significantly delayed the implementation of flood mitigation projects in flood-prone downstream areas. This study demonstrates the potential of incorporating upstream water retention through private development and public realm improvement activities in upstream areas. This approach provides proactive funding mechanisms to help mitigate downstream flooding while building more environmentally, economically, and socially coherent upstream cities.

10.2 Impetus of voluntary migration to safer locations
Temporary and permanent migration to safer places has been deemed the most effective means for individuals to adapt to potentially life-threatening environmental changes in developing countries (Black, Bennett, Thomas, & Beddington, 2011; Laczko & Aghazarm, 2009). Compared with emergency evacuation and displacement prevention, voluntary migration has been recommended as a more holistic approach to adaptation and disaster planning for developed countries (Savvas, 2003). Unlike developing nations, where voluntary migration has become increasingly driven by individuals’ desires to circumvent climate change impacts, voluntary migration in developed countries has been progressively influenced by proximity-seeking to natural amenities among those individuals with growing wealth (Howe, McMahon, & Propst, 2012).

10.3 Natural amenities as relocation consideration
Nord and Cromartie (1997) define natural amenities as moderate, sunny winters and summers with low humidity, as well as diverse topography with mountains and abundant water. Except for water, other natural amenities cannot easily be created by humans. Natural amenities, water-based resources in particular, significantly explain economic and population growth (Deller, Tsai, Marcouiller, & English, 2001; Marcouiller, Kim, & Deller, 2004). Such a water amenity-driven migration pattern has, however, been thought to potentially increase unemployment, as rural water amenities did not seem to increase employment opportunities (Deller et al., 2001). At the same time, Cohen (2000) noted that an increasing number of jobs had been migrating to high-amenity cities due to the theses cities’ appeal to well-educated workers in search of amenities as a key relocation consideration. Upstream areas within commuting distance to employment centers of downstream cities may be the most promising locations for using water retention projects to instigate voluntary migration for climate adaptation.

10.4 Integrating multiple migration incentives
Combined with other migration incentives, such as employment opportunities or tax breaks, the implementation of upstream water urbanism may help contribute to a greater long-term positive pull toward safer high grounds in currently amenity-poor upstream areas. This integrated and proactive approach to voluntary migration could potentially help upstream cities attract more individuals and businesses. This approach also has the potential to minimize involuntary displacement and damage to lives and properties in downstream areas faced with increasing climate change impacts.

11 REFERENCES


IMPACTS OF NEIGHBORHOOD BUILT ENVIRONMENT FACTORS ON SENIOR CITIZENS’ PHYSICAL ACTIVITY LEVEL IN WUHAN, CHINA

HUANG, XI
Huazhong Agricultural University, huangxixi91@sina.com

XU, MENGYUAN
Huazhong Agricultural University, mengyuan03@foxmail.com

FU, YIYI
Huazhong Agricultural University, 296190928@qq.com

1 ABSTRACT
The impact of built environment on the well-being of senior citizens has received increased research attention in recent years. In light of the fact that senior citizens often rely on open spaces within their neighborhoods for physical activity, many studies have been conducted on ways to improve outdoor environments to benefit physical and mental health for seniors. However, the impacts of specific built environment factors on senior citizens’ physical activity level have yet to be fully investigated in a quantitative way. This study examined associations between the neighborhood environment factors and physical activity level of senior citizens in a large city in China; specifically, durations of physical for 655 senior citizens from 16 residential neighborhoods were studied through questionnaires conducted in Wuhan, China. Neighborhood built environment attributes were classified into four categories: physical activity facilities, neighborhood open space characteristics, residential density, and surrounding built environment characteristics. A multivariable linear regression model was developed to examine the association. The results indicated that hard-surface exercise ground area ratio, floor area ratio, residential household density, and nearby public open space accessibility, correlated to higher level of senior citizens’ physical activity, while other attributes of the built environment, including aesthetics, green area ratio, light condition of hard-surface exercise ground area, are not. In addition, differences between male and female residents were observed: Generally, the influence of built environment factors on female seniors were more significant than that on males and nearby public open space accessibility was only significantly correlated to female participants’ physical activity (t=-3.864, P=0.005), but not related to male’s. This research contributes to the existing studies of impacts of neighborhood built environment on levels of physical activity. The findings can assist urban planners and landscape architects to create better senior-friendly residential neighborhood design guidelines.

1.1 Keywords
neighborhood built environment, physical activity, senior citizens, environment characteristics
2 BACKGROUND

Well-being of senior citizens has been receiving increasing research interest in China because of the rapidly aging Chinese population. In 2015, the number of Chinese age 65 and older was 144.34 million, and this number is expected to rise over 300 million by 2050. Therefore, it is important to research ways to improve built environment attributes that promote the well-being of senior citizens. Physical activity is essential for seniors in preventing diabetes, obesity, cardiovascular disease and stroke. Many studies have shown mounting evidence indicating that physical activity can extend years of independent living and improve the quality of life for older people. A recently focus in this area is correlating built environmental activity with levels of physical activity. The reasoning behind the trend is that senior citizens tend to highly rely upon the open spaces and facilities in their local residential neighborhoods for outdoor activity and thus are particularly vulnerable to the obstacles of built environment (King et al, 2000; Michael et al, 2006; Sugiyama & Thompson, 2007; Clarke et al, 2013; Wang et al, 2016; Gallagher et al, 2010). In addition, built environment interventions can benefit persons of all ages in the neighborhood.

To successfully implement built environment interventions, understanding of the effects of built environment factors is critical. Most existing research focus on walking and cycling activities. A few studies develop comprehensive frameworks of built environment factors associated with people's walking and cycling behaviors. Pikora et al. (2003) developed four category of features of neighborhood environment: destinations (availability of commercial and community facilities); functional (structural characteristics of street network); aesthetics of the environment; and safety. Among Chinese researchers, Zhou et al. (2012) proposed a framework of neighborhood features associated with people's physical activity, including housing density, land-use mix, street connectivity, walking/cycling facility, neighborhood aesthetic, safety, and others. In the previous empirical studies, the most common statistical studies applied regression models. Some studies applied logistic regression models to analysis the associations between levels of physical activity and built environmental attributes (Sugiyama et al., 2007; Salvador et al., 2009; Jelle et al., 2012). Other studies used linear regression models (Nagel et al., 2008). Many researchers built upon these frameworks and conducted empirical studies to investigate the correlations between neighborhood built environment factors and likelihood of senior residents' physical activity in their local neighborhoods. Several studies found that the walkable access to parks and greenways positively related to senior residents' physical activity level (Shin et al., 2011; Lees et al, 2007). Hunag and her colleague (2014) found that senior residents living in neighborhood with higher residential densities were less likely to participate in daily outdoor physical activity. Ottoni et al. (2016) suggested that outdoor sitting amenities also improved the likelihood of seniors' physical activity. These research outcomes all provided insights for how neighborhood built environment influence senior residents' physical activities.

There remains two major gaps in the existing research. First, most existing studies have focused on planning-oriented factors at neighborhood scale (such as street connectivity and land-use mix) while few have considered design-oriented factors at smaller scale of open spaces (such as exercise-supporting facilities availability, or playground area per capital within a given neighborhood). However, the impacts of these factors on seniors' physical activity may vary at different scales. So there is a need to examine the effects of neighborhood built environment factors on both macro and micro scales to reach a clearer understanding of relationships between environmental factors on physical activities of senior people. Second, measures applied in existing studies were mostly quantitative; few studies have taken the morphological characteristics of the neighborhood environmental factors at smaller scales into consideration. Quantitative measures only reflect total neighborhood built environment features; these can be inaccurate in reflecting to what extent the residents actually utilize the neighborhood spaces. Morphological characteristic, for example, layout pattern of the green space or other design features on the neighborhood, may also influence residents’ activities. Take green coverage ratio as an example, it is a quantifiable measure reflecting the amount of green space provided to the residents in the neighborhood. But neighborhoods with the same green coverage ratio may largely differ in terms of green space layouts, such as the centralized public green space layout, or linear green space along neighborhood pathways, or scattered small green spaces. These layouts influence seniors' daily usage because the green spaces with different forms support different kinds of physical activities. Thus, measures limited to quantities of green space, without considering morphological characteristics, may lead to misleading associations between built environmental factors and senior physical activity.

In addition, although current official Neighborhood Planning and Design Guidelines in China provide basic quantitative standards of neighborhood design (such as floor area ratio and green space ratio), as
well as some general suggestions on neighborhood green space and hard-surface ground design based on normative practice, there is little guidance on how specific design features (such as size or facility) can be organized in order to meet various needs of senior residents. Thorough understanding of how the behaviors of senior residents associate with neighborhood built environment can lead to more informed neighborhood design guidelines that can assist urban planners and landscape architects with future design practice.

To address these gaps, this study investigated the effects of neighborhood built environment factors on physical activity of the senior residents with emphasis on morphological characteristic of green spaces at smaller scales. Multiple linear regression analysis allows for quantitatively assessment of correlations between neighborhood built environment features and seniors' physical activity levels. Explorations into the disparities among the correlations in the sample neighborhoods reveal how neighborhood built environment impacts senior resident’s physical activity behavior and to what extent. The results provide community designers and policy makers with decision supports on future built environment intervention for physical activity promotion purpose in the context of Chinese metropolitan areas. This study also contributes to the existing environment-behavior literature in theoretical frameworks measuring environmental factors for seniors' physical activities at the neighborhood scales.

3 METHODOLOGY AND DATA

3.1 Study Design and Study Neighborhoods

The study collected data of physical activities of senior residents with the aim to explore if the levels of their physical activities were associated with neighborhood built environment factors and to what extent. This study selected 16 sample neighborhoods from Wuhan metropolitan area (see Table 1). Wuhan is the largest city in central China with a population of 10 million. The climate and socio-economic characteristics of Wuhan are representative of the situation of a large number of Chinese large metropolitans.

As previous research showed that individual socio-economic status also largely impacts people’s physical activity behavior, sample neighborhoods in this study were selected within a range of general socio-economic status in order to minimize the random bias from individual socio-economic characteristics differences. The criteria included: construction period from 2000 to 2014; housing price from 10000 RMB/m² to 14000 RMB/m². All measurements of the criteria were conducted in September 2016.

Table 1. General socio-economic characteristics of the 16 selected neighborhoods.

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>construction period</th>
<th>May,2016 housing price (RMB/m²)</th>
<th>green area ratio(%)</th>
<th>District</th>
<th>Acreage(m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dongfang Huacheng</td>
<td>2005</td>
<td>12347</td>
<td>49%</td>
<td>Hankou</td>
<td>142000</td>
</tr>
<tr>
<td>2</td>
<td>Baoli Huadu</td>
<td>2009</td>
<td>11192</td>
<td>35%</td>
<td>Wuchang Hongshan</td>
<td>148000</td>
</tr>
<tr>
<td>3</td>
<td>Baoli Huayuan</td>
<td>2006</td>
<td>12191</td>
<td>42.37%</td>
<td>Wuchang Hongshan</td>
<td>137600</td>
</tr>
<tr>
<td>4</td>
<td>Meilin Qingcheng</td>
<td>2007</td>
<td>12589</td>
<td>37%</td>
<td>Wuchang Xudong</td>
<td>170000</td>
</tr>
<tr>
<td>5</td>
<td>Mingdu Huayuan</td>
<td>2006</td>
<td>10210</td>
<td>50%</td>
<td>Wuchang Hongshan</td>
<td>146000</td>
</tr>
<tr>
<td>6</td>
<td>Dahua Nanhu Gongyuan Shijia Section 2</td>
<td>2013</td>
<td>11760</td>
<td>28%</td>
<td>Wuchang Hongshan</td>
<td>176000</td>
</tr>
<tr>
<td>7</td>
<td>Aijia Guoji Huacheng</td>
<td>2010</td>
<td>11173</td>
<td>40%</td>
<td>Wuchang Qingshan</td>
<td>192000</td>
</tr>
<tr>
<td>8</td>
<td>Dushi Jingdian</td>
<td>2008</td>
<td>12312</td>
<td>44%</td>
<td>Wuchang Xudong</td>
<td>112000</td>
</tr>
<tr>
<td>9</td>
<td>Binhu Mingdi</td>
<td>2006</td>
<td>10075</td>
<td>43%</td>
<td>Wuchang Hongshan</td>
<td>52000</td>
</tr>
</tbody>
</table>
3.2 Neighborhood Built Environment Factors

We selected the factors in this analysis, as well as their measurements, based on review of the relative literature published in the last ten years that: (1) chose senior residents as the focus group; (2) applied empirical approaches with clear illustration on sample sizes, study units, built environment factors, data analysis models. Based on the literature review, the independent variables in this study consisted of seven neighborhood built environment characteristics in four categories, as shown in Table 2. Among these variables, most of them were calculated using a GIS platform, including neighborhood floor area ratio, green area ratio, hard-surface exercise ground area ratio, and nearby public open space accessibility. The areas of green area and hard-surface exercise ground in each study neighborhood were calculated based on high-resolution satellite image derived from city planning department of Wuhan. Nearby public open space accessibility variable was defined as the distance from study neighborhoods to the closest urban public space (park, city square, etc.) in the nearby urban district, calculated with the Network Analysis tool in ArcGIS10 software. Data of facility-related variables, including street light and exercise facility condition, were collected by neighborhood observation. Neighborhood aesthetics quality variable was determined by neighborhood questionnaire survey that covered randomly selected neighborhood residents of different genders and ages, whose attitude toward the aesthetic quality of the neighborhood was evaluated with a seven-point Likert scale; and the average points from all participants represented the measurement of neighborhood aesthetics quality of the given neighborhood. All study neighborhoods were also classified based on morphological characteristics of the neighborhoods public spaces into the following two categories: (1) Centralized public space; (2) Decentralized public spaces (See Figure 1 & 2). Centralized public space refers to the condition that the given neighborhood has only one compact green space within it; while decentralized means these public spaces are in a state of dispersed distribution.

All data of neighborhood built environment characteristics were derived from September to October 2016.

Table 2. Built Environment Characteristics of the 16 neighborhoods.

<table>
<thead>
<tr>
<th>Name of neighborhoods</th>
<th>Weekly average physical activity duration (h)</th>
<th>Aesthetics</th>
<th>Nearby public open space accessibility (km)</th>
<th>hard-surface exercise ground area ratio</th>
<th>green area ratio</th>
<th>Residential household density (Set / ha)</th>
<th>Light density of hard-surface exercise ground area (/ m²)</th>
<th>Neighborhood floor area ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tairan Nanhu Meiguiwan</td>
<td>6.500</td>
<td>5.100</td>
<td>0.880</td>
<td>0.042</td>
<td>0.350</td>
<td>142.857</td>
<td>0.007</td>
<td>1.700</td>
</tr>
<tr>
<td>Nanguo Mingzhu2</td>
<td>6.570</td>
<td>6.070</td>
<td>0.980</td>
<td>0.032</td>
<td>0.400</td>
<td>96.532</td>
<td>0.005</td>
<td>1.500</td>
</tr>
<tr>
<td>Location</td>
<td>X Coord</td>
<td>Y Coord</td>
<td>Width (m)</td>
<td>Height (m)</td>
<td>Area (m²)</td>
<td>Max Slope</td>
<td>Slope (%)</td>
<td>Density (m²/h)</td>
</tr>
<tr>
<td>----------------</td>
<td>---------</td>
<td>---------</td>
<td>-----------</td>
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<td>-----------</td>
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</tr>
<tr>
<td>Nanguo Mingzhu 1</td>
<td>6.670</td>
<td>5.750</td>
<td>1.415</td>
<td>0.043</td>
<td>81.967</td>
<td>0.005</td>
<td>1.300</td>
<td></td>
</tr>
<tr>
<td>Meilin Qingcheng</td>
<td>7.160</td>
<td>5.356</td>
<td>1.530</td>
<td>0.035</td>
<td>162.353</td>
<td>0.004</td>
<td>1.700</td>
<td></td>
</tr>
<tr>
<td>Dushi Jingdian</td>
<td>8.220</td>
<td>5.420</td>
<td>0.570</td>
<td>0.061</td>
<td>128.840</td>
<td>0.004</td>
<td>2.080</td>
<td></td>
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<tr>
<td>HanKou Chuntian</td>
<td>8.340</td>
<td>5.480</td>
<td>0.860</td>
<td>0.041</td>
<td>128.366</td>
<td>0.011</td>
<td>1.880</td>
<td></td>
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<tr>
<td>Dongfang Huacheng</td>
<td>9.700</td>
<td>4.880</td>
<td>0.520</td>
<td>0.036</td>
<td>153.803</td>
<td>0.011</td>
<td>1.560</td>
<td></td>
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<tr>
<td>Jinqiao Gangwan</td>
<td>9.810</td>
<td>5.250</td>
<td>1.090</td>
<td>0.034</td>
<td>266.667</td>
<td>0.001</td>
<td>2.200</td>
<td></td>
</tr>
<tr>
<td>Baoli Huayuan</td>
<td>10.610</td>
<td>5.640</td>
<td>0.810</td>
<td>0.044</td>
<td>194.404</td>
<td>0.010</td>
<td>2.200</td>
<td></td>
</tr>
<tr>
<td>Huajin Huayuan</td>
<td>11.230</td>
<td>5.510</td>
<td>0.840</td>
<td>0.055</td>
<td>165.013</td>
<td>0.005</td>
<td>1.798</td>
<td></td>
</tr>
<tr>
<td>Mingdu Huayuan</td>
<td>11.650</td>
<td>5.550</td>
<td>0.870</td>
<td>0.059</td>
<td>133.014</td>
<td>0.007</td>
<td>1.050</td>
<td></td>
</tr>
<tr>
<td>Dahua Nanhu Gongyuanning Shijia 2</td>
<td>11.970</td>
<td>5.620</td>
<td>0.250</td>
<td>0.059</td>
<td>143.182</td>
<td>0.006</td>
<td>1.730</td>
<td></td>
</tr>
<tr>
<td>Aijia Guoji Huacheng</td>
<td>12.180</td>
<td>5.240</td>
<td>0.700</td>
<td>0.113</td>
<td>249.271</td>
<td>0.004</td>
<td>2.723</td>
<td></td>
</tr>
<tr>
<td>Binhu Mingdi</td>
<td>12.560</td>
<td>5.580</td>
<td>0.550</td>
<td>0.077</td>
<td>195.167</td>
<td>0.008</td>
<td>2.200</td>
<td></td>
</tr>
<tr>
<td>Baoli Huadu</td>
<td>12.630</td>
<td>5.790</td>
<td>0.510</td>
<td>0.064</td>
<td>337.838</td>
<td>0.006</td>
<td>2.930</td>
<td></td>
</tr>
<tr>
<td>Dahua Nanhu Gongyuanning Shijia 3</td>
<td>12.880</td>
<td>5.880</td>
<td>0.590</td>
<td>0.083</td>
<td>139.878</td>
<td>0.011</td>
<td>1.600</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1** Centralized public space map  
**Figure 2** Decentralized public space map.
3.3 Population and Physical Activities

The survey was conducted concurrently in study neighborhoods from September 2016 to October 2016 when the climate was suitable for outdoor physical activity in Wuhan. The survey occurred during two-time spans (from 7 a.m. to 10 a.m., and from 16 p.m. to 21 p.m.) on both weekdays and weekends with good weather during the previous week. The target population in this study was defined as senior residents (age > 55) living in the study neighborhoods. Their individual-level data included age, education, and gender. The education levels of the participants were classified into the following categories: Junior middle school or below, High school, college or higher. Age was grouped into seven categories as follows: (55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85 and above). A total of 665 senior residents were reached and 655 effective responses were collected. The final sample consists of 270 male and 385 female with a mean age of 68.63. All 16 neighborhoods were represented in the sample: the number of participants per neighborhood ranged from 31 to 45, with an average of 40.94.

The overall socio-demographic characteristics of the participants were summarized in Table 3.

Table 3. Overall Socio-demographic Characteristics of the Participants.

<table>
<thead>
<tr>
<th>Individual level</th>
<th>Categories</th>
<th>Number</th>
<th>Proportion (%)</th>
<th>Weekly average physical activity duration (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>270</td>
<td>41.20</td>
<td>9.89</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>385</td>
<td>58.80</td>
<td>9.54</td>
</tr>
<tr>
<td></td>
<td>Junior middle school and below</td>
<td>254</td>
<td>43.70</td>
<td>9.34</td>
</tr>
<tr>
<td></td>
<td>High school</td>
<td>214</td>
<td>36.80</td>
<td>10.69</td>
</tr>
<tr>
<td></td>
<td>College or higher</td>
<td>113</td>
<td>19.50</td>
<td>11.09</td>
</tr>
<tr>
<td></td>
<td>Lack of data</td>
<td>74</td>
<td>11.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55-59</td>
<td>76</td>
<td>11.60</td>
<td>10.27</td>
</tr>
<tr>
<td></td>
<td>60-64</td>
<td>235</td>
<td>35.90</td>
<td>10.71</td>
</tr>
<tr>
<td></td>
<td>65-69</td>
<td>166</td>
<td>25.30</td>
<td>9.84</td>
</tr>
<tr>
<td></td>
<td>70-74</td>
<td>69</td>
<td>10.50</td>
<td>9.20</td>
</tr>
<tr>
<td></td>
<td>75-79</td>
<td>60</td>
<td>9.20</td>
<td>8.09</td>
</tr>
<tr>
<td></td>
<td>80-84</td>
<td>39</td>
<td>6.00</td>
<td>9.67</td>
</tr>
<tr>
<td></td>
<td>85 and above</td>
<td>10</td>
<td>1.50</td>
<td>5.30</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>655</td>
<td></td>
<td>9.89</td>
</tr>
</tbody>
</table>

Questions related to physical activity were adopted from the International Physical Activity Questionnaire (IPAQ) to collect information on estimated physical activities of the seniors. Participants were asked to report the hours and minutes they had participated in physical activities in the previous 7 days. The form of the physical activity in the questionnaire intentionally excluded housing working and utilitarian commuting but focusing on recreational physical activity as recommended by previous research (Chaix et al, 2014). The average value of total physical activity duration in the previous week of all participants in one neighborhood was defined as the dependent variable in this study.
3.4 Statistical Analysis

Statistical analysis was conducted in SPSS 19.0. First, one-way ANOVA analyses were used to examine the associations between participants individual characteristics and the levels of physical activities. Then a multivariable linear regression model was conducted to examine the relationships between neighborhood built environment factors and the levels of physical activities of the senior residents living in the neighborhoods. In addition, male and female participants were examined jointly and separately to explore the potential differences in the effects of neighborhood built environment factors. Last, Pearson Correlation Coefficient was applied separately to examine the differences between neighborhoods with centralized public space and ones with decentralized public space.

4 RESULTS

74.50 percent of the senior residents in these study reported participating in physical activities at least 1 hour in the previous week. And 10.38 percent of the senior residents participated physical activity over 2.5 hours during that span, which was the recommended minimal exercise time per week for adults according to WHO (WHO, 2008). The mean physical activity duration within the survey week was 9.89h.

One-way ANOVA analyses showed that participants’ individual characteristics were significantly associated with their physical activity behaviors (See Table 4). Men spent more time than women taking exercise within the week. Physical activity duration decreased with age, as expected. In addition, participants with higher education (college or higher degree) were more likely to participate in daily physical activity.

Table 4. One-way ANOVA analyses results.

<table>
<thead>
<tr>
<th>Individual Characteristics</th>
<th>P</th>
<th>Whether have significant correlation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.007**</td>
<td>√</td>
<td>655</td>
</tr>
<tr>
<td>Gender</td>
<td>.064</td>
<td>×</td>
<td>655</td>
</tr>
<tr>
<td>Education</td>
<td>.011*</td>
<td>√</td>
<td>581</td>
</tr>
</tbody>
</table>

Notes: *P < .05, **P < .01

The multivariable linear regression model indicated that four of the seven neighborhood built environment characteristics in this study were significantly associated with senior residents' physical activity duration, including hard-surface exercise ground area ratio, floor area ratio, residential household density, nearby public open space accessibility (See Table 5a). Higher hard-surface exercise ground area ratio was strongly associated with more time spent on physical activity \( t=3.429, P=0.009 \), which was not surprising considering the context that hard-surface exercise ground was primary space for senior residents' physical activity. In addition, senior residents living in neighborhoods with lower floor area ratio were more likely to participate in physical activities \( t=4.744, P=0.001 \). While higher residential household density \( t=-2.677, P=0.028 \) of the neighborhoods were positively associated with likelihood of physical activities of the senior residents. In addition, distance from neighborhoods to the closest public open space was also found significantly associated with durations of physical activities of senior residents \( t=-2.330, P=0.048 \), which was similar to previous research. Senior residents were less likely to spend time on physical activity with the increase of distance from the neighborhood entrances to surrounding public open spaces. This finding suggested that although built environment within the neighborhood boundary was hypothesized to directly influence seniors' physical activity behavior, the availability of surrounding public spaces also played a significant role, which was consistent with previous research. Other variables, including aesthetics, green area ratio, light density of hard-surface exercise ground area were not found to be significantly associated with dependent variables.
In addition, differences between male and female residents were observed. Three of the same neighborhood built environment characteristics were found significantly associated with the male and females' physical activity duration, but those had a more significant impact on females, including hard-surface exercise ground area ratio, floor area ratio and residential household density. Nearby public open space accessibility was significantly associated with female participants' physical activity (t=-3.864, P=0.005) but had nothing to do with male (See Table 5a).

The Pearson Correlation Coefficient indicated that different categories of neighborhood had different environment characteristics associated with the time spent on physical activity. A positive correlation was found between aesthetics (r=0.737, P=0.023), nearby public open space accessibility (r=-0.678, P=0.045), hard-surface exercise ground area ratio (r=0.704, P=0.034) and time spent on physical activity in the neighborhood type of centralized public space. Hard-surface exercise ground area ratio (r=0.798, P=0.032), floor area ratio (r=0.782, P=0.038) and residential household density (r=0.929, P=0.003) of decentralized public space' neighborhoods were all found correlated with participants' physical activities duration (See Table 5b).

Table 5 Multivariable linear regression and Pearson Correlation Coefficient analysis results.

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t</td>
<td>P</td>
<td>t</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>1.364</td>
<td>.210</td>
<td>1.511</td>
</tr>
<tr>
<td>Nearby public open space accessibility</td>
<td>-2.330</td>
<td>.048*</td>
<td>-.132</td>
</tr>
<tr>
<td>hard-surface exercise ground area ratio</td>
<td>3.429</td>
<td>.009**</td>
<td>3.401</td>
</tr>
<tr>
<td>green area ratio</td>
<td>-.098</td>
<td>.924</td>
<td>.307</td>
</tr>
<tr>
<td>Residential household density</td>
<td>4.127</td>
<td>.003**</td>
<td>2.695</td>
</tr>
<tr>
<td>Light density of hard-surface exercise ground area</td>
<td>1.054</td>
<td>.322</td>
<td>.904</td>
</tr>
<tr>
<td>Floor area ratio</td>
<td>-2.946</td>
<td>.019*</td>
<td>-2.462</td>
</tr>
<tr>
<td>R Square</td>
<td>.884</td>
<td>.735</td>
<td>.918</td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>.783</td>
<td>.503</td>
<td>.847</td>
</tr>
<tr>
<td>P</td>
<td>.003**</td>
<td>.064</td>
<td>.001**</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>Weekly average physical activity duration</td>
<td>Weekly average physical activity duration of male</td>
<td>Weekly average physical activity duration of female</td>
</tr>
<tr>
<td>Centralized public space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decentralized public space</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. Pearson Correlation Coefficient

<table>
<thead>
<tr>
<th>variables</th>
<th>Centralized public space</th>
<th>Decentralized public space</th>
</tr>
</thead>
</table>

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DISCUSSION AND CONCLUSION

This study confirmed the hypothesis that the likelihood that senior residents participated in physical activity was associated with the built environment features of the neighborhoods where they lived in Chinese urban context. Overall, higher hard-surface exercise ground ratio and residential household density, decreasing floor area ratio and distance to the closest public open space in surrounding urban district, were positively related to the time senior residents spend on physical activity. Additionally, there were also some noticeable differences in built environment factors between male and female seniors. Generally, the influences of built environment factors on female seniors were more significant than that on males. Surrounding public open space availability variable was only significantly associated with physical activity time of female seniors.

One main lesson from this study was that both of the public open spaces within the neighborhoods and in surrounding urban districts were significantly related to the levels of physical activities of seniors; while the hard-surface exercise ground was the most important one among a variety of amenities of the neighborhoods. The potential reasoning might be that the primary forms of physical activities of Chinese seniors were generally in groups, which required relatively large hard-surface open spaces. This rationale could also explained why the levels of physical activities of females, who tended to participate in group exercise more actively, were even more significantly correlated with the availability of closest public open spaces than that of males. This result indicated that hard-surface exercise ground improvement could be the one of efficient approach of built environment interventions that encouraged seniors’ physical activities. Therefore mandatory requirement on a minimal percentage of hard-surface open spaces in the neighborhood can be a valuable addition in the current neighborhood design guidelines in order to encourage senior residents to reach sufficient duration of physical activities.

This study also found that senior residents living in neighborhoods with high residential household density, especially the females, were more likely to participate in physical activities, indicating that seniors residents participated in physical activity in groups and thus could be influenced by other seniors who lived close. This finding highlighted further consideration on potential spatial autocorrelation effects of seniors’ physical activity pattern. As a result, it is vital for future studies to include the spatial autocorrelation effects in the theoretical framework and further examine how exactly seniors' physical activity tendency would impact each other, in order to better clarify the impacts of the various interventions on both built environment aspect as well social activity encouragement.

This study also lead to some enlightening evidence that how morphological characteristics of neighborhood open space could also impact on seniors’ physical activity. One interesting finding was that the seniors living in neighborhoods with centralized public spaces were more likely influenced by the accessibility to nearby public open space, while ones living in neighborhoods with decentralized public
spaces not so much. This result could suggest that in neighborhoods with centralized public spaces, seniors who did not live close to the neighborhood public space might have to turn to nearby available public spaces as substitution, while ones lived in neighborhoods with decentralized public spaces had better access to the open spaces that scattered in the neighborhood so they were less likely to rely on open spaces outside the neighborhood. This finding suggested that for the neighborhood that did not have any public open space within walking distance, designers should consider decentralized layout as the preferred pattern because it would allow residents to access public spaces easily and thus promote their level of physical activity. Another finding related to morphological characteristic was that the aesthetics of the open spaces showed significance only in neighborhoods with centralized public spaces, indicating that designer who worked on these type of neighborhood should pay more attention to improving open space environment in order to maximize its effect on the tendency of seniors’ physical activities.

Another lesson from findings in this study was expectation regarding facilities-based interventions should be modest: One unexpected finding of this study was none of the facilities, including lighting and exercise facilities, turned to be significantly associated with duration of physical activity, which indicated that the primary form of physical activity that senior residents participated did not rely on facilities.

To conclude, this research confirmed that neighborhood built environment were significantly related to the durations of physical activities of senior residents and suggested a variety of built environment interventions that could increase the likelihood of physical activities among seniors. The results could be conducive to the decision-making process of neighborhood design and also help further facilitate detailed improvements of future neighborhood planning and design guidelines to support senior residents’ well-being in the context of rapid-aging Chinese metropolitan areas.

6 REFERENCES


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WALKING AS INQUIRY

RAE, JESS
Lincoln University School of Landscape Architecture, New Zealand, jess.rae@lincoln.ac.nz

ABBOTT, MICK
Lincoln University School of Landscape Architecture, New Zealand, mick.abbott@lincoln.ac.nz

BOWRING, JACKY
Lincoln University School of Landscape Architecture, New Zealand, jacky.bowring@lincoln.ac.nz

1 ABSTRACT
Walking intensifies people-environment relationships, where traversing landscape elicits a deepening of connections between walker and landscape. This paper examines the role of walking in exploring in what is seen and how it is seen, and tests alternative ways of knowing (and coming to know) landscape through the use of various observational tools and assessment. Walking is the primary mode of acquisition, with design operations (sketching/diagramming/critique) the key tools for interpretation and exploration. Iterative walking and diagramming combine with temporal and experiential mapping to provide new translations of known spaces. The research finds that while objective methods of looking at landscape inform what is made known, design exercises enable new and enriched ways of understanding spaces, and of finding diverse materials, processes and meanings within landscape.

1.1 Keywords
Walking as experiencing, landscape perceptions, interrogation through walking and design.
2 INTRODUCTION

This article explores the potential of walking as a design informant and as a tool for contextualised understanding of site. Extending past surficial visualisation, walking-as-design entangles the walker in landscape and navigates a way forward. Traditional methods of site observation focus on understanding how a landscape is physical formed and what materials, events or actions exist on site (as recordable inventory data). Emphasis is placed on observing, describing and classifying the presence, properties and development of materials. Landscape change may be recorded through the identification of physical or cultural drivers as events and activities altered the landscape composition (Howett 1998, Schrott 2013). Landscape forms can be captured in detail drawings. This research investigates how walking has the capacity to open up landscape, to question what is seen and what might be known.

Walking permeates the field of landscape architecture: as a performance prompted in the landscape (Ingold 2000, 2004); and as a form afforded by the paths we both construct and/or generate (Carter 1996, Abbott 2013, Rae 2015). Tapping into the rich experiential, sensual and physical qualities of walking is an enduring area of study for the discipline (Jackson 1994, Jacks 2004, 2006, 2007). However, while construction drawings might describe the structure of a path, such representations fall short in expressing the potency of path and the practices of walking, ambling, strolling, sauntering, hiking, tramping, strolling, trekking, wandering, roaming, trudging and so on (Halprin 1965, Thiel 1995).

Walking can be used to identify and observe the relationship between the walker and landscape and to provide a narrative beyond material observation. Landscape is more than physical. More than a collection of things seen, it is physical and cultural, material and articulated, and can be seen both objectively and subjectively. Walking changes perspectives, both literally as the walker moves through site, and perceptually as the walker dwells in place. Built of tangible experience and contact with ground, landscape becomes known in immersive and complex ways. Social anthropologist Tim Ingold describes how it is through movement that we come to be and to know. Through capturing the walk, a body of work develops which allows the walker to understand how “movement is knowing” (Ingold 2011: 160). Walking apprehends landscape from a particular point of view and allows this view to be altered as movement progresses.

Catherine Dee and Rikva Fine discuss the value inherent in a holistic and changing set of viewpoints. In their 2005 article, the landscape architects reveal the role of the visual and the use of image and critique as a disruptor of what is assumed to be known in landscape. “The viewer moves between whole and parts, successive interpretations necessitating a fragmental way of thinking” (Dee and Fine 2005: 81). Walks can be used in an identical fashion, with the walker creating abstracted images and maps subject to fragmented and disruptive interpretation.

Walk records are image rich, design generated explorations that provide a forum where the seemingly immutable known landscape is able to be interrogated and translated into new understanding. Designing becomes part of the walking and questions further what is seen, what might be seen and what might become known through visualising a walk.

Walking is iterative and generative. Each walk reveals new things: changes in a place, across a season, over a day, in a minute. Experiential mapping provides a way of capturing change and interaction, each walk generating a unique temporal and material record. Iterative walking and diagramming combine with temporal and experiential mapping to provide new translations of known spaces. While objective methods of looking at landscape inform what is made known, design exercises enable new and enriched ways of understanding spaces, and of finding diverse materials, processes and meanings.

3 RESEARCH APPROACH

In a diverse and materially complex landscape, how might we make sense of materials and how might site be structured? How do we crystallise the path? Landscape architecture is shaped by the ability of its protagonists to observe and respond to what is encountered. Walking forms a strategy for interrogation. This research uses walking to question the completeness of a view constructed purely of objective data and explores the role of the subjective in informing landscape discovery. Through immersion and deeper exploration of particular spaces landscape become critically known. Echoing the work of Dee and Fine (2005) this research seeks to explore the potential of a critical visual method using both image making and adaption. Walking experiments and image-making are used to interrogate landscape readings and develop new ways of seeing landscape. Design operations (drawing and diagramming tools) make the discoveries tangible and obtainable to others.
These experiments and images were produced following a period of walking inquiry (undertaken as part of MLA thesis research). In a series of walking-based explorations, the walker sought to discover how landscape might become known in unique ways through a series of solo and collaborative walks. Exercises were completed in a successive process, as a series of alternating steps that mirror in written form Ingold’s directive for finding one’s way where “we know as we go not before we go” (Ingold 2000: 230).

In this study, each walk is connected through their location within one area, Banks Peninsula, New Zealand (Figure 1). The peninsula landscape is easily recognizable by its distinctive forms and its prominent position sitting tall, astride the seaward edge of the Canterbury Plains. Isolated and rugged, the peninsula is criss-crossed with a network of farm tracks and hill trails stretching from sea cliff to summit.

![Figure 1. Banks Peninsula key locations. Image by author (Jess Rae).](image-url)

Walking is adopted as an investigative tool which reveals site consistencies, connectivities and particularities. The walks utilise a broad range of observational techniques and field analysis methods, which extend from traditional mapping techniques through to more phenomenological explorations. The two main techniques for acquiring data are explained in more detail in a subsequent methodology section (see sections 4.1 and 4.2).

Landscape is observed and recorded as both a subject and an agent of response. The records obtained from exercises are used to highlight and frame interaction between the walker and landscape, and form a rich inventory for future design exploration.

Walking was used to record data about a particular landscape, the path travelled and the walker themselves. In using walking as a research tool it becomes apparent that it is impossible to separate walker from the path. The walker’s self becomes expressed in the research record. Methods, processes and habits
are ingrained in the walker and blend into the experiences of the walks. Walk notes reflect a precipitation of self upon landscape and landscape upon self.

This relational way of understanding is adapted and mined in a design directed approach. Exploring both the process of data recording and sequencing, experiential encounters are extracted and proposed. The product is a series of temporal cartographies and typologies, lines of research that question and reframe the walker-observer relationship.

4 RESEARCH METHODS

The first step of interrogation involves developing a series of walk records: descriptive sketches, notes, maps and diagrams. The next step is more critical and reflective. To explore interpretations, sketches are taken back to studio and subject to investigation through critique and design. Questions explored a range of aspects e.g. what particular structures were drawn and why? What was the focus and why? What scale/proximity was the walker fixated on and why? What materials were important? What did others sketch?

Discussions provoke questions over the importance of physical structures (site tectonics) or microclimates, they draw attention to minute details and seemingly invisible features. They question how reactions might change if another route was taken or a different scale adopted.

4.1 Walking Experiments (walking-as-design)

Images, whether those directly developed from the field or those later modified in design studio, are a rich source of information. Exploratory walks produce records which are primarily captured using hand rendering and critical observation (in field or in studio review). Photography and GPS are used during walks to record a broad, supplementary view of site and provide an instantaneous record of a scene and location, with additional software used for image processing and research. Drawing is deliberately chosen as the key tool to explore and represent the walks.

Walking develops a knowledge of things in relation to other things (Ingold, 2011). This knowledge is captured and interpreted through a collection of detailed ‘walk lines’ or typologies. Through tracing walk routes and observations, a body of drawings, diagrams and scores is built. This catalogue of experiences and encounters reflects the materials and spaces from within a context of movement and time. This is further developed through image-making and analysis. The act of sketching allows time for focusing in and absorbing further, and the sketch itself provides a subject for analysis (Dee and Fine, 2005). Sketching allows elements to be explored and defined through the physical creation of the image. The reading of the image is fluid and partially ambiguous.

4.2 Critique, Sketching, Design

While the walks apprehend landscape from a walker’s point of view, they need translating into a legible image or story others can comprehend. Abstracted images and maps are subject to viewer interpretation. They require review as part of a critical process which questions the value and significance of materials observed and the things recorded. Opening up maps to interpretation in an active reading is a valuable source of insight into landscape.

Insights developed in studio critique suggest further ways of walking and reading, seek to enrich what is already known, and signify a shift in interrogation towards a dynamic, narrative-based inventory where material interaction and temporality is central. A typology of tracks is developed with a storyboard of experienced materials and spaces created through compiling maps and information, comparing notes and contrasting records.

4.3 Developing Typologies

This section provides a description of design tools and process used to extract and condense what might be discovered of landscape through walking, into a framework for possible application. Table 1 (over page) provides a summary of the key stages of the wider process involved in walking as inquiry and can be used to develop a program of designerly walking.
Table 1. Design as walking – A Process for Walking as Inquiry.

<table>
<thead>
<tr>
<th>Step</th>
<th>Aim</th>
<th>Inventory Goals</th>
<th>Task</th>
<th>Inventory</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Survey Activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 1: Building a Typology of Materials</td>
<td>Catalogue and form typologies of materials encountered along the path</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td>Determine what is already known and structure study areas</td>
<td>Create a base map and gather existing information</td>
<td>Reading, review</td>
<td>Existing maps, literature review, historic accounts</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>Survey and describe material form and features</td>
<td>Compile comprehensive track notes and experiential account</td>
<td>Survey Mapping</td>
<td>Base map, guide/notes</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Examine how features relate and compare/contrast inventory</td>
<td>Structure a catalogue of materials and form types</td>
<td>Sketches, Maps, Notation</td>
<td>Collected inventory and walk records</td>
<td></td>
</tr>
</tbody>
</table>

Stage 2: Typing Operations

<table>
<thead>
<tr>
<th>Step</th>
<th>Investigate how material typologies can be taken further to create new itinerary or form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 4</td>
<td>Ideation: Consider how typologies might be explored further, Explore a range of relationships between types and explore connections</td>
</tr>
<tr>
<td>Step 5</td>
<td>Reimagine track materials and experiences based on reordered sequences</td>
</tr>
</tbody>
</table>

Stage 3: Recording the Temporal as Experienced in a Walk

<table>
<thead>
<tr>
<th>Step</th>
<th>Explore how the walker responds to materials when walking and use new typologies in creating walks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 7</td>
<td>Record how the walker moves through space and builds itinerary. Establish itinerary of route taken</td>
</tr>
<tr>
<td>Step 8</td>
<td>Examine recorded itinerary Build timeline of events (establish walk line)</td>
</tr>
<tr>
<td>Step 9</td>
<td>Analyse walk line. What can the walk line tell us about walker motivations? Annotated map/sketches and marked up maps – itinerary of route</td>
</tr>
</tbody>
</table>

Data was recorded using standard visual survey methods (looking, noting, image collection/development, walk notes/journaling). Each record focused on developing landscape types, each type relating to a core landform and characterised by topographical and morphological features. Material typing begins with the collecting and classifying of a variety of spatial and environmental information (pre-walk mapping using existing maps, accounts and records). A set of types may be found along one path in a sketch series which alternately represents and evokes a series of responses generated by the walk.

Each walk seeks to record a set continual series of material data: types which when combined in a sequence detail a longer length of path (a walk line). Once a walk record or linear sequence is developed,
it can be reviewed in a second stage of review. Table 2 summarises the key features that might be identified during field work (active walking) and briefly outlines how these may be reflected upon.

**Table 2. Key features to identify when developing typologies.**

<table>
<thead>
<tr>
<th>Material Typologies – Key Field Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Survey (Primary prompts for feature identification/record)</strong></td>
</tr>
<tr>
<td>Record features using mapping, journaling, sketching</td>
</tr>
<tr>
<td>Material Palettes (visual description /material spectrum)</td>
</tr>
<tr>
<td>Material properties (quality/ character/ type/size of materials)</td>
</tr>
<tr>
<td>Spatial qualities (spatial form/dimensions of key forms)</td>
</tr>
<tr>
<td>Landmarks [Natural and Cultural]</td>
</tr>
<tr>
<td>Vegetation/Colour/Substances</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>First Analysis (Review walk notes/outcomes)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Compare, contrast, collate</td>
</tr>
<tr>
<td>Compare and contrast observations</td>
</tr>
<tr>
<td>Sketch and explore interpretations/ideas</td>
</tr>
<tr>
<td>Overlay types/materials/forms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Summarise Findings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe, review, rescore</td>
</tr>
<tr>
<td>Write up summary notes</td>
</tr>
<tr>
<td>Key elements/features</td>
</tr>
<tr>
<td>Spatial layout/forms</td>
</tr>
<tr>
<td>Processes/Flows</td>
</tr>
</tbody>
</table>

The sequence of walks builds on observational methods from a purely physical set of observations through to the development of a more haptic approach to observing, and the exploration of movement and travel time. Other experiential qualities can also be mapped (responses to temperature change, walker comfort, points of interest, reasons for delay and distraction).

Walk studies were primarily formulated and undertaken as solo exercises. However, at times, group walks were used to stimulate discussion and to critique thinking.

Group walks were either participant led (where each walker chooses a route/path based on their own perceptions or capabilities) or walks were guided (walkers were given prompts to move using cue cards, maps, action triggers or verbal prompts). A supplementary form of observation was also recorded while collecting data, namely that of walker watching (observing other walkers encountered on a path from a passive or distal point).

5 **DISCOVERING WALKING: RESEARCH FINDINGS**

Walking exercises produced a vast array of records and experiences. In the beginning, each walk produced a unique type. Each type was represented in a diagrammatic vignette with a set of specific schematic and descriptive notation outlining materials and temporal properties. Each vignette represents a measure of a path, with a longer section of track being represented by multiple sketched sections or a walk line. When formulating each type elements are marked selectively. Figure 2 (over page) contains a sample of the initial type record, as generated in the field. Each line is considered and deliberate, a record of response between walker and environment.
Figure 2. A example of field typing notation, taken from authors walk journal. Notes include quick descriptive terms, diagrammatic sketches showing key features/processes identified on site with rudimentary sketches of landscape form and surfaces. Image by author (Jess Rae).

Type generation was limited to solo walks. Solo walks were considered most consistent and easily observed mode of walking. In solo walking the actions and motives of the walker were able to be recorded in exacting detail and directly correlated against recorded descriptions. Group walks however proved inherently useful, providing a counterview and contrast with the more introspective solo walks and future research may focus on further type generation based on comparative group studies. In an analysis of solo walks, the individual walkers motivations and decisions could be studied (observation of walker state) and clear drivers able to be identified. When reviewing group walks (either walks undertaken as a joint collective or a series of individual experiences) a diverse array of reasoning and drivers was observed which often highlighted or contrasted individual outcomes. While this can be expected when considering the differences that exist between individual and collective, it allowed the act of walking and observing to be directly questioned and outcomes to be expounded. Even when given the same prompts, cues, and geographic space individuals responded differently, based on their own personal perceptions and agendas.

As a whole, across the broad body of data generated a set of clear perspectives were revealed. Each of these perspectives centres on a practical use or modal role that walking plays within landscape knowing and exploring. The outcomes show an almost endless array for walking’s capacity to stimulate research possibilities in landscape architecture however nine key modes are discussed here. These are outlined below.

5.1 Walking is Investigative

Walking is integral to the investigative process. Moving through site, exploring what is known and becomes known, the act of walking is integral to the investigative process. Site survey, description of material properties and process, morphology and landform change are familiar territory. The objective observation and recording of what is found, analysed and interpreted as product and process of research is ingrained in scientific thinking. Objective methods challenge the observer to confirm and test rather than assume a matter as correct. To many this seems a direct contrast to the purposes and products of design but this is not so: design directly questions the relationships between things and allows for exploration and experimentation with rigour equal to that of objective, scientific study. It is liberating and critical, propositional and suggestive. Walking confirms inquiry or redirects attentions and allows new discovery. Moving through space allows a direct physical connection and what may have been overlooked or misread on a map is made real.
5.2 Walking is Inquisitive

Walking is a natural vessel for exploration, an active pursuit that requires the walker to go further, to not stand still. It is instinctive and personal, bringing us to new places and experiences, enabling encounters with diverse materials. Landscape moved in is landscape lived in. In walking along a path the walker comes into contact with materials outside themselves. Walking produces an active narration of space as the walker encounters a progression of material things. Actions and elements intersect and allow a unique reading of place. The walker comes to know a particular story built through their active reading and experiential learning (Ingold 2007). These tangible and relational aspects are recorded in walk notes and diagrams, walk lines which also act as design tools and prompts for further exploration.

5.3 Walking is Measuring

Each step is measureable, describable. Solnit (2000) describes walking as a form of measurement and the body as a tool for measuring space and time. As the walker moves through a space they discern distances, slopes, textures and materials. Jacks (2004:6) describes this type of measuring as “ordinary walking to determine the dimensions of land and the relative locations of objects”. Through establishing visual connections the walker “intuitively understands the relationship between physical things in the landscape” (Jacks 2004:6).

Walking produces both quantitative and qualitative data. The walker is able to measure more than physical materials. Movement reveals more: seeing from a distance; coming closer, encountering and confirming; passing by and contrasting. Motion reveals the rhythms of material form observed through space. The act of moving and touching envelopes the walker with sounds, with atmospheric shifts in light and air and temperature; captures changes in wind, in material, in temperature, in light. These elements affect the walker and guide movement through space, directing the route taken.

5.4 Walking is Participatory

Walking is often viewed as solitary, however it can also be social and collaborative. Many of the walks explored were undertaken as solo ventures, others as part of studio exercises and shared site visits. Even a solo walk involves walker participation however this is enhanced when walking with others. As a social process, walks are subject to suggestion, driven by desire (whether social cue or participant need). One walkers’ choice forces another to react and respond. Walk lines collide and overlap as participants make their way. When we walk with others (both past and present) we are pushed, prodded and cast along new pathways of moving, learning and knowing. In walking with others, notes and experiences are shared and compared, instinctive ways of observing and recording are challenged and new patterns emerge.

5.5 Walking is Active

The motion and method of walking follows a process-rich path allowing rigorous, grounded interrogation of landscape. Walk lines can be turned into scores which in turn give instruction and inspiration as to how to move and interact with the surrounding environment. Lines can be played with mechanically or mathematically through sequencing operations. This altering of path lines and typologies gives insight as to how material knowledge and studio exploration might further provoke more vigorous ideas of path making and taking. Studio process can explore path making in many ways through the research tools of design operations and tangible constructing.

In-lab design operations explore the relational potential of the various track typologies. Diagrams are used to construct typological prepositions. By adding or subtracting typologies new interfaces and associations are formed, revealing potential path structures and surfaces. Figure 3 (following page) provides an example of a completed typology and how it might be used in further study. A series of typologies is altered to form a new tracks and walk experiences. A new materiality and temporality of paths results. A range of potential connections and relationships from simple joins through to complex intersections result in potential walk scores.
5.6 Walking is Experimental

Physical experiments can be developed that manipulate visual imagery and create new path options. An example of this is paper folding, where tangible actions alter cartography in order to path make. Through the practical exercise of bending, cutting, stitching and folding the abstract is transformed into a visual possibility. Compressions and extensions of form became apparent as desire lines are made evident. As the paper is folded and the model shaped, a new line begins to take shape and a potential track form results. The combinations propose paths that are figuratively stretched or contracted. Materials are brought together like an orchestrated score to form a new potential walkscape: scores and new types which may be trialled and tested through walking (Figure 4).
Figure 4. Paper stitching and folding studies create tangible tools for exploring. Image by the authors (Jess Rae).

5.7 Walking is Testing
Walking or re-walking newly scored routes tests paths and design proposals. Creating ordered typologies allows the observer to test and check observations. Paths and landscape experiences are translated through imagery, written as scores and walked out in ordered sequences (as guided walks or directed pathways). Scores can be used for guided walks. This sharing of stories and routes not only enables other walkers to follow a path but also to provide feedback if the experience. In this manner a solo walk can become participatory and social.

A walk line can intersect with a site, to “accumulate as layers of history, organize sequences” and change a reader’s understanding of a particular place (Potteiger & Purinton 1998:5). Figure 5 (over page) shows how an ordered walk can be sourced from a simple set of typologies (score forming). The score generates an itinerary which guides the walker through space along a particular trajectory. This can be developed into a series of notes and then used as guide notes or prompts to encourage and stimulate other walkers to adopt routes and experiences.

Figure 5. An abstracted image turned into itinerary. Image by the authors (Jess Rae).

5.8 Walking is Diagnostic
The walk tells us about the state of the path and the walker. Walk lines and scores were seen to be diagnostic, performative and instructive, a “hieroglyphic the dancer can perform directly” (Burrows 2010:32). Scores can be used to make sense of the complex, capturing and translating, providing visual clues or a way of expanding performance through enhancing imagination (e.g. a dancer’s written choreography). They can be informative and provoking.

A path can be authored and given a direct narrative. The path may be encountered through a set sequence, like the revealing of a tale, and reveal new discoveries in stages: the arrangement of materials, their layout and form, can be used to structure narrative, to tell a particular story of site.

Score writing and directed walking allows us to follow another’s footsteps. We are able to quote those who have gone before, literally retracing footstep or routes. Whether taken alone (with a set of cues and prompts) or with a guide, the path is opened up to new interpretation and the walker-reader extends beyond themselves. Novice walkers can learn from others’ experiences. Particular landscape histories may be shared in the telling and reading, others are able to gain awareness and understanding of the author-walkers’ meaning and a mutual sharing of knowledge exists.
5.9 Walking is Constructing

Movement and materials are intimately connected. In participating in the path and responding to environmental cues, the walker begins to construct and build the path (Careri 2002). The walk becomes performative and theatrical (ibid). The choreographer undertaking a performance which can teach us about the performer and inform with ideas of perception, memory and stimulation (Crang & Travlou 2001). A walker immersed in walking becomes one with the rhythm and the walker becomes observer and performer. In performance the walk becomes free and uninhibited, the walker writes their own path. The story of which can be recorded as a walk line or a script of walker-driven choreography and given to others. Certain elements gain meaning and interpretive forms become assigned and positioned. The walker engages with temporal qualities, a relative measuring of materials as a product of time and temporal change. Walking confirms surfaces, we use our own visual cues, we walk along a known or ideal path, a projected line, observing and recording. With time and use, new layers are made and new dialogue added to the existing story.

6 CONCLUSION: A PATHWAY OF KNOWING

Ingold identifies that the world is felt through our feet, and “in contact with the ground ... that we are most fundamentally and continually ‘in touch’ with our surroundings” (Ingold 2004:330). Walking, its performance, its rhythmic sounding as a score, has potential to provide cues and stimulus for further exploration of walking and material use.

Every time a walk is undertaken a unique outcomes results. Walking is inherently personal and subjective. The walker responds to the landscape walked in. Conditions and circumstances cannot be replicated as walking is an intuitive and responsive action. The same walker, walking the same path is able to experience new things (moods, events, distractions). Walk records capture differences in response and reveal a shifting dynamic, changing observations seen in the walker-actor (observing an observer). The walk line gives a reading of conditions, like an ECG reveals the inner workings of a cardiac patient, a reading of the walker is obtained. Slight adjustments to environment can create vastly difference experiences and reactions. Reflecting on these differences, rich understanding can be extracted. It is in this turbulence that the most value is ultimately found. Just as Dee and Fine (2005) seek to disrupt and challenge what is viewed, by altering the journey (through changing path conditions and typologies) unexpected and surprising discoveries can be made by following and directing walker responses.

Observing other walkers opens up new ways of looking at paths. To follow another’s footsteps, reminiscent of Jacks’ idea of quotation (Jacks, 2004), allows new perspectives to be gathered. Walker watching allows for the observation of motion in action to be gained from a distal and uninvolved perspective. The walkers’ choices and decisions can only be speculated upon, allowing for a greater imagining to take place. The walker becomes the vessel for opening imagination.

Walking is a catalyst and source of design that design operations can accelerate and clarify. Building affordance for human interaction and contact with the ground informs us of the path’s qualities, and in the process enabling a deeper knowing of landscape and what landscape can become.

7 REFERENCES


DISTANCE AND VEGETATION FACTORS AFFECT LITTLE EGRETS (ARDEA GARZETTA) HABITAT SELECTION IN NATURAL AND CONSTRUCTED WETLANDS

LU, LIN
College of Landscape Architecture, Sichuan Agriculture University, Chengdu 611130, P. R. China
001lulin2003@163.com

XIONG, HAO
College of Landscape Architecture, Sichuan Agriculture University, Chengdu 611130, P. R. China
393008122@qq.com

HU, YAZHU
College of Landscape Architecture, Sichuan Agriculture University, Chengdu 611130, P. R. China
634330605@qq.com

ZHANG, HAIQING
College of Landscape Architecture, Sichuan Agriculture University, Chengdu 611130, P. R. China
471318019@163.com

1 ABSTRACT
In order to unveil main factors which affect habitat selection of little egrets for their perching and foraging, the survey was conducted in three wetland parks, Gouxihe National Wetland Park, Huanhuaxi egret wetland park, and Bailuxi wetland park, in Sichuan province, China. The results showed that:
The guarding and flushing distances of little egrets were longer in natural wetlands than those in constructed or man-made wetlands.
Significant differences (P<0.05) exist between experimental samples and control samples in distance from disturbed area, vegetation density, vegetation coverage, slope, distance from water surface, and distance factor and vegetation factor were two principal components.
Little egrets intended to inhabit in areas with gentle slope, dense vegetation, wide forest belt, short distance from water surface, long distance from disturbed area, and forest near a fork estuary.
There were significantly differences (P<0.05) between natural wetlands and constructed wetlands or man-made wetlands in three habitat factors. Which include distance from disturbed area, ground coverage and vegetation coverage. The distance from disturbed area was the most limiting factor in constructed wetlands.
Little egrets preferred to selected farmlands, fishponds, rivers and shallows as their foraging sites, and likely lived in shoals of artificial rivers and lakes in constructed wetlands.
In conclusion, great differences existed in egret habitat selection between natural wetland and constructed wetland, and there was a significant correlation between habitat factors in foraging and habitat selection, among which distance and vegetation factors contributed more to this selection.

1.1 Keywords
Natural wetlands, Constructed wetlands, Habitat selection, Egret
2 INTRODUCTION

Due to a lack of research on the ecological habits and habitat selection preferences of wetland aquatic birds, the construction of artificial wetlands in cities does not have technical standards or methods that can be used to study and practice habitat creation (Adam, 1908). Habitats used for wetland animals are an indispensable part of wetlands and are an important factor of the ornamental value of wetlands (Brown 1988; Bergin 1992; Mosnier et al., 2003; Buenestad et al., 2008; Gillies et al., 2010; Chao et al., 2011; Chen, 2011). In artificial wetlands in urban areas, the design and construction of animal landscapes and habitat can not only increase the regional biodiversity, improve the ecological function of the wetland, and make it more similar to natural wetlands but also can also make the landscape more dynamic and abundant (Chen, 1998). The destruction and disappearance of large areas of natural wetlands and waterfowls have led to a decrease in biodiversity, and there is an urgent need to protect the habitats and living environments of animals. Therefore, research in this area is also needed to provide the basis for the ecological restoration of wetlands (Emlen 1985; Morris 1987; Apps et al., 2001; Erwin et al., 2004; Farina 2006; Abiliz 2009; Dong et al., 2010; Fraser et al., 2010; Dong et al., 2013). In this paper, research on egret habitat selection was conducted in three wetland parks in Sichuan Province, China. The preference in the selection of habitat factors was quantified at multiple scales. Ecological habits and habitat selection between natural wetlands and artificial wetlands were compared. The habitat selection mechanisms of egrets were analyzed to provide data to support and reference for egret immigration, egret habitat and drainage construction, and for the ecological restoration of natural wetlands.

3 METHODS

3.1 Research sites

Three wetlands in Sichuan Province were selected as the research targets, namely, Gouxih National Wetland Park, Huanhuaxi Egret Wetland Park, and Bailuxi Wetland Park. Of which, the Gouxih National Wetland Park is located in Langzhong County and is a natural wetland with a total length of 95 km (79 km long in Langzhong County). This research was conducted over approximately 60 km from Qianfu to Miaogao, including many types of wetlands, such as wetlands, river shoals, lake wetlands, aquatic ponds, and irrigation reservoirs. Huanhuaxi Egret Wetland Park is located in Chengdu City and covers an area of 32.32 hm2, including the areas of Wanshushan (mainly tall trees), Changlanghu and Egret Island. The latter two areas are mainly composed of artificial lakes and artificial wetlands in shallow waters. Bailuxi Wetland Park is located in Chengdu and covers an area of 5000 acres that is composed of the three large lakes and six small lakes, which are connected by original and artificial rivers of various widths.

3.2 Investigation method

A sampling method was used to investigate the habitat and feeding grounds of egrets. In the habitat and foraging sites of egrets, a 10 * 10 m plot was used as the sample plot, and the same number of plots were randomly selected and used for the control within 300 m of the sample plot. At the habitat selection sites, six habitat factors, namely, slope, vegetation density, vegetation cover, litter cover, distance from artificial interference, and shortest distance to open water, were measured in the sample and control plots. While at the foraging habitat selection sites, cover degree, distance from artificial interference, distance to river, distance to nest, vegetation cover and water depth (Fuller et al., 2005; Huang et al., 2007; Gao et al., 2009; Jinet et al., 2011; Huang et al., 2013; Hu et al., 2014) were investigated in the sample and control plots.

3.3 Data processing

All data were processed using the software SPSS 17.0, and a Kolmogorov-Smirnov test was applied to evaluate the normal distribution of the data. Then, the significance of the differences between the habitat factors was evaluated by a T test. A difference was considered significant when the P value was greater than 0.05, while the difference was not significant when the P value was less than 0.05. When the P value was less than 0.01, it was considered to be an extremely significant difference (Lima et al., 1990; Li et al., 1991; Li et al., 1999; Jin et al., 2008).

The principal component analysis method was used to analyze the factors affecting the egret nesting choices, determine the habitat factors that have greater values, and then compare the differences in the habitat selection of egret (Ma et al., 2001; Lu et al., 2003; Li, 2010; Mrriam, 2010; Migu et al., 2013).
The indexes \( W_i \) and \( E_i \) from Vanderploeg and Scavia were used to evaluate the foraging habitat preferences (Rosenzweig et al., 1986; Martin, 1998; Ramsay et al., 1999; Heezik et al., 2002; Shu et al., 2009; Wu et al., 2013). The formula is:

\[
W_i = \frac{r_i}{p_i} \sum \frac{r_i}{p_i} \\
E_i = \left( \frac{W_i - 1/n}{W_i + 1/n} \right)
\]

(Note, \( i \) is the rank of a feature; \( n \) is the number of the rank (\( i = 1, 2, 3 \ldots n \)); \( p_i \) is the number of samples in the environment with \( i \) features accounting for all plots; and the \( E_i \) value is from -1 to 1. \( E > 0 \) represents love, \( E = 1 \) represents particularly fond of, \( E < 0 \) represents not loved, \( E = -1 \) represents not selected. \( E = 0 \) represents a random selection, and \( E \) close to 0 represents an almost random selection.)

### 4 RESULTS

#### 4.1 The comparison of average warning distance and average flush distance of egrets

The average warning distances and average flush distances of egrets from the three investigated parks were quite different (Table 1). The two egret indexes from Gouxihe National Wetland Park were higher than those from the other two wetland parks, while Bailuxi Wetland Park had the smallest indexes of all three wetland parks.

<table>
<thead>
<tr>
<th>Indexes</th>
<th>GXH Wetland (m)</th>
<th>HHX Wetland (m)</th>
<th>BLX Wetland (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWD</td>
<td>107.5</td>
<td>49.6</td>
<td>59.9</td>
</tr>
<tr>
<td>AFD</td>
<td>56.1</td>
<td>33.5</td>
<td>42.7</td>
</tr>
</tbody>
</table>

(AWD, average warning distance; AFD, average flush distance; GXH, Guixihe; HHX, Huanhuaxi; BLX, Bailuxi.)

#### 4.2 The investigation of egret habitat in Gouxihe National Wetland Park

Three egret habitats were found in this park, namely, the Shitan outfall junction, Banzhulin outfall junction, and Baitangyawan outfall junction. The egret habitats were Cypress-Liquidambar forest and bamboo forest with straight-line distances of 9.9 km and 3.9 km, respectively.

##### 4.2.1 Habitat in the Cypress-Liquidambar forest

The Shitan outfall junction is located upstream of the Gouxihe River and has a width of approximately 60 m; the common species are cypress and Liquidambar. In the habitat, 10 sample plots were used, and three groups of control plots located on the left bank of the upper reaches (first group), the left side of the tributaries (second group), and the left and right banks of the downstream portion of the river (third groups) were chosen. Each group consists of 10 plots. The results are shown in Table 2.

<table>
<thead>
<tr>
<th>Indexes</th>
<th>Sample plots</th>
<th>Control plots</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>t value</td>
</tr>
<tr>
<td>The first group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>0.14±0.08</td>
<td>0.32±0.11</td>
<td>-4.038</td>
</tr>
<tr>
<td>DAI</td>
<td>70.30±11.51</td>
<td>74.50±15.96</td>
<td>-0.675</td>
</tr>
<tr>
<td>DCWS</td>
<td>10.00±10.54</td>
<td>9.00±9.66</td>
<td>0.221</td>
</tr>
<tr>
<td>vegetation coverage</td>
<td>0.46±0.04</td>
<td>0.60±0.05</td>
<td>-5.588</td>
</tr>
<tr>
<td>vegetation density</td>
<td>0.26±0.03</td>
<td>0.25±0.03</td>
<td>0.391</td>
</tr>
<tr>
<td>GCC</td>
<td>0.60±0.66</td>
<td>0.90±0.09</td>
<td>-8.216</td>
</tr>
<tr>
<td>The second group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>0.14±0.08</td>
<td>0.10±0.04</td>
<td>1.118</td>
</tr>
<tr>
<td>DAI</td>
<td>70.30±11.51</td>
<td>3.30±3.02</td>
<td>\</td>
</tr>
<tr>
<td>DCWS</td>
<td>10.00±10.54</td>
<td>5.90±2.76</td>
<td>1.190</td>
</tr>
<tr>
<td>vegetation coverage</td>
<td>0.46±0.04</td>
<td>0.60±0.23</td>
<td>-7.684</td>
</tr>
<tr>
<td>vegetation density</td>
<td>0.26±0.03</td>
<td>0.28± 0.01</td>
<td>-1.704</td>
</tr>
<tr>
<td>GCC</td>
<td>0.60±0.66</td>
<td>0.80±0.10</td>
<td>-5.071</td>
</tr>
</tbody>
</table>

| Slope   | 0.14±0.08    | 0.19±0.09     | -1.394  | 0.180  |
| DAI     | 70.30±11.51  | 23.60±20.50   | 2.035   | 0.000  |
There were no significant differences between the sample and the first control group in terms of the distance from artificial interference, the distance from the clear water surface and the vegetation density, while there were significant differences in the slope, vegetation coverage and the coverage of the ground cover. In the third group, there were no significant differences between the slope, the distance from artificial interference and the distance from the water surface, while the vegetation density was significantly different, and the degrees of vegetation coverage and ground cover were extremely significantly different. However, this result showed no practical significance because the tree crown was obviously destroyed by egret nibbling and the ground cover plants were destroyed by egret manure, which led to lower degrees of vegetation coverage and ground cover in the sample plot than in the control.

Based on the analysis of the results of three groups and the control plots, it can be deduced that slope, human disturbance, and vegetation density are highly related to egret habitat selection.

4.2.2 The habitat in bamboo forest

There were two bamboo forest egret habitats in our survey, namely, bamboo forest outfall junction and Baitangyawan outfall junction. Ten sample plots were set up in the south area of the first outfall junction, while 10 control plots were set up randomly on the north shore area. At the same time, 10 sample plots and 10 control plots were set up in the Baitangyawan outfall junction, and the control plots were set up randomly around the sample plots within a range of 200 m. The results are shown in Table 3.

<table>
<thead>
<tr>
<th>indexes</th>
<th>Sample plots</th>
<th>Control plots</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>0.19±0.02</td>
<td>0.21±0.05</td>
<td>-0.756</td>
<td>0.471</td>
</tr>
<tr>
<td>bamboo forest outfall junction</td>
<td>20.60±5.12</td>
<td>92.20±6.18</td>
<td>-19.935</td>
<td>0.000</td>
</tr>
<tr>
<td>DAI</td>
<td>0.00±0.00</td>
<td>4.00±4.18</td>
<td>\</td>
<td>\</td>
</tr>
<tr>
<td>DCWS</td>
<td>0.68±0.05</td>
<td>0.53±0.05</td>
<td>4.376</td>
<td>0.002</td>
</tr>
<tr>
<td>vegetation coverage</td>
<td>3.72±0.28</td>
<td>0.28±0.04</td>
<td>\</td>
<td>\</td>
</tr>
<tr>
<td>vegetation density</td>
<td>0.20±0.07</td>
<td>0.94±0.08</td>
<td>-14.513</td>
<td>0.000</td>
</tr>
<tr>
<td>GCC</td>
<td>0.60±0.66</td>
<td>0.35±0.09</td>
<td>6.708</td>
<td>0.000</td>
</tr>
</tbody>
</table>

(DAI, distance from artificial interference; DCWS, distance from the clear water surface; GCC, ground cover coverage.)

In the outfall junction habitat in the bamboo forest, there were no significant differences between the sample and control plots in terms of slope and distance to open water, while there were extremely significant differences in terms of the distance from artificial interference, vegetation coverage, vegetation density and ground cover. In the Baitangyawan outfall junction habitat, there were no significant differences between the sample and control plots in terms of slope, distance to open water, and ground cover, while there were extremely significant differences in vegetation coverage and vegetation density. When there were no differences in slope or distance to open water, the egrets likely selected habitats near regions with
artificial interference. For vegetation selection, the egrets were inclined to select bamboo forests with greater degrees of vegetation coverage and coverage density rather than cypress-Liquidambar forests. This tendency reduced their reliance on the distance of artificial interference.

4.2.3 Principal component analysis
The three habitats were analyzed by using the principal component analysis method, and the results are shown in Table 4.

Table 4 Factor analysis of egrets habitat selection in Gouxihe wetland.

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial eigenvalue</th>
<th>Quadratic sum extraction and load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total variance %</td>
<td>Up to %</td>
</tr>
<tr>
<td>1</td>
<td>2.994</td>
<td>49.893</td>
</tr>
<tr>
<td>2</td>
<td>1.952</td>
<td>32.529</td>
</tr>
<tr>
<td>3</td>
<td>0.674</td>
<td>11.237</td>
</tr>
<tr>
<td>4</td>
<td>0.261</td>
<td>4.355</td>
</tr>
<tr>
<td>5</td>
<td>0.062</td>
<td>1.038</td>
</tr>
<tr>
<td>6</td>
<td>0.057</td>
<td>0.947</td>
</tr>
</tbody>
</table>

There are two principal components with eigenvalues greater than 1, and their cumulative contribution rate was 82.423%; these components can be considered the main factors that influenced the habitat selection of the egret, and the factor rotation matrix table is shown in Table 5. The first principal component mainly consisted of the distance from artificial interference (0.918), distance from the water surface (0.870) and ground coverage (0.939), and can be considered as the distance factor that affected egret habitat selection. On the other hand, the second principal component mainly consisted of vegetation coverage (0.956) and vegetation density (0.970) and was considered the vegetation factor that affected egret habitat selection (Table 5).

Table 5 Rotated component matrix.

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>-0.656</td>
<td>-0.061</td>
</tr>
<tr>
<td>DAI</td>
<td>0.918</td>
<td>-0.098</td>
</tr>
<tr>
<td>DCWS</td>
<td>0.870</td>
<td>0.267</td>
</tr>
<tr>
<td>vegetation coverage</td>
<td>0.210</td>
<td>0.956</td>
</tr>
<tr>
<td>vegetation density</td>
<td>-0.171</td>
<td>0.970</td>
</tr>
<tr>
<td>GCC</td>
<td>0.939</td>
<td>-0.140</td>
</tr>
</tbody>
</table>

4.3 Comparison of egret habitat selection in constructed wetlands and natural wetlands

4.3.1 Egret habitat selection in constructed wetlands
To study the egret habitat selection in Huanhuaxi Egret Wetland Park, 9 sample plots and 9 control plots were set up randomly, while in Bailuxi Wetland Park, 6 sample plots and 12 control plots were also set up randomly. Then, the significant differences in the habitat factor variables were analyzed, and the results are shown in Table 6.

The results showed that there were no significant differences between the sample and control plots in terms of slope, vegetation coverage, vegetation density, or degree of ground coverage, while there were significant differences in the distance from artificial interference and distance to open water in.
Huanhuaxi Egret Wetland Park. In contrast, there were no significant differences in vegetation coverage and vegetation density, but there were significant differences in the slope, distance from artificial interference, degree of ground coverage, and distance to open water in Bailuxi Wetland Park.

**Table 6. Comparison of the indexes between sample and control plots in wetland egrets habitat.**

<table>
<thead>
<tr>
<th>Indexes</th>
<th>Sample plots</th>
<th>Control plots</th>
<th>t-test</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>0.11±0.11</td>
<td>0.21±0.27</td>
<td>-1.053</td>
<td>0.308</td>
<td></td>
</tr>
<tr>
<td>DAH</td>
<td>50.33±4.94</td>
<td>31.33±6.83</td>
<td>6.753</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>DCWS</td>
<td>12.77±4.81</td>
<td>8.77±8.13</td>
<td>5.269</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Huanhuaxi wetland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vegetation coverage</td>
<td>0.61±0.04</td>
<td>0.65±0.08</td>
<td>-1.187</td>
<td>0.253</td>
<td></td>
</tr>
<tr>
<td>vegetation density</td>
<td>0.28±0.01</td>
<td>0.28±0.02</td>
<td>-0.099</td>
<td>0.922</td>
<td></td>
</tr>
<tr>
<td>GCC</td>
<td>0.68±0.09</td>
<td>0.67±0.13</td>
<td>0.199</td>
<td>0.845</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>0.00±0.00</td>
<td>0.08±0.05</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>DAH</td>
<td>61.33±3.44</td>
<td>38.66±23.78</td>
<td>3.235</td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td>DCWS</td>
<td>0.00±0.00</td>
<td>34.66±15.02</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>Bailuxi wetland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vegetation coverage</td>
<td>0.43±0.01</td>
<td>0.44±0.10</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>vegetation density</td>
<td>0.21±0.01</td>
<td>0.21±0.42</td>
<td>0.365</td>
<td>0.720</td>
<td></td>
</tr>
<tr>
<td>GCC</td>
<td>0.00±0.00</td>
<td>0.50±0.21</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
</tbody>
</table>

(DAI, distance from artificial interference; DCWS, distance from the clear water surface; GCC, ground cover coverage.)

**4.3.2 Comparison of egret habitats in constructed and natural wetlands**

A significant difference test was employed to compare the egret habitats in Huanhuaxi Egret Wetland Park and Bailuxi Wetland Park to those in the Gouxihe outfall conjunction area. In the comparison of the habitats in Huanhuaxi Egret Wetland Park with the natural wetland control, there were significant differences in the distance from artificial interference, degree of vegetation cover and degree of ground cover, while there were no differences in slope, distance to open water surface and vegetation density (Table 7). In contrast, there were no significant differences in the distance from artificial interference and degree of vegetation cover in Bailuxi Wetland Park or the natural wetland control comparison group, while there were extremely significant differences in the slope, distance to open water surface, degree of ground cover and vegetation density.

**Table 7. Comparison of the indexes of egrets habitat between constructed wetland and Shitan outfall junction.**

<table>
<thead>
<tr>
<th>Indexes</th>
<th>Sample plots</th>
<th>Control plots</th>
<th>t-test</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>0.14±0.08</td>
<td>0.11±0.11</td>
<td>0.630</td>
<td>0.537</td>
<td></td>
</tr>
<tr>
<td>DAH</td>
<td>70.30±11.51</td>
<td>50.33±4.94</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>DCWS</td>
<td>10.00±10.54</td>
<td>12.77±4.81</td>
<td>-0.724</td>
<td>0.479</td>
<td></td>
</tr>
<tr>
<td>Huanhuaxi wetland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vegetation coverage</td>
<td>0.46±0.04</td>
<td>0.61±0.04</td>
<td>-6.813</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>vegetation density</td>
<td>0.26±0.03</td>
<td>0.28±0.01</td>
<td>-2.035</td>
<td>0.058</td>
<td></td>
</tr>
<tr>
<td>GCC</td>
<td>0.60±0.06</td>
<td>0.68±0.09</td>
<td>-2.417</td>
<td>0.027</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>0.14±0.08</td>
<td>0.00±0.00</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>DAH</td>
<td>70.30±11.51</td>
<td>61.33±3.44</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>DCWS</td>
<td>10.00±10.54</td>
<td>0.00±0.00</td>
<td>\</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>Bailuxi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results of the two groups showed that there were some similarities between the natural wetlands and the artificial wetlands in terms of habitat selection, and there were some differences, such as the distance from artificial interference, between the two groups.

### 4.4 The investigation of egret foraging habitat selection

#### 4.4.1 Egret foraging habitat selection in Gouxihe National Wetland Park

At the beach 200 m away from the lower part of the Chenjiatan hydropower station, we found an egret foraging location, and four samples were collected from the area with white feathers and feces. Egrets were also observed to be foraging in the riparian area, five times in the paddy field, four times in the fish pond, and four times in the river bank. The nearest egret foraging sample plot was 238 m from the river, and the furthest was 4827 m from the river. Fifteen samples were randomly sampled around the sample plots as control plots. The Vanderploeg and Scavia selection coefficients were analyzed, and the results are shown in Table 8.

#### Table 8. Egrets habitat selection preference in Gouxihe wetland.

<table>
<thead>
<tr>
<th>Habitat factor</th>
<th>i</th>
<th>ri</th>
<th>pi</th>
<th>Ei</th>
<th>Preference degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water depth (cm)</td>
<td>0</td>
<td>0.00</td>
<td>0.21</td>
<td>-1</td>
<td>NS</td>
</tr>
<tr>
<td>0-30</td>
<td>0.88</td>
<td>0.53</td>
<td>0.405</td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>30</td>
<td>0.12</td>
<td>0.25</td>
<td>-0.200</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Distance from artificial</td>
<td>50</td>
<td>0.05</td>
<td>0.28</td>
<td>-0.592</td>
<td>NP</td>
</tr>
<tr>
<td>interference (m)</td>
<td>50-100</td>
<td>0.83</td>
<td>0.54</td>
<td>0.320</td>
<td>P</td>
</tr>
<tr>
<td>100</td>
<td>0.12</td>
<td>0.18</td>
<td>-0.117</td>
<td></td>
<td>NP</td>
</tr>
<tr>
<td>Distance from river (m)</td>
<td>20</td>
<td>0.47</td>
<td>0.40</td>
<td>0.080</td>
<td>AR</td>
</tr>
<tr>
<td>20-200</td>
<td>0.35</td>
<td>0.28</td>
<td>0.120</td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>200</td>
<td>0.17</td>
<td>0.31</td>
<td>-0.260</td>
<td></td>
<td>NP</td>
</tr>
<tr>
<td>Distance from nests (m)</td>
<td>1000</td>
<td>0.47</td>
<td>0.31</td>
<td>0.190</td>
<td>P</td>
</tr>
<tr>
<td>1000-2000</td>
<td>0.23</td>
<td>0.38</td>
<td>-0.240</td>
<td></td>
<td>NP</td>
</tr>
<tr>
<td>2000</td>
<td>0.30</td>
<td>0.31</td>
<td>-0.040</td>
<td></td>
<td>AR</td>
</tr>
<tr>
<td>Cover degree</td>
<td>0.33</td>
<td>0.30</td>
<td>0.35</td>
<td>-0.070</td>
<td>AR</td>
</tr>
<tr>
<td>0.33-0.66</td>
<td>0.23</td>
<td>0.25</td>
<td>-0.010</td>
<td></td>
<td>AR</td>
</tr>
<tr>
<td>0.66</td>
<td>0.47</td>
<td>0.40</td>
<td>0.080</td>
<td></td>
<td>AR</td>
</tr>
<tr>
<td>Vegetation coverage</td>
<td>0.33</td>
<td>0.71</td>
<td>0.56</td>
<td>0.175</td>
<td>P</td>
</tr>
<tr>
<td>0.33-0.66</td>
<td>0.12</td>
<td>0.16</td>
<td>-0.081</td>
<td></td>
<td>AR</td>
</tr>
<tr>
<td>0.66</td>
<td>0.17</td>
<td>0.28</td>
<td>-0.178</td>
<td></td>
<td>NP</td>
</tr>
</tbody>
</table>

i, ri, pi and Ei, as described in data processing section; P, favourite; NP, unfavourite; R, randomly select; AR, almost randomly select; NS, no select.

#### 4.4.2 Egret foraging habitat selection in Huanhuaxi Egret and Bailuxi Wetland Parks

Egrets were found foraging 14 times in Huanhuaxi Egret Park, including 8 times in the artificial river and 6 times in the shoal area, and they were found foraging 12 times in Bailuxi Wetland Park, including 3 times on the bank of the artificial river and 9 times in the shoal area of the artificial lake. The mean value of all the plots was analyzed, and the results are shown in Table 9.
5 DISCUSSION

Multiple scales of wetland waterfowl factors influence the selection of egret habitat. This study focuses on the habitat factors at the microhabitat scale and discusses the influence of habitat factors on the habitat selection of egrets.

5.1 Large-scale habitat

There are five outfall junctions located in the middle and downstream portions of the Gouxi River, and three of these junctions were found to be close to egret habitats. However, there is no literature that reports the influence of river outfall junctions on the selection of egret habitat in river wetlands. Our results may explain the relations between river outfall junctions and egret habitat selection.

To take the Shitan outfall junction as an example, the egrets that were foraging outside and homing back moved in the directions of the three rivers; therefore, the river can be seen as a traffic guidance signal. Choosing river outfall junctions can help homing egrets gather along the riverside.

It has been reported that waterfowls prefer to select their living habitats in regions with large open water areas (Yang et al., 2000; Zhang et al., 2003; Zhang et al., 2005; Yan, 2006; Yan et al., 2007; Wu, 2012; Yan et al., 2014). Usually, the open water surface areas are larger in outfall junctions than in junctions without outfalls. Therefore, egrets are more inclined to select habitats in the river wetlands at the junctions of river mainstreams and tributaries. It can also be deduced that outfall junctions provide guidance and signals for egret foraging and homing flights, and a larger proportion of open water surfaces attract egret nesting.

5.2 Microhabitat

The analysis of the data from all sample plots showed that there was a strong correlation between the slope and the habitat selection of egrets. However, there is no evidence that there is a causal relationship between the slope and the habitat selection of egrets.

By comparing the differences between bamboo forests and cypress-liquidambar forests, it was found that the bamboo forest canopy was smoother than the cypress-liquidambar forest canopy, which had a relative slope less than 0.1. Furthermore, egrets prefer to select bamboo forests as its habitat. Therefore, it could be that the slope determines the smoothness of the tree canopy within the area. On the other hand, the vegetation coverage in the bamboo forest was relatively higher, and its canopy foliage was extremely rich, which leads to a preference for egrets to nest. Therefore, the smoothness and richness of the canopy foliage will possibly affect egret habitat selection, and the effect of slope on the egret habitat selection is achieved by these two elements.

The vegetation in some sample plots was also found to be destroyed by egrets in our research. In these plots, there were no differences between the sample plots and the control plots in terms of vegetation type, vegetation density, vegetation height and vegetation age. However, the degrees of ground cover and vegetation coverage were lower in these sample plots than in the control plots. The reason may result from the nibbling of egrets on vegetation canopy, the changes of soil properties and the damage to the ground cover and shrubs by egret feces (Zhu et al., 1988; Zhou et al., 1998; Zhu et al., 1998; Zhu et al., 2000; Zhu et al., 2001; Zhou et al., 2010; Zhou, 2011).

5.3 Construction of egret habitat

For city wetland parks in Sichuan Province, coniferous and broad-leaved mixed forest composed of evergreen trees or bamboo forests, which are suitable for the nesting and resting of egrets, should be planted in disturbed areas and areas less than 20 m from open water. The vegetation density in these areas should be greater than 0.3 plants/m2, and the vegetation density in bamboo forests should be greater than 30 trees/m2, while the belt width should be greater than 30 m and the belt length should be longer than 100 m. If there is no need for other egrets to utilize shrubs as their habitats, the shrub and ground cover should be as sparse as possible to reduce the destruction of vegetation by egrets. Waters with depths greater than 0.3 m should be increased in the park, and the distances of these waters from artificial interference should be greater than 60 m. At the same time, the design of the waterfront should be emphasized, and the number of inlets with better shelter should be increased.
6 CONCLUSION
In natural wetlands, the activity of egrets is frequent, their behavior is active, foraging and resting are regular, the daily flight distance is far, the flight time is long, the foraging area radius is wide, and the foraging areas are mostly farmlands, fish ponds, rivers and shoals. The distance factors (including the distance from artificial interference, distance to open water and ground cover degree) and the vegetation factors (vegetation density and vegetation coverage) are two key factors for egret habitat selection in natural wetlands.

In the constructed wetlands, there are only two kinds of egret habitat, namely, the shoals of artificial rivers and artificial lakes. In artificial wetlands, due to long-term human interference, egrets have gradually formed a tolerance to human interference, and the alert and flush distances have increased.

7 REFERENCES
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DESIGNLAB IN ACTION: REGIONAL SCALE LANDSCAPE DESIGN

ABBOTT, MICK
Lincoln University School of Landscape Architecture, New Zealand, mick.abbott@lincoln.ac.nz

BLACKBURNE, KATE
Lincoln University School of Landscape Architecture, New Zealand, kate.blackburne@lincoln.ac.nz

LEE, WOODY
Lincoln University School of Landscape Architecture, New Zealand, woody.lee@lincoln.ac.nz

LI, XUEJING
Lincoln University School of Landscape Architecture, New Zealand, xuejing.li@lincoln.ac.nz

BOYLE, CAMERON
Lincoln University School of Landscape Architecture, New Zealand, cameron.boyle@lincoln.ac.nz

1 ABSTRACT
In this paper we present two DesignLab projects that provide insight into the practice of design directed research. Te Whenua Hou reimagines a 7600 ha dairy conversion project as a gateway for brand values and also a biodiversity corridor across monocultural agricultural landscapes. The Mackenzie Drylands Conservation Park investigates ways biodiversity values can be fostered through diverse land tenure relationships within a distributed park system. The two projects generate possibilities that challenge default expectations of these landscape types. Their function is to identify novel possibilities that might unsettle aesthetic clichés and normative landscape architecture practice, and instead acting as experiments into innovative expressions of bio-diversity, culture, and sense of place.

1.1 Keywords
Design-directed research, regional scale design, agriculture, conservation
2 INTRODUCTION

In this article two regional scale projects are considered. The first focuses on a currently being implemented farm design that uses a distributed native forest design as the means to open up a regional scale native bird corridor across the highly modified and intensively farmed Canterbury Plains. The second project presents speculative options for a distributed conservation park whose form is generated through the layering of a range of land tenure types, agriculture practices, biodiversity protections and tourism and recreation activities as a means of considering how a multifunctional landscape approach might also protect protected area values.

3 PROJECT ONE: TE WHENUA HOU

Dairy production, alongside a much larger sheep farming industry, has underpinned the New Zealand economy since the early days of European colonisation in the mid-19th century. Dairy farms traditionally had an aesthetic of tidy green pastures surrounded by hedges, but the recent expansion of dairy across more and more land has required mechanised irrigation, resulting in the removal of hedges and other vegetation (Peden, 2008). The Canterbury Plains is one region in which the shift from grain and sheep farming to dairy is significant (Peden, 2008). The 750,000 ha Plains are composed of introduced crops, exotic production forests, and grazing land, with only about 0.06% of cover being indigenous vegetation. This produces a distinctive landscape visually, and one which lacks bio-diversity ecologically, providing few resources for native fauna, and representing only one cultural history (figure 1).

Figure 1: Aerial view of the northern Canterbury Plains. Photo: Andrew Cooper. Reproduced by permission of Andrew Cooper.

Te Whenua Hou is a 7,600 ha dairy conversion being undertaken on the Canterbury Plains by Ngai Tahu property, on behalf of the South Island’s largest Maori tribe. Through the use of irrigation it involves the transformation of former forestry lands and dryland pastures into dairy production. In total, 20 standalone
farms are being created in this billion-dollar investment. DesignLab was engaged to consider the opportunities landscape architecture could develop through creating a sense of a gateway and entrance to the project. While the project partner’s expectation was that this would focus on entrances to each of the farms, and also to the farm as a whole, our investigations identified deeper opportunities to express this quality of a gateway.

The water for irrigation across the property comes from the nearby Waimakariri River. At its headwaters it is fed by glaciers and snowmelt before emerging from a gorge to weave its way braiding across the Canterbury Plains and down to the ocean. This river is significant to Ngai Tahu. In our studies we identified that there was both value and opportunities to express the life this water brings to native forest plantings across the project.

The Canterbury Plains are heavily modified ecologically. Given this level of modification, very few pockets of pre-settlement shrub lands and forests remain. Nor can these lands be simply returned to their former constitution. Given the current context, if native plants were to be returned today, it would be difficult to do so in such a way that would match their existence within a past ecology. In accepting this, we sought to identify ways native planting could be established and foster biodiversity, while also strengthening the production values of this development. To achieve this a palette of native plants was identified and differentiated according to the functions they could perform within the farm. Together they could deliver benefits at a regional scale. This project is currently being implemented and involves the planting of 750,000 native plants. Their configuration is highly structured, but using a fractal-based organisation allows for a diversity of plant relationships to arise and flourish.

The vision takes advantage of irrigation to support endemic forestry, adding to biodiversity through the increase of invertebrate and avian fauna these native trees will host as well as supporting native birds moving across the Plains. The fusion of dairying and forestry is innovative, inverting negative perceptions of dairying. The pivot irrigator patterns form the basis for planting, allowing the full development to include 5% of its land area for native planting; a significant contribution, even on productive land, to the goal of 17% protected land by 2020 under the Aichi protocol. The planting framework weaves through the site, transforming it from a limited agricultural palette to a vibrant and diverse cultural presence. The planting becomes a provenance story of ‘eating pure,’ countering the negative view of industrial agriculture. It is a dynamic and flexible approach which allows for change, for a decline in dairying might lead to areas transforming into residential development.

One of the key drivers for the planting design was the use of fractals, which are self-similar patterns that replicate across scales. This mechanism drove the form and content of the planting at the farm scale, extending right down to a fractal ordering of the more than 750,000 plants, covering 350 ha of the 7600 ha development. At the plant scale, species are arranged in a rhythmical sequence, with this patterning expressing the ethos of order and organisation that structures the entire farm operation. Twin colonnades of totara dominate the primary shelterbelt network, supported by other indigenous species (figure 2).

![Figure 2. Planting concept and expression that shows the ordered planting structures that combine to generate habitat for native birds and invertebrates. Image by the authors.](image-url)
At the scale of the pivot irrigators, patterning responds to the dominant winds and sun direction. The native plantings provide shelter for stock, and a native timber resource for future generations. Canterbury’s braided river patterns are echoed at the development-scale, and will eventually be seen when flying into Christchurch (figure 3).

Figure 3. Fractal planting as seen from the air. Image by the authors.

This aerial view emphasises how the development scale becomes part of the region, giving a sense of arrival, not just for those driving to the farms, but also for those flying into the South Island’s main gateway airport.

It is at the regional scale that this project establishes its greatest potential impact. The Canterbury Plains, with its paucity of native species acts as a barrier to native birds being able to travel across. This has resulted in Banks Peninsula becoming almost an ecological island. Projects such as Te Ara Kakariki have sought to establish connectivity across the plains through the planting of small reserves. Competing uses for land have arguably impeded the level of planting possible, and subsequently, its effectiveness. This project, working at the expansive scale of the landscape, that being 10 kilometers wide and 20 kilometers long creates a potential corridor for native birds to travel from the South Island’s back country over the sparsely vegetated plains to Banks Peninsula (figure 4).
It also establishes a possible model in which irrigation becomes a vector, allowing further conductivity to be established as part of the introduction of irrigation across the plains. Here planting design is a potent dimension of landscape architecture practice. Bound up in the practice of tree planting are an inter-generational temporal perspective and a place-sensitive approach to landscape. These factors of long-term vision and local distinctiveness resonate with the values of Māori, making planting a core component for this dairy development owned by Ngai Tahu, one of Aotearoa New Zealand’s Māori tribes.

4 PROJECT TWO: MACKENZIE DRYLANDS CONSERVATION PARK

The MacKenzie Basin is an extensive drylands ecosystem that has been used for sheep grazing since the time of European settlement 150 years ago (Wilson, 2015). Its distinctive character is shaped by the action of glaciers, which dumped gravels across the region before retreating. Within the landscape are endemic plants and invertebrates whose unique characteristics have been developed through the processes of adaptation to the shallows and humps formed by the bed of the retreating glaciers. Like many similar regions, the development of irrigation technologies has led to a rapid level of landscape change, as centre pivot irrigation is installed throughout the basin (Macfie, 2016). This has led to much debate, with farming, conservation, and tourism interests having competing expectations with regards to the best way to manage this landscape (Macfie, 2016).

The 2012 Mackenzie Agreement brought together these diverse stakeholders to create an effective mechanism under which to negotiate and structure the way these landscapes are to be used and protected. This led to development and protection targets being set alongside management approaches that emphasise offsetting as mitigation for those protecting. This may be an additional constraint for those whose focus is irrigation based development. While the agreement tabulated respective numbers of hectares for each use, it did not consider how these might play out spatially.

Design lab, in a design-directed research project, sought to identify key drivers that would shape the landscape’s spatial form, and then through development of scenarios, how these might play out over time. The research had two distinct phases. In the first, 12 senior landscape architecture students worked with two of the three specific themes identified in the MacKenzie agreement. For two students, conservation
was selected as the dominant theme, with farming production included as a supporting, secondary
consideration, while tourism factors were expressly ignored. Another group of two students kept
conservation as the dominant theme, but with tourism was this time made a supporting theme, and farming
expressly ignored. Table 1 shows how the six student groups were organised so each option was
considered.

Table 1. Matrix of Design Drivers as Explored by Student Teams.

<table>
<thead>
<tr>
<th>Research Matrix</th>
<th>Farming</th>
<th>Conservation</th>
<th>Tourism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students 1 &amp; 2</td>
<td>Dominant</td>
<td>Secondary</td>
<td>Ignored</td>
</tr>
<tr>
<td>Students 3 &amp; 4</td>
<td>Dominant</td>
<td>Ignored</td>
<td>Secondary</td>
</tr>
<tr>
<td>Students 5 &amp; 6</td>
<td>Secondary</td>
<td>Ignored</td>
<td>Dominant</td>
</tr>
<tr>
<td>Students 7 &amp; 8</td>
<td>Ignored</td>
<td>Secondary</td>
<td>Dominant</td>
</tr>
<tr>
<td>Students 9 &amp; 10</td>
<td>Secondary</td>
<td>Dominant</td>
<td>Ignored</td>
</tr>
<tr>
<td>Students 11 &amp; 12</td>
<td>Ignored</td>
<td>Dominant</td>
<td>Secondary</td>
</tr>
</tbody>
</table>

During the research studio each student developed a spatial master plan at the regional scale, and
also more detailed indicative site-based planning and program development. Following this, DesignLab
researchers extracted the project’s common components that were integral to tourism, conservation, and/or
farming production. Figure 5 shows part of this process. This involved a further process of refined design,
as we sought to schematically model these components at both a regional and local scale.

Figure 5 Mackenzie Drylands Concept development. Student work by Ian Tucker Peach.

Through this approach the following seven key drivers were identified that could shape a regional
scale ‘Drylands Park’: protecting and connecting along the rivers and lakes; creating a path across the basin;
developing a distributed park with distributed ownership; restoring selected ecosystems from current
impacts; seeking opportunities for tourism activity; canal water farming; and targeted land irrigation. The
second phase used a speculative approach to consider how these different drivers might play out both
across the region over time. Rather than articulate a demarcation into respective zones, a more layered
approach was taken, in which opportunities to combine tourism with farming, farming with conservation,
conservation with tourism, and also across all three factors was considered across the different land
classifications.

This research found, that at a regional scale, it is possible to tease out a more complex and
multifunctional expression of a conservation park. While default norms might suggest such parks should
be standalone and continuous, this work developed scenarios that allow a more distributed conservation
park to be considered. The park can link a range of protections, some of which maybe publicly accessible,
while others remain in private stewardship, managed according to a more diverse range of conditions. Such
management can be more attuned to the biodiversity outcomes being sought at each site, rather than forcing
a simplistic binary choice of full protection or full development. Instead, a spectrum becomes possible that
expresses conservation as being many shades of green.

5 CONCLUSION

The two projects, one on the Canterbury Plains and the other in the MacKenzie Basin, illustrate how
landscapes of change are settings for landscape architectural innovation. DesignLab’s research is
collaborative, involving students and staff, including a range of colleagues from different disciplines. This research setting provides the context for responding to changes to agriculture and technology in ways which envisage new landscape forms. In this landscape architecture can be a generator of subsequent discussions in which new scenarios add to a simultaneous focus on agriculture, ecology, culture, hydrology and technology. In this design can be considered as an interdisciplinary, innovative and collaborative endeavour. New scenarios add to the richness of possibilities in our everyday landscapes.

Landscape architecture can be multi-scalar, capable of bringing both design and ecological values to projects at the most intimate of scales – for example pocket parks, pocket gardens, and rooftop interventions – and also at the regional and national scale. This research seeks to investigate the creative opportunity opened up by the significant levels of landscape change brought about through increased intensive farming. This work results in opportunities to express changing relationships with the environment, and also to identify potential options for increasing ecological and biodiversity benefits. In this we do not want to ameliorate or mitigate. Rather, we seek to suggest potential ways landscape change can directly increase ecological outcomes.

6 REFERENCES
A LANDSCAPE ARCHITECTURE OF ‘HUTTING’

PICKETT, TENILLE
Lincoln University School of Landscape Architecture, New Zealand, tenille.pickett@lincoln.ac.nz

ABBOTT, MICK
Lincoln University School of Landscape Architecture, New Zealand, mick.abbott@lincoln.ac.nz

BOWRING, JACKY
Lincoln University School of Landscape Architecture, New Zealand, jacky.bowring@lincoln.ac.nz

1 ABSTRACT
This article explores two terms: walking and hutting, two components of an immersive and experiential investigation of intervening along a walking track in one of Aotearoa New Zealand’s Forest Parks. Here, the familiar terms of ‘walk’ and ‘hut’ are disrupted and re-proposed. This research was first undertaken as an on-site experience, then subsequently ‘mapped’ in a design studio setting. Through the relationship of designer, experience, and experiencer, a reciprocating dialogue is constructed. Through this conversation, particular attention is given to the revealing of often invisible aspects of landscape experience. Drawing on the work of Tim Ingold and Rachel McCann, we explore the immersive and experiential qualities of the landscape, and as a consequence the seemingly contained categories of walking and resting, become fluid and enfolded. The noun ‘hut’ becomes in an Ingoldian sense ‘to hut,’ with an expanded field of ‘hutting’ which embraces a breadth of being in the landscape.

1.1 Keywords
Walking, hutting, phenomenology, experience, mapping
2 INTRODUCTION
Encountering nature and wilderness is a firm part of the New Zealand identity. Our relationship with the land is imbued with a host of social and cultural values. Abbott and Reeve position: “Wilderness is an ongoing fascination in this country. The most compelling evidence for how highly we value wilderness in this country lies in the sheer scale of the lands and waters constituting our [protected areas]”. (2011:8). Through this framing the interaction of people and nature invites an interrogation of the ways in which we might interact with it when guided by values and perceptions. Both defining and experiential implications of this relationship with the environment are looked at through the lens of a two day tramp, meandering along the Nina River in Lake Sumner Forest Park, South Island, Aotearoa New Zealand. Here, we examine the experience undertaken, and through applying the tool of experiential mapping, challenge preconceptions associated first with defining terms ‘walk’ and ‘hut’, and second with the ways in which we experience Landscape.

3 DISRUPTING STATIC TERMS: THE ‘WALK’ AND THE ‘HUT’
Two conventional terms - the walk; and the hut - were the central focus of this research. These two concepts comfortably imply known parts of a tramp, (the New Zealand term for a hike). In conventional usage these terms invoke images of walking tracks and humble backcountry huts. This perception is in one sense, accurate, but, as is unpacked in the following discussion, there is also an intricacy to this relationship not readily expressed.

In order to spatially and temporally locate these concepts, it is useful at this stage to perceive the whole tramp experience as two distinctive sections: first, the section undertaken through walking- ‘The walk’; and second, the section undertaken through staying in a hut- ‘The hut’. As will be examined through this article, this binary implies the notion of ‘crossing a threshold’, as if at some point on the tramp you could indicate that you were definitely within ‘the hut’ section and therefore no longer in ‘the walk’ section and vice versa. Whilst these terms are useful when discussing or explaining a tramp or outdoor experience because they illustrate movement through space, a disruption in definition occurs when experienced actively through an on-site journey. This brings to question ideas of encountering versus defining; interacting versus meaning. Moreover, which is more reflective of how we engage with the world? Authors such as Abbott (2011), Ingold (1993), Mcann (2013), Merleau-Ponty (2013) and Murphy (2014), as discussed below, expand on how this idea of engagement challenges the binary and contained concept of walking. As a more readily graspable term than ‘hutting’, walking is unpacked and examined- a precursory transition to the tem hutting.

3.1 The ‘Walk’
As expressed, there is a duality in meaning: ‘the walk’ as a defined construct, ‘the walk’ as a known quantity, and of an expected experience; or, ‘the walk’ as an activity, a mode of encountering, an experience made. Landscape Architect Mick Abbott proposes a useful study of this difference: “In the photograph at Observation Col can be seen a line of footprints that leads from the camera to me…What these footprints manifest is a landscape that is in part being delicately made and remade by the accumulated footprints of successive groups of people” (pg 76). Aside from the direct link of footprints and walking, what he emphasises here is how an act of walking, making footprints, shaping landscape and landscape shaping walking are all part of the same process that is at once unfolding and transformative as activities of movement are accumulated in space. In this short and intimate description of a moment playing out in place, commonly described as ‘The walk’ appears insufficient.

3.2 Dissolving the binary
Anthropologist Tim Ingold (1993) offers a set of useful frameworks which expand the possibilities of this section-to-section relationship of ‘walk’ and ‘hut’. Moreover, perceiving ‘walk’ and ‘hut’ as acted experiences- as in ‘to walk’, or ‘to hut’- invites an emerging set of qualities. To dissect this, we begin with Ingold’s expression of the necessary interpretation of the world as something which is encountered: “…To adopt a perspective of this kind means bringing to bear the knowledge born of immediate experience, by privileging the understandings that people derive from their lived, everyday involvement in the world” (1993:154). Here Ingold writes of an evolving encountering. But he also highlights that this is more readily understood as a binary: “The world of nature…is what lies ‘out there’. All kinds of entities are supposed to exist out there, but not you and I. We live ‘in here’, in the intersubjective space marked out by our mental
representations. Application of this logic forces an insistent dualism, between object and subject, the material and the ideal, operational and cognized" (1993:154). Ingold proposes a rejection of the binary relationship and instead advocates an encompassing of both: "In Landscape, each component enfolds within its essence the totality of its relations with each and every other" (1993:154). Therefore Landscape and experience, according to Ingold, do not exist in an either/or relationship, but in a between relationship. Lastly, Ingold proposes an inevitable activation within landscape through interaction between form and function. “The [themes] of the landscape are not, however, prepared in advance for creatures to [discover]. [Instead, these interactions] are generated and sustained in and through the processual unfolding of a total field of relations that cuts across the emergent interface between [person] and environment” (1993:156).

Architectural Academic Rachel Mcann, in her discussion of philosopher Merleau-Ponty's phenomenological ideas, expresses a complimentary scenario: “the painter sees a portion of the world, brings it inside the body through vision, mixes it with his or her embodied way of understanding the world, and expresses the mixture back into the world in the form of a painting. This act makes the painting a carnal echo, a residuum of the dynamic mixing of the visual world and the painter’s carnal schema”. (pg. 265). The ideas of Mcann and Ingold present to this work the context in which ‘the hut’ and ‘the walk’ takes place - convoluted and imbricated, and much more than static sections of distance or time.

3.3  The ‘hut’
In section 3.1, ‘the walk’ was challenged in terms of its conventional understanding and application. Section 3.2 introduces the notion of a far more nuanced experiencing of the world, thus calling for a more nuanced way of defining or expressing such experiences. As a term more embedded in the specifics of this particular research, the transition from ‘the hut’ to ‘hutting’ is unpacked in the following section. As with the evolving nature revealed through Abbott’s description of footsteps at Observation Col, so too are the evolving subtleties of hut exposed through a describing of a night at Nina Hut.

4  RESEARCH CONTEXT
At the core of this research was a visit undertaken in August 2015, along the Nina Hut Walkway in a South Island protected area. On one level, the visit could be read as an ordinary and uneventful two day walk. Yet, through engaging with place through designing and mapping, new layers of possibility emerged. It was from this very process of mapping, that the notion of to walk and to hut emerged. The visit therefore becomes much more nuanced: an overall experience contributed to as much by the ‘coming together’ or ‘between-ness’ of ‘the site’ and ‘the participant’.

4.1  Method
As expressed, the site visit which has provided the basis for this research, is essentially a very common activity and experience. As a standalone, everyday experience, it does not in itself reveal particularly complex insights. This can be understood as a form of ‘muted engagement’. Landscape Architect Charlotte Murphy writes: “as an experience is repeated it develops an aura of familiarity. We do not have to fully experience [it] as our previous experience tells us that we already know [what to expect]” (2014:33). In order to make this substantial jump to an investigation of hidden relationships and convoluted perceptions, a disrupting process was applied to the site visit content. This process was an interpretive and experiential ‘mapping’ of the site visit (see figure 1). Rather than recording locations, and distances and dimensions of things - as a traditional ‘map’ might-, a focus was instead placed on recording and unpacking far more intangible aspects such as feelings, and qualities of atmospheres, and sensations of memories from the tramp: distance and time were seen as ‘elastic’; locations were seen as perceptively relational, not spatially anchored; and ‘unformed’ and ‘fully-formed’ memories were equally considered. These phenomenological underpinnings were employed and interrogated in the process of mapping.
4.2 Nina Hut and Walk - An animated experience

Returning to the original site visit, and the host of both familiar and nuanced aspects of that experience, the following is an excerpt from the journal written during the visit: “the visit itself took place early August, 2015. Three friends and drove from Christchurch and parked at the Palmer Lodge off State Highway 7. Rain persisted the entire first day and did not ease until evening. This made for a soggy 4 hour tramp to Nina Hut. We set off at 11.30 am, crossed the second swing bridge an hour later where we had a quick lunch standing in the rain. The next three hours took us across several streams which had swelled during the rain. A continual climb over slippery greywacke made this part the most arduous of the two days. We stopped 50 metres or so from the hut (although we didn’t realise this) and checked our Map. One of the group spotted the hut through the trees and we all but ran up the last 50 metres. The hut was empty upon arrival, and we remained the only group for the stay. We set about lighting a fire, hanging up wet clothing and bringing in wet wood to dry. We passed the afternoon playing games, talking, cooking dinner and drinking tea. Having spent 4 hours in cold rain, none of us felt like exploring outside the hut that afternoon or evening, but the hours passed quickly until we turned in at 8.30 pm and slept through till about 7 am. Day two was overcast, but rain free. We set about cleaning the hut, re-setting the fire and restocking the wood supply and exploring around the hut area. The weather forecast had predicted rain for this day so we got on with the walk back after exploring the hut’s surrounding grove of beech trees and moss carpet. Day two was far more engaging, particularly across what had been our last three hours the day before. Most of the landscape we either hadn’t seen or taken in the previous day. Streams flowed a little less boisterously, and our previous day’s crossings were more useable as most water had found its way into Nina River. We moved quickly and animatedly across tree roots and spongy floor, through Beechs, and across bogs. We ate, photographed, raced, talked and all over engaged far more so with our setting day 2.

Through this journal entry a number of emerging realities are presented. These are useful to isolate, as they offer an insight into this transition from a simple tramp, to a re-proposing of terms and understanding of landscape experiences: the presentation of the tramp is of a connected and evolving journey, and not of clear sections or segments of activity, or as a binary relationship; in this entry, we come to know both the ‘walk’ and the ‘hut’ through the activities of people, the atmospheres of the memories and the emotive layer of events that occurred; lastly, at no stage are the descriptive. Returning to the two key terms, walk becomes much more than a distance traversed, and hut much more than a shelter (figure 2).
Hutting is arrival and elation, stocking of firewood, making of a fire, hanging up clothing, playing games, talking about the tramp, making and drinking cups of tea, cooking dinner, washing the dishes, setting up our beds, falling asleep warm and cosy. Here, hutting is much more than a site, rather it is a host of experiences and activities (figure 3).

Exploring the same such transition for the term ‘walking’, walking is: soggy, crossings, standing in the rain, swollen rivers, slippery greywacke, continual climbing, arduous, checking of the map, spotting our accommodation, investigating the resources around the hut, beech trees and a carpet of moss, tree roots and spongy floors, racing, chasing and animating through the landscape (figure 4)
Just as in Abbott’s description of ‘walking’, footprints in the snow are part of an ongoing making of landscape, these intimate acts of ‘hutting’ are part of an ongoing making of a hut. In encounters there are elements both wholly familiar and ‘expected’, whilst other descriptions are very experience specific. As Cultural Landscape Professor Peter Howard (2013:70) highlights, “Landscapes in this rendering are not static backdrops, but instead are imagined as fluid and animating processes in a constant state of becoming.” Here, as with Ingold’s proposition, We do not propose an ‘either/or’, but rather an expanded understanding of concepts which are, both terms and activities. Through a process of interpretive mapping, this content was expanded, challenged and re-proposed (Pickett: 2016).

5 DISCUSSION

5.1 The Processing of Landscape through Experience
The work of Ingold, Mcann and Abbott provide a multi-disciplinary lens highlighting key parameters of our relationship with Landscape. Ingold’s concept of dwelling in the world reveal a central nature of unfolding-ness and affective/affecting dualities. Merleau-Ponty through Mcann expresses an inseparable mixing of simultaneous interpretation and projection when experiencing. Lastly Abbott writes of the active making – rather than passive encountering – of experiencing through Landscape. Together they express the ‘activity’-generated qualities of revealing, projecting, interpreting, making, and changing as we go. All of these qualities speak of a movement through and with the Landscape.

5.2 Expanding Binary Descriptions of Landscape
In reflecting of on-site making, this work highlights the fragility of the idea of binaric relationships in Landscape. Often implicit in people’s descriptions (such as ‘The house’ and ‘The garden’), this investigation disrupts this static relationship, and reveals an intrinsic sense of movement and flow between a central relationship: ‘the walk’ and ‘the hut’. Bound together, each takes it’s identity from the existence and interaction of it’s partner – there is no ‘walk’ (as it is framed in this relationship) if there is no hut:. Like two sides of a coin (Ingold, 1993), their identity is reciprocally and experientially reinforced.

5.3 Experience as a Concept Disruptor
The notion of concept expansion, the ‘grey areas’ of experience and the unfolding qualities of landscape have been examined and re-proposed through this work, but an opportunity to bring this varied discussion together, lies in the validating of ‘experience’ as a concept disruptor. Contained ideas can – as has been shown – be defined, deliberated and applied to settings, but a key message in this work is the un-contained reality of activity-inclusive concepts when acted out through an experience. Moving past the discussions of ‘challenging concepts’, we further position that investigations of landscape experience build possibility in and for site-design responses.

6 CONCLUSION: Hutting as a disrupted term
This discussion of the concepts: walk, hut, time and distance, as examined through the temporal and spatial unfolding of their processual qualities, leads to an expanded presentation of hutting. Writing from a landscape architectural perspective, Michael Lewis offers a succinct and complex expression of this transformation, paralleling the disruption we explored in this research, from hut to hutting. For Lewis, “The [hut] is not merely a thing, a collection of objects, or a problem to be fixed, but a place of process and relationships” (2010:1). As he proposes “to champion the transitional state of interaction between mobile entities” (2010:2) a focus on “the subtle nuance and allusive courtship in which each assumed entity (hut + user) becomes another in a mutual resonance” (2010:1). Moving past the familiarity of ‘a hut’, as was uncovered through mapping, when activated through experiencing, the term hutting more readily expresses this sense of evolving interaction and activity.

For landscape architecture, this offers an insightful model for challenging concepts, revealing the hidden depths of the taken-for-granted elements of the built landscape. Opportunity is presented here in leveraging out of tension between form-dominated definition, and activity-borne behaviours. Examples such as: wayfind-ing, carpark-ing, swimming-pool-ing, neighbourhood-street-ing, residential garden-ing, green/grey infrastructure-ing, all invoke, as with walk, hut and signs, form-based images. But as has been shown through this process, the unpacked reality of walk and hut reveals a processual depth not addressed
in form-favouring definitions. Unsettling the fixed containers of landscape can mobilise the seemingly static categories of things into processual, interactive, dynamic elements. Through immersive and interactive engagement we can become, again, part of the landscape, in landscape, and understanding the creative practice which is to landscape.

7 REFERENCES
SERVICE LEARNING AND COMMUNITY ENGAGEMENT

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COLLABORATION TOOLS TO SUPPORT INFORMED PUBLIC ENGAGEMENT

GIRLING, CYNTHIA L.  
University of British Columbia, cgirling@sala.ubc.ca

BOOTH, KELLOGG S.  
University of British Columbia, ksbooth@cs.ubc.ca

KELLETT, RONALD W.  
University of British Columbia, rkellett@sala.ubc.ca

MAHYAR, NARGES  
University of California at San Diego, nmahyar@ucsd.edu

BURKE, KELLY J.  
University of British Columbia, kelly.burke@ubc.ca

KRAHN, ALIX  
University of British Columbia, alix.krahn@gmail.com

1  ABSTRACT

New public engagement methods are increasingly geared toward discourse, collaboration, and interaction that emphasize: providing understandable yet credible information targeted to the audience; integrating data and visualizations; employing experiential and interactive modes of engagement; and collaborative design. Active engagement through hands-on workshops increases the diversity of viewpoints and groups participating and can improve learning and buy-in for final solutions. Digital planning support tools enable concurrent “live” consideration of multivariate and interdependent information, including marrying geo-spatial information with social processes and empirical metrics. But many such tools intended to meet these needs are expert-intensive, forcing the public to be passive consumers. A new generation of digital tools puts users in the driver seat and enables interaction and collaboration. We report on a user study that tested one such user-driven system, designed to engage the public in collaborative urban design exercises, against a traditional paper-based workspace. University students from various disciplines served as surrogates for the public in an exercise of designing a walkable neighborhood center. Pre- and post-surveys, group debriefing interviews, and video-taping provided detailed data about group processes, interactions and experiences. We found that the single workspace for co-design, clearly defined work task, evidence-based feedback and tactile nature of both workspaces contributed to active engagement and collaboration. The digital system provided deeper information with better visualizations, and enabled a different collaborative process, but both workspaces were rated as engaging by participants, which may suggest that both paper and digital engagement tools have a valuable place in public engagement workshops.

1.1 Keywords

public engagement; visualization; digital engagement tools, co-design
2  INTRODUCTION

The problems and therefore solutions to attain more sustainable, resilient forms of urban development are complex and so are the voices or stakeholders who must be consulted in public processes. Diverse voices enable consideration of issues of environment, society, equity, and economy, however, each different voice will come with different knowledge areas, values, and modes of learning, thus finding effective methods of working and communicating is a challenge (Wheeler, 2013). Responding to these complex problems and the necessary diversity of stakeholders, new public engagement methods are increasingly geared toward discourse, collaboration, and interaction that emphasize: providing understandable yet credible information targeted to the audience; integrating data and visualizations of information; employing experiential and interactive modes to engage people; employing social and peer learning (Sheppard, 2012; Moser, 2010; Holden 2008; Davis, 2008).

The increased complexity of urban planning and design, which must respond to complex social and environmental issues, necessitates that professionals utilize sophisticated computational models and analytics. However, this can create a knowledge gap between professionals and lay people and makes it far more difficult to engage lay people in planning and decision-making. As well, many such tools are expert-intensive, or operated by experts, leaving public participants to be passive consumers of information (Girling, 2017). In an effort to bridge this knowledge gap, digital tools are increasingly used to facilitate such collaborative engagement in planning (Girling, 2017, Senbel, 2011; Salter 2009).

This study was conducted in this context of evaluating processes and tools to engage diverse stakeholders in urban design decision-making. It focused on employing hands-on interactive modes of engagement, providing rich information in understandable formats combined with visualization of both spatial and numeric information. It compared two different co-design workspaces and evaluated the workspaces for: providing understandable, timely information; integrated data and visualizations; and most importantly for encouraging collaboration, engagement and learning.

2.1  Background

Innes and Booher (2004) proposed that 21st Century public engagement in planning must be genuinely collaborative, inclusive of diverse stakeholders, and include multi-dimensional communication. Their rationale is that such collaborative processes can help to solve complex and contentious problems and concurrently build social capital whereas one-way public engagement has failed. Others similarly propose that contemporary collaborative planning and urban design should be accountable, responsive, and forward looking (Healey, 1997; Daniels, 1996). To achieve these aspirations, planning processes increasingly utilize collaboration, discourse, face-to-face interaction, and problem-solving amongst diverse stakeholders including governments, the public, and special interest groups (Innes, 2004; NCI, 2004; Daniels, 1996). Collaboration generally involves stakeholders working together to solve a problem using decision-making processes in which “trust and knowledge are generated and circulated, to provide a foundation of social and intellectual capital upon which collaboration can build” (Healey, 1997, p. 247).

A very diverse array of engagement techniques are used in planning practice, including opinion surveys, information dispersal (i.e. social media), open houses, interactive web sites, workshops, and design charrettes (Lennertz, 2006). We focus on hands-on design-oriented workshops intended to engender the principles of collaboration, discourse, and engagement. Such workshops are typically targeted to smaller numbers of people (can fit in a room) and smaller scales of problems such as development sites or neighborhoods. Sanoff (2000) proposes that successful workshops are characterized by high levels of interaction amongst participants, working toward a common goal, and people learning from each other. Common characteristics of such workshops include: collaborative; tacit knowledge creation through discourse, collective (or peer) learning, and creative experimentation; split-second, intuitive knowledge about what is right that is typically developed through hands-on experimentation; an environment that supports (encourages) creativity; horizontal organization (all are equal); and improvisation (Roggema, 2014). Several authors have observed that active engagement through hands-on workshops and design charrettes increases the diversity of viewpoints and groups participating (Lennertz, 2006; Brody, 2003) and enables discourse that improves peer learning and buy-in for final solutions (Holden, 2008; Innes, 2004).

Active engagement through hands-on workshops and design charrettes increases the diversity of viewpoints and groups participating (Lennertz, 2006; Brody, 2003) and enables discourse that improves peer learning and buy-in for final solutions (Hollander, 2012; Innes, 2004). Co-design is a term for collaborative public engagement workshops which focuses on interactive engagement around solving a
design challenge. The term co-design refers to cooperative or collaborative design, participatory design, and user-centered design. It applies across many disciplines (Sanders, 2008; Sanoff, 2008; King, 1983). Originating in Scandinavia in the 1970s around industrial systems design (Sanders, 2008; Sanoff, 2008), co-design, as it has evolved in various design disciplines, refers to hands-on participatory modes of physical design that typically involve professionals as well as lay people (Sanoff, 2008; King, 1983; Cross, 1972). In North American design circles, the term design charrette has similar meanings and applications. Co-design applies Kolb’s theory of active, experiential learning, “[t]he simple perception of experience is not sufficient for learning; something must be done with [knowledge]. Similarly, transformation alone cannot represent learning, for there must be something transformed, some state or experience that is being acted upon” (Kolb, 1984, p. 42). In other words, active or experiential learning is more effective than passive modes of knowledge transfer. Similarly, peer-to-peer learning in collaborative processes is more effective in active versus passive situations (Daniels, 1996). Innes (1998) proposed that information will influence policy decisions and public understandings if it is meaningfully discussed to the point of becoming “shared knowledge.” Where people are making decisions or plans together and concurrently discussing the consequences of such decisions, greater acceptance will occur (Daniels, 1996).

Providing the right information at the right time in understandable formats is equally important in public engagement processes (Al-Kodmany, 2001). What information to provide in a public engagement process and in what formats, how, and at what times in the process impacts the effectiveness of public engagement (Brody, 2003). Bringing relevant information to the process in diverse formats is deemed important for reaching people of different backgrounds or with different learning styles (Daniels, 1996; Hollander, 2012). Whether information provided is comprehensive or narrowly targeted, whether it is given as ‘fact’ or open to discourse, and whether it is transparent vs. opaque (black box) all can influence stakeholder buy-in, empowerment and process outcomes (Innes, 1998; Hanna, 2000). Innes (1998) proposed that information must be of different kinds, including objective, science-based information, experiential information, and values-based information. The formats that information is presented in should be varied, including textual, verbal, numeric, graphic, and photographic so that diverse people can meaningfully engage with complex and information-rich discussions and decisions (Al-Kodmany, 2001).

Current theory holds that processes and tools that encourage and enable dialogue and interaction can assist with more effective public engagement (Senbel, 2011; Innes, 2004) and with communicating information. Furthermore, employing multiple channels (or formats) of information helps to reach diverse people in a process (Daniels, 1996; Hollander, 2012). Hollander (2012, p. 350) stated, “Intelligent Participation [multiple channel information] offers a framework for reinserting…the people into the story, by rethinking and redesigning public processes to meet their diverse learning styles and their multiple intelligences, while improving dialogue and encouraging dialogue.” Digital tools can provide multiple channels of information concurrently, such as 2D maps, 3D renderings, photos, video, and both verbal and numeric data. Digital tools enable concurrent “live” consideration of multivariable and complex interdependent information, including marrying geo-spatial information (what is where) with social processes and empirical metrics (Arciniegas, 2012; Talen, 2011; Snyder, 2003). However as digital tools become more sophisticated, they often require expert operators, distancing the information from public participants (Ben-Joseph, 2001). A class of recent digital tools is explicitly targeted to lay users. This new generation of tools puts users in the driver’s seat and enables interaction and collaboration (van der Laan, 2013; Arciniegas, 2012; Salter, 2009; Ben-Joseph, 2001). They help lay people understand how changes made at the scale of a building might impact the neighborhood and how neighborhoods may affect larger urban systems such as transportation networks (Girling, 2017). They also connect spatial information to indicators of performance, which helps people to understand the impacts of their decisions.

Visualization of information is one of the common contemporary tools used to increase understanding. Visualization, according to Planning and Urban Design Standards, is “the process of taking abstract ideas or data and translating them into easily understood or interpreted images to enhance planning, urban design and decision-making processes” (American Planning Association, 2006, p. 543) or, the act of interpreting information in visual terms. While it very commonly refers to realistic three-dimensional images of land or cityscapes (Kwartler, 2008), it increasingly also includes charts or diagrams of numerical or conceptual information. Contemporary modes of visualization in planning and design include systems that integrate 2D spatial (map-based) information and 3D visualizations with verbal and numeric data. Newer modalities for conveying information include serious games and virtual reality (Gordon, 2011). Digital systems enable “live” interconnected information and immediate feedback. Planners are increasingly using
digital visualizations to allow real-time alternatives exploration accompanied by just-in-time performance metrics (van der Laan, 2013; Sheppard, 2012; Kaliski, 2006). These systems can communicate complex urban design concepts through clear, accessible information. In participatory or collaborative planning processes these can help inform diverse stakeholder groups, establish a common language, foster community dialog (van der Laan, 2013; Senbel, 2011; Al Kodmany, 2000; Ben-Joseph, 2001), and enable social learning (Holden, 2008).

Paper-based, hand-made methods of representation (paper and hand) still predominate in design charrettes and hands-on workshops. While these paper and hand tools provide a tangible, experiential element and often allow multiple “hands” to contribute to design solutions, they also privilege consideration of the visual qualities of places over consideration of more complex or abstract information. This means that paper and hand methods could make it difficult to conduct rigorous evaluation in a timely manner (Girling, 2006). Some authors have discovered bias with regard to what information is shared with participants, who is invited to participate (Sorkin, 2006, Bond, 2007), and “editing” of which information is presented in which formats (Hollander, 2012). For example, Grant (2006, page 184) accuses some design charrette facilitators of presenting “slick graphics, romantic watercolours, and celebrity designers” to woo the public. In other words, pictures and graphics are often provided with intent to convince the public the proposed solutions are good solutions as opposed to offering up a range of divergent solutions, equally represented and compared with appropriate evaluative measures (Girling, 2006).

Digital tools on the other hand can help lay people understand how their decisions may impact the neighborhood and larger urban systems such as transportation networks (Arciniegas, 2012; Talen, 2011; Al-Kodmany, 2001). “While at one time it took several meetings to enable the public to make decisions, today feedback occurs instantaneously, enabling the same group of people to test alternatives and make informed decisions within a single meeting” (Kwartler, 2008, p 13.). Digital tools are increasingly being introduced into design charrettes and public engagement workshops to bring more diverse information into the conversation in a way that is accessible to diverse participants and in some cases to provide better analytical capabilities (Gordon, 2011; Lennertz, 2006). This study evaluated one such digital collaboration workspace, called UD Co-Spaces (Mahyar, 2016) (digital) against a comparable paper-based (paper) workspace. Our goal was to evaluate the tools and workspaces for (a) fostering engagement and collaboration in the co-creation of urban designs, (b) enabling participants to connect sustainability metrics to urban form, (c) making information tangible for a range of stakeholders, and (d) fostering discourse and learning.

3 METHODS

We focused the study on a particular type of design task, which is common in many public engagement workshops. We asked stakeholders, represented by student participants, to design an infill neighborhood center within a hypothetical existing single family neighborhood in the suburbs. Posed as a scenario, it assumed that the city in question (also hypothetical) had already been through a planning process and as a result had re-zoned the site of the design task to higher density mixed use development along a main street with higher density housing on adjacent parcels of land (zoning was colour-coded on a map). The scenario proposed that by adding higher density housing and commercial services, the walkability of the neighborhood would be improved. The participants were charged with collaboratively designing the neighborhood center. Since a main goal of this type of design task is to explore alternative design options, the participants were encouraged to experiment, and create as many iterations of the neighborhood design as possible in the time permitted.

University students from various disciplines served as surrogates for the public. A total of 40 students (17 male, 23 female) participated in the study. Twenty-six were graduate students and 13 were undergraduates, with one non-student. Seven of the participants were graduate students in the Community and Regional Planning Program and six were students in the School of Architecture and Landscape Architecture. The ages of the participants ranged from 18 to 48 with a mean age of 25.6 years of age. Students were assigned to the groups according to their availability, and we distributed the planning and design students across all groups. Pre- and post-surveys, focus groups, and video-taping provided detailed data about group processes, interactions and experiences. Forty participants completed the pre- survey but only 37 completed the exit survey. There were a total of 8 focus group sessions with 4-5 participants in each session.
To engender conflicting values and goals, which are common in public engagement, the participants were randomly assigned roles: a long-time resident, a future resident, a developer, a senior citizen, and a renter in the neighborhood. Each stakeholder (role) was additionally assigned preferences that influenced their design choices and required consensus decision-making (Table 1).

Table 1. Participant roles.

<table>
<thead>
<tr>
<th>Role color</th>
<th>Role type</th>
<th>Preferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pink</td>
<td>Long time resident</td>
<td>Pink: lived in this neighborhood for about 10 years; is opposed to high density development as it will change the character of the neighborhood; owns a home very near to the old school; would like to see the school site reserved for park uses; 4 storeys are overly high density.</td>
</tr>
<tr>
<td>Blue</td>
<td>Future resident</td>
<td>Blue: rents a basement apartment in a home within biking distance of this site; is looking to purchase an apartment or rowhouse in the near future; participated in the planning process, which designated this site for a neighborhood center; supports the principles of walkable neighborhoods; thinks a commercial area will make this area more walkable.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Local developer</td>
<td>Yellow: a local developer who lives in this city but not in this neighborhood; is interested in developing a 4 storey mixed use building (residential + commercial) on the site; believes the population of this neighborhood must be much higher to support commercial development.</td>
</tr>
<tr>
<td>Green</td>
<td>Senior citizen</td>
<td>Green: a recently retired, single senior citizen, who loves the neighborhood; owns a home about 10 minute walk away from the site; wants to live in the neighbourhood a long time; planning to downsize to an apartment near to shopping; 4 storeys are overly high density.</td>
</tr>
<tr>
<td>White</td>
<td>Renter</td>
<td>White: rents a room in a house within a 5 minute walk of the site; works part-time in the city; does not own a car/ does not want to; mildly interested in experiencing a public workshop.</td>
</tr>
</tbody>
</table>

Two workspaces: Half of the groups worked in a paper-based workspace while the other half worked in the digital workspace (Figure 1). The two workspaces included many similar elements—the map was at the same scale and appeared very similar; the same selection of buildings and parks, called “cases” was available (Table 2). In the paper workspace, the “cases” were provided on stiff paper pieces with a 2D plan view on one side and a 3D image on the other side, whereas they were displayed in a “case bar,” including the same selection of buildings and parks (as the paper workspace), along each of the four edges of the digital workspace so that each participant had equal access to this information (Figure 2). While the paper workspace included most important metrics for each case on the paper chips (numbers of dwellings and people, number of stories, and area of commercial space), participants had access to much more in-depth information on the digital environment. The digital workspace enabled “live” generation of both 2D and 3D urban design visualizations on the table and projected on a wall respectively. On individual iPads, each participant could also see and control a set of metrics that also live-updated (density, population, dwelling numbers, dwelling diversity, commercial floor areas, household energy use, and percentage trips that were walking trips) (Mahyar, 2016; Van der Laan, 2013).

Table 2. Digital and paper workspaces- information and media.

<table>
<thead>
<tr>
<th>Information/media available</th>
<th>Digital workspace</th>
<th>Paper workspace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map of study site at 1:1000</td>
<td>√ (participants could zoom)</td>
<td>√ (static)</td>
</tr>
<tr>
<td>2D (plan) view of “cases”</td>
<td>√ (on case bar)</td>
<td>√ (on paper chips)</td>
</tr>
<tr>
<td>3D view of “cases”</td>
<td>√ (on case bar + in 3D view)</td>
<td>√ (on paper chips)</td>
</tr>
<tr>
<td>Data about each “case”</td>
<td>√ Extensive</td>
<td>√ Very limited</td>
</tr>
<tr>
<td>Performance metrics about design solutions</td>
<td>√ Live-updated/controlled by participants</td>
<td>√ Prepared by researcher</td>
</tr>
<tr>
<td>Bird's-eye view of design solution</td>
<td>√ (controlled by participants)</td>
<td>X (none)</td>
</tr>
</tbody>
</table>
The interactive multi-touch table system software (digital workspace) used in this project was developed explicitly to facilitate collaboration (including dialogue and interaction) around urban design tasks. The system was designed to be operated by untrained public workshop participants without direct operation by technicians. Participants received approximately two minutes of training on how to operate the table system before undertaking the collaborative design task.

![Figure 1: Two workspaces. Left: one group working in the digital workspace showing the touch table 2D work surface, the iPad with metrics, and the 3D view projected on the wall. Right: One group working in the paper-based workspace with the paper pieces scattered about on the table. Photos by the authors.]

**Schedule of the workshops:** Each workshop followed the same choreography as explained in Table 3. The five-minute lecture about principles of walkable neighborhoods included these concepts: parks and daily services should be within a five minute walk of most residents; provide a diversity of shops and services; provide housing for a diversity of people; enough people (density) to support the businesses; well-connected streets with sidewalks. Participants worked in groups of four to five to design a walkable neighborhood center, and the groups were left on their own to devise a working process – they were not led by a facilitator.

<table>
<thead>
<tr>
<th>Workshop agenda</th>
<th>Time allowed (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Arrival, role assigned</td>
<td>10</td>
</tr>
<tr>
<td>2. Entry survey</td>
<td>10</td>
</tr>
<tr>
<td>3. Introductory lecture</td>
<td>5</td>
</tr>
<tr>
<td>4. Instruction on design task and tools</td>
<td>2</td>
</tr>
<tr>
<td>5. Work on design task</td>
<td>20</td>
</tr>
<tr>
<td>6. Targets provided by researchers</td>
<td>3</td>
</tr>
<tr>
<td>7. Continue to work on design task</td>
<td>25</td>
</tr>
<tr>
<td>8. Break</td>
<td>20</td>
</tr>
<tr>
<td>9. Post-task questionnaire</td>
<td>15</td>
</tr>
<tr>
<td>10. Focus group discussion</td>
<td>30</td>
</tr>
<tr>
<td>TOTAL</td>
<td>140</td>
</tr>
</tbody>
</table>
Data analysis: All work sessions and all focus groups were video and audio recorded. To evaluate collaboration, we coded from the videos 10 minutes immediately after the groups initiated working and 10 minutes after the groups were given the targets. This was a subjective video analysis in which a researcher recorded time spent on various individual or collaborative tasks, such as studying the building pieces (individual), placing building pieces on the workspace (individual or group), moving them around and discussing the pros and cons of these design moves (collaborative). Every session ended with a focus group discussion, therefore there were eight such sessions with four to five participants in each session. A consistent set of questions was asked at each session. Transcripts of each session were created, coded and summarized by question and answers. Quotes were taken from the transcripts of the focus group discussions. Because the total number of participants is low, actual numbers of the entrance and exit survey responses are presented here. Design performance metrics are built into the UD Co-Spaces system and some were replicated using spreadsheets in the paper workspace. Those metrics are reported here.

4 FINDINGS

Preliminary findings indicate that both the paper and digital tools were easy to use, engaging, and enabled collaboration, discourse about implications of urban design decisions, and both self- and peer-learning. Working processes varied as explained below. Resulting design solutions had some differences: all of the digital groups met the minimum targets for a walkable neighborhood and some exceeded the targets; all but one paper group met the minimum targets. All digital groups and all except one paper group improved their designs relative to neighborhood walkability after learning of the walkability targets. However as discussed below, it was difficult to conclusively establish significant differences between the experiences and learning of the two different groups.

4.1 Design performance:

As stated above, all groups were presented with principles of walkable neighborhoods at the start of the workshop. Every team prepared a credible solution by adding both commercial spaces and new dwellings to the site (Figure 2). Throughout their working process, all groups discussed the types of housing and the density of the different housing types and considered where to put higher density housing relative to commercial areas and the existing dwellings adjacent to the site. All groups considered where commercial spaces should be located relative to the streets and the residential areas. Most groups spent considerable time discussing if and where public open space should be located relative to housing, commercial spaces and roadways. At the 20-minute mark two targets (to add a minimum of 5000 square meters of commercial space, and to add a minimum of 250 new residents) were introduced. In addition, the digital groups, who had available visualizations of a metric for percentage of walking trips, were advised that they should exceed 25% walking trips (existing condition was 5%). Prior to receiving the targets, only two of eight groups had met the targets for commercial space, while four of eight had met the targets for population (Figure 3). After learning about the targets, seven of eight groups improved their metrics of walkability, whereas one team, who had initially met the targets, did not meet them with their final solution. Two digital groups exceeded one target by a significant measure. Most of the paper groups worked to just meet the targets, excepting the one group who went backwards on commercial space and in the end did not meet the commercial target.
Figure 2: Digital design solution. Screenshots of one group’s solution in the digital workspace. Top: 3D view projected on a wall; Bottom: 2D view shown on the tabletop. Images by the authors.

Figure 3: Groups’ design solutions measured against commercial space and population. Left: metrics for commercial space before and after learning the targets. Right: metrics for numbers of bedrooms (proxy for population) before and after learning the targets. The grey areas are at or above the targets. Image by the authors.
4.2 Engagement:
In exit surveys 92% of respondents found the exercise engaging or very engaging. One person was neutral and two found it somewhat engaging. Nine people (of all participants) qualified their comments about being engaged by saying they did not have enough “back story” about the neighborhood (demographics, infrastructure information; more photos) and as such they questioned the realism of the exercise. In the focus groups they elaborated with comments such as: the visual aspects were very engaging (digital group); liked the cards with two views and metrics on them (paper); liked having people play different roles; more engaged after the targets were given. Digital groups also stated that they found the real-time synced displays to be engaging, however, when asked which display they found most helpful, they were evenly split about the 2D table workspace, the 3D visualization, and the metrics on the iPads. Digital group participants mentioned some issues with the technology were problematic (scaling of some 2D pieces; no indication of case data once placed in design; inability to undo an action) and a small number felt the touch-table workspace was challenging to learn.

4.3 Collaboration:
It is important to clarify that only one shared workspace was provided in each of the paper and the digital environments. Groups were therefore required to collaborate to some extent on a single solution. When asked if they felt that they worked collaboratively, 89% of survey respondents to the exit survey agreed or strongly agreed that their group worked collaboratively. In the focus groups sessions, groups commented that everyone contributed to the solution; different roles helped them to collaborate; they collaborated more after they got the targets.

Analysis of video revealed differences between the amount and timing of individual vs. collaborative activity and the nature of discourse between the paper-based and the digital groups (Figure 4). In every session, there were periods of time when individuals worked alone, studying the map, the cases, or the metrics and sometimes smaller groups worked together or discussed. In all instances, they returned to whole group for discussion and decision-making. The paper groups worked at a table around the map, thus they were sitting very close together. In every instance, the paper groups started out by individually studying the workspace and paper pieces as well as the wall projection, which summarized all of the “cases” information. Similarly, the digital groups also started by studying the “case bar” and opening up cases to study their information. However, they more often discussed and helped each other to figure out how to use the tools (i.e. read the cases information, drag, rotate, expand, delete cases on the table; rotate the 3D view; add or subtract metrics on the iPads).
Figure 4. Video analysis of four groups working process covering the first ten minutes of working (left) and the ten minutes after receiving the targets (right). Each colored line represents an individual. The grey bars indicate full group collaborative work. The method was a subjective video analysis. Image by the authors.

Figure 5. Summary of groups working processes. Percentage of time working as a whole group, in smaller groups or individually, covering the first ten minutes of working and the first ten minutes after receiving the targets. Image by the authors.
Video analysis of two ten-minute segments for each of four groups (two paper and two digital) indicates that the two paper groups spent more total time working together as a whole group of four (or five) and for longer periods of time than did the two digital groups (Figures 4 and 5). The digital groups worked individually or in smaller groups and came back together as a whole group more frequently, but for shorter periods of time. Overall, paper groups spent, on average, 58% of their time working together as a whole group whereas the digital groups spent 46% of their time working that way. Both digital groups spent less time working together as a whole group after receiving the targets, however, both paper groups increased their time working together after receiving the targets. Video analysis indicates that individuals in the digital groups broke from the whole group to study case information, the metrics on the iPads or to rotate and study the 3D view, then returned to the whole group with commentary or suggestions informed by their side studies. The paper groups had only the paper pieces to work with, thus as they became more familiar with the pieces, they spent less time individually studying them and more time working together on their design solution.

4.4 Information and visualization:
In the focus groups discussions, people in three of four focus groups (paper) felt the paper pieces were helpful but some were put off by having to flip them over to see a different view. They were able to see either a 2D or a 3D view, not both concurrently. Some people liked the limited choices of cases, others wanted more choices, and one person wanted to be able to modify them. One group discussed the potential merits of real 3D blocks instead of paper pieces. All four groups mentioned the value of having targets to work toward. Individuals in one paper group suggested that it would be better to be able to control the metrics calculations themselves (these were calculated by a researcher). One person specifically requested metrics on an iPad (although he or she had not seen our iPads in operation). In the digital groups, two of four groups mentioned that they found the syncing of the three screens (2D tabletop, 3D visualization and metrics on iPads) to be very instructive. They specifically mentioned that the metrics on the iPads helped them to understand the impacts of the design solutions. When asked in the exit survey, which interface or screen was most helpful (2D tabletop, the iPads with metrics; 3D visualization) 68% said the touch table work surface was most helpful, followed by 22% finding the iPads with metrics to be most helpful (the balance found the 3D view most helpful). However, this is contradicted by responses in the focus groups where six of fifteen said they found all three tools together to be most helpful, with five finding the 3D view and four finding the iPads as most helpful. Finally, all groups reported in the focus groups that collaboration increased after targets were introduced, however, some felt their groups became too goal oriented.

4.5 Discourse:
The discourse between group members during the working process was very relevant to how to make neighborhoods more walkable while remaining sensitive to the values of the group members (in their roles) and to the existing neighborhood context. People regularly referenced the visual information and data during their discussions. There were common topics of discussion across all groups, including: neighborhood character, particularly building style and heights; how increased density (and some building types) will impact the existing neighborhood; how increased density will improve walkability and transit service; the role and influence of adding commercial space (a proxy for commercial services) in improving walkability; the importance of having greenspace or parks and where they should be located; safety issues relative to vehicles on roads and in parking areas. While not entirely absent, economic aspects of new development were rarely discussed (and no data was provided about this topic).

4.6 Learning:
When asked in the exit survey if their knowledge of how the design of a neighborhood affects walkability had changed as a result of the experience, 51% agreed or strongly agreed, 27% answered “neutral” and 22% disagreed or strongly disagreed. As mentioned above, 35% of the participants were graduate students in planning, landscape architecture or architecture where they had previously learned about factors that encourage or inhibit walkability, and several of these students commented that they had not learned anything new. In an open-ended question about what they learned numerous individuals listed that they learned about how to make neighborhoods more walkable, specifically: population and commercial requirements must be closely met; walkability strategies; zoning for commercial space versus straightway residential space; density is critical for business to be sustained; the effects on use of space and walkability
in the context of urban density; what is needed to make something walkable; better understanding the walkability concept; complexity of the neighborhood as an overall system. One participant elaborated, “I learned about the effects on use of space and walkability in the context of urban density. It has been great to see the effects of urban development in terms of transportation, walkability, environmental impact, etc.”

Numerous others commented that they learned about the public engagement process, specifically: learned more about collaborative strategies than about non-interpersonal elements of planning; learned a little about compromising objectives and being convinced by others; people from different majors have different perspectives; taking all stakeholder views into account and coming up with a compromise so everyone is happy was new to me; different things matter to different people; difficulties of balancing various group desires with the project targets. A planning student stated that the workshop was valuable for “giving me some insight into the potential conflicts and challenges of participatory design processes.”

5 DISCUSSION

Sanoff (2008, p. 62) stated, “Planning for participation requires that participation methods be matched to the objectives, and the appropriate method be selected. The professional’s role is to facilitate the community’s ability to reach decisions about aspects of their environment through an easily understood process.” Al-Kodmany (2001) added that digital systems may not be suited to all types or stages of public engagement and may not be the best tool to meaningfully engage the public. He had earlier concluded that digital technology and information have potential to marginalize some people because digital systems can seem too foreign or complex for people who are not digitally comfortable (Al-Kodmany, 2000). This was somewhat corroborated by this study. In terms of being surrogates for stakeholders in real community engagement processes, today’s students are digital natives and are very comfortable with touch screens and synced visualizations. As well, roughly a third of the participants were knowledgeable about walkable communities. In the focus group sessions, several students wondered if senior citizens or non-tech-savvy people might feel alienated by the digital system, and one of our participants, a 48-year old non-student, did not engage the table and had difficulty orienting to the 3D view. The system had been tested previously on both professional audiences and the public in community engagement processes (Mahyar, 2016; Girling, 2016). These studies similarly found that the workshop format and the multi-display system “enables dialogue and learning about others’ perspectives, improves understanding, and increases comfort levels,” as well as increased understandings of complex planning problems (Girling, 2016, p. 155). However, similar questions remained about how the visualizations affected different people’s overall acceptance of more sustainable development solutions (Girling 2016). The demographic limitations of digital tools such as these clearly merit further study and different research methods should be employed to answer questions such as these in real public engagement processes with lay participants.

The workshop method of public engagement tested here has limitations of size or numbers of people who can be reached. In both cases a “table” of people was ideally four to six, thus for many municipally driven processes, many sessions with numerous tables of people would be needed to reach a significant number of people. These workspaces also have limitations of geographic scale. They are more suited to public engagement around issues of neighborhood scale urban design as opposed to consideration of broad policy topics or large geographic extents. While iPads and similar small touch screen devices are ubiquitous, larger-scale touch tables are not yet in widespread use. Few municipalities have access to this technology at present and although several similar systems are being tested in academic environments, at present there are no commercial systems available that are comparable to UD Co-Spaces (Mahyar, 2016; Ben Joseph, 2001).

Although both paper-based groups and digital groups reported that they worked collaboratively, we found through video analysis that the nature of the collaboration differed somewhat. Every group had a unique working process and thus it was difficult to define patterns. However, based on the analysis reported in Figure 4, we found the paper groups were more intimate and conversational in their processes, whereas the digital groups moved in and out of whole group discussions. They worked alone, in small groups and in the whole group somewhat fluidly. Individuals in the digital groups tended to work more with one of the interfaces and some actually took charge of one interface on behalf of the group (working on the table, checking metrics on the iPads, or “driving” the 3D view). We were unable to evaluate which is better or if there is a better process, thus this aspect of small groups working in a multi-display, information-rich environment deserves much more attention.
Kolb’s theory of experiential learning was at least in part substantiated. Students reported self-learning via the exercise and we observed some peer learning. Most importantly, students reported that they learned about other people’s viewpoints – that they do differ and that they have valid points to make, and half of the students learned something new about how urban design impacts walkability. Both workspaces enabled an iterative design process in which groups experimented with ideas, then evaluated them against metrics and through critical discourse. Ninety-seven percent of the participants agreed that creating different alternatives helped them to make a better final design. Like Gordon (2011), we found that engaging and immersive media can provide meaning to participants and result in peer learning and buy-in.

In this exercise, we were expecting to find that the digital environment would be more engaging than the paper environment and that we would therefore see some evidence of greater engagement and or greater learning. We do not have enough evidence to back up this hypothesis. In fact, our evidence somewhat contradicts this – 17 of 18 individuals in the paper groups and 17 of 19 individuals, in the digital groups found the exercise was engaging or very engaging.

Integrating data and visualizations of information enabled high-level, informed and focused discourse about neighborhood walkability. In this study, we made the two workspaces as similar as possible, however, the digital workspace had far more information available on demand by the users and they could control both the selection of metrics they could view and the 3D view. The paper groups had 3D views of individual cases but they were restricted to a 2D map view of their solutions. We expected to find greater differences between the working processes, nature of discourse, and resulting solutions between the paper and digital groups. As stated, the digital groups had access to real 3D visualizations, far more information about the individual cases and more metrics by which to evaluate their solutions. However, exactly how this information impacted working processes, learning and satisfaction with results was difficult to uncover in this particular study.

Multi-display design decision support tools such as the one tested here can contribute rich information in understandable formats to public engagement workshops. The synced and live-updated displays were valued by participants and enabled informed discourse, collaboration and self and peer learning. The system tested here was considered to be very user-friendly and fast to learn for most participants, thus it was not an impediment to the work process. In fact, it engendered a somewhat different working process than the paper workspace. The single collaboration workspace, clearly defined work task, evidence-based feedback and tactile nature of both workspaces contributed to active engagement and collaboration. Both workspaces were rated as engaging by participants, which may suggest that both paper and digital engagement tools, which include multiple-channel visualizations and feedback information, and are centered on co-design, have a valuable place in public engagement workshops.

6 REFERENCES


MOTIVATING STUDENTS WITH EXPERIENTIAL LEARNING VIA REAL-WORLD PROJECTS

LUO, QING
Oklahoma State University, Stillwater, QingLuo@okstate.edu

1 ABSTRACT
In design education, some professors strive to find real-world projects from the community for students to practice their design skills instead of giving students speculative projects. This paper describes how a landscape architecture faculty used actual projects with real clients for academic teaching and community service through service-learning. Such practical, hands-on experience is crucial in landscape architectural design programs, as real-world projects provide students with more effective learning outcomes. Although service learning and community engagement are part of the CELA’s mission, the focuses mainly have been on the issues of urban green spaces, community heritage landscapes, sustainable community design, neighborhood transformation, cross-cultural community engagement, urban design collaborative and rural development. As a result, students’ learning and motivation stemming from philanthropic values have often been overlooked. This study applied real-world learning approaches with the additional focus on students’ experiential learning experience, client-professional interaction, and community service awareness. The faculty selected three service projects for three design classes to engage in this study and conducted a follow-up survey. The data and collected comments were analyzed, and the results were presented in bar charts, data tables, and preference distribution curves. This paper examines how the students were motivated when they faced a real-world project with a real client versus a speculative project. It also revealed the benefits of being able to interact with real clients during the design process of a real-world project. The survey results confirmed that real-world projects provided benefits to students’ learning and facilitated better teaching outcomes in design education.

1.1 Keywords
Real-World Project, Design Education, Real Client, Service-Learning, Community Service.
2 INTRODUCTION

Traditionally, design skills and knowledge were transferred through a master to apprentice relationship. Nowadays, design education has moved to the studio tables in the university classroom where experienced designers guide students through “speculative design problems” (Mewburn, 2010, p. 363). This paper described how a landscape architecture faculty with an Extension appointment functioned as a bridge between formal education and community service through service-learning with real-world projects. Faculty invited students to tackle their community’s design challenges, concurrently developing their on-site learning and sense of civic responsibility. This paper examines landscape architecture students’ interest and motivation when presented with a real-world project versus a speculative project and the author would like to share the process with other design educators.

Although service-learning and community engagement are part of the Council of Educators in Landscape Architecture’s (CELA’s) mission, CELA focuses mainly on the issues of urban green spaces, public space disparities, community heritage landscapes, sustainable community design, neighborhood transformation, cross cultural community engagement, the heritage of agrarianism, the structure of engaging communities, performative space, discourse on community development, urban design collaboration and rural development (ISOMUL and CELA, 2010, pp. 77-90; CELA, 2016, pp. 250-263). As a result, students’ learning and community engagement have often not been emphasized. This study proposed four approaches to service projects for student learning: (1) real project-centered learning, (2) experiential learning experience, (3) client-professional interaction, and (4) community service awareness. To test the approaches, the lead faculty assigned 27 Oklahoma State University (OSU) landscape architecture students a selection of three different types of service-learning projects from three different communities. Students had the opportunity to study the physical project site, meet the clients, develop programs, propose design solutions and present their master plans for review and evaluation. As Sipe (2001, p. 38) states, academic service-learning projects provide students “with authentic experiences that allow them to better understand and value perspectives of others, to build their own powers as reflective and critical thinkers, and to create habits of service with a vital role in shaping the world”. During this study, OSU faculty, students and community members interacted at various stages of the design process, providing project-based skills for students to enhance their landscape architecture design learning, critical thinking and civic responsibility.

3 CONCEPTUAL FRAMEWORK

The main objective of this study was an analysis of the effectiveness of service-learning approaches among students participating in real-world projects. The author initiated this study as a response to OSU landscape architecture students’ request for a studio project that would be an alternative to the speculative campus project that OSU faculty had repeated for many years. Although speculative projects simulate real-world restrictions, budgets, site constraints, etc., they do not have real clients. This paper highlights the presence of clients, the community, and the service-learning interaction as the significant difference between service-learning projects and speculative projects. Faculty identified a suitable alternative project for the students: a soon-to-be-built OSU Extension service project. During the site design process, students showed great enthusiasm and delivered a very successful design package at the end of the semester. Encouraged by the first service-learning project results, in later semesters more service-learning projects were introduced to classrooms to continue to give students a worthwhile and unique learning experience. After three projects, positive feedback from students has motivated the author to write this paper to share the process with other design educators.

This study proposed four approaches to service-learning projects. These four approaches focused on four important themes: (1) real project-centered learning, (2) experiential learning experience, (3) client-professional interaction, and (4) community service awareness. The real project-centered learning approach aimed to create a real-world learning environment in a landscape architecture studio for students to get involved with their community. Through participation in speculative projects, students gain experience in writing reports and preparing schematic design solutions that they can later apply to real world design problems (Loon, 2010, pp. 23-32; Govekar & Rishi, 2007, p. 3). The experiential learning experience approach allowed students to grow and mature through their exposure to community needs, community member’s expectations, technical assistance and reciprocal benefits (Gallagher and McGorry, 2015, p. 467). The client-professional interaction approach aimed to link communities and schools, creating hybrid “third spaces” where teachers and students could contribute their knowledge by providing professional service to
the community (Gomez et al., 2015, p. 162). The community service awareness approach aimed to develop philanthropic values and behaviors in students that could influence their postgraduate years. Students were able to learn to serve their communities through their involvement in community activities (Seider et al., 2011, p. 485).

Under each approach, the author applied several service-learning methods, including the real project-centered, real site constraints, students in training, collaboration, participation, community assistance, client input/student output, hands-on design skills, public presentation, value awareness, and motivation and teacher as a professional service-learning methods. The author incorporated these methods into various phases of each project as tools for the design process; and the means of communicating among students, teachers and the community. A diagram of the conceptual framework of this paper is presented as follows: (Figure 1)

![Conceptual framework of this study](image)

Figure 1: Conceptual framework of this study.

4 LITERATURE REVIEW

Landscape architecture is a discipline of project-based design practice. It is a profession whose design approach can be applied to nearly any scale of landscape space, ranging from a small garden to an entire region. The landscape architecture design solution strives to create better communities, whether it is for one individual, a family, or a neighborhood. Therefore, the integrated relationship of students, faculty and community members is the key to the successful execution of a design project. The outcomes benefit students’ overall civic learning, academic learning and personal growth (Felten and Clayton, 2011, p. 78).

4.1 Land-grant tradition and the National Community and Service Trust Act

The National Community and Service Trust Act (NCSTA) of 1993 stated that the purpose of service-learning is to “meet the unmet human, educational, environmental, and public safety needs; renew the ethic of civic responsibility …; expand educational opportunity …; encourage national service; support locally established initiatives; and provide structured service opportunities to the participants and community” (NCSTA, 1993, p.74). Section 103 of the Act further defines school and community-based service-learning programs as collaborations between teachers in schools within a community “to create and offer service-learning opportunities for students; …incorporate service-learning opportunities into a classroom to strengthen academic learning; and coordinate the community service activities” (NCSTA, 1993, p. 32).

OSU, a land-grant university, has been designated by its state legislature or Congress to receive the benefits of the Morrill Acts of 1862 and 1890. The mission of OSU, as set forth in the first Morrill Act, is “to teach agriculture, military tactics, and the mechanic arts as well as classical studies so members of the working classes could obtain a liberal, practical education” (APLU, 2012, p. 1). The Smith-Lever Act of 1914 amended the Cooperative Extension work to consist of “the development of practical applications of research knowledge and giving of instruction and practical demonstration, and other means” (APLU, 2012,
4.2 Service-learning definitions

The OSU Landscape Architecture (LA) program’s service-learning projects serve complementary goals: academic learning, civic responsibility, personal growth and community assistance. The development of service-learning projects occurs via various methods, such as phone call requests to the LA program, community-requested assistance through Extension, and an assignment from the university. As service-learning has progressed over time, it has evolved to focus on several core characteristics, such as embedding “learning goals with academic, civic and community purposes, involving reciprocal collaboration among students, faculty/staff, community members, community organizations, and educational institutions, and including critical reflection and assessment processes that document meaningful learning and service outcomes” (Felten and Clayton, 2011, p.76).

Service-learning is often termed “academic service-learning”. Howard (1998, p. 22) provides a working definition: “Academic service-learning is a pedagogical model that intentionally integrates academic learning and relevant community service.” He further suggests that there are four key components to this definition, “First, academic service-learning is a pedagogical model of teaching methodology. Second, there is an intentional effort made to utilize the community-based learning on behalf of academic learning. Third, there is an integration of experiential learning and academic learning. Fourth, the community service experience must be relevant to the academic course of study” (Howard, 1998, p. 22). For OSU LA service-learning projects, careful project selection provides students with real-world experience interacting with clients and project sites. As faculty coordinate the design process with clients for input and feedback, the students reap the benefits of real-world experience by serving the community. This philosophy resonates with Govekar’s (2007, p. 3) assertion that experiential teaching methodologies have been using service-learning “as a means of linking formal classroom instruction with real-world learning that occurs beyond the classroom and involves the community.”

4.3 Typology and approaches to service and learning

Britt (2012, p. 80) outlined three approaches to “the typology of service-learning, (a) skill-set practice and reflexivity, (b) civic values and critical citizenship, and (c) social justice activism”. This study considered service-learning as a method by which students and faculty collaborate on community projects that develop students’ mastery of landscape architecture design and enhance their sense of civic responsibility. Therefore, this study proposed four approaches to service-learning projects, focusing on four important themes: (1) real project-centered learning, (2) experiential learning experience, (3) client-professional interaction, and (4) community service awareness.

The real project-centered learning approach aimed to create a real-world learning environment in a landscape architecture studio. Traditional speculative landscape architecture projects offer students the typical landscape architecture design process with steps of site analysis, schematic design, design development and design presentation; however, they lack the reality of a project site visit, client interview, client input and feedback, and client-community presentation. Real-world learning brings students to the physical project site and engages with real clients and real-world situations. Students learn through such real-world experiences, gaining firsthand landscape architecture knowledge and skills. “Real-world learning by doing not only adds these elements of meaningfulness to the learning endeavor, but also exposes students to the real politic of the organization and to real-world evaluation of their actions” (Bilimoria, 1998, p. 266). Other research points out that through participation in speculative projects, students gain experience in writing reports and preparing schematic design solutions that they can later apply to real world design problems (Loon, 2010, pp. 23-32; Govekar & Rishi, 2007, p. 3). When engaged in academic service-learning with local communities, the teacher needs to apply theory with practice “by reframing service-learning as learning and participation. Learning is happening because of, and in the presence of, social relations and practices” (Kinloch, Nemeth and Patterson, 2015, p. 39).

The experiential learning experience approach allowed students to grow and mature through exposure to the community’s needs, clients’ expectations, technical assistance and reciprocal benefits. In a capstone course, service-learning is introduced to students using experiential learning techniques to assess student-learning outcomes (Gallagher and McGorry, 2015, p. 467). One study confirms that students’ experiences from participating in service-learning with vulnerable populations in inner cities often begins with navigating stereotypes and community needs; however, with time, students transform into more
culturally competent citizens, becoming the advocates for their community’s needs and gaining reciprocal benefits. (Knecht and Fischer, 2015, p. 378). Educators need to tap into students’ service-learning experiences to gain an in-depth perspective of their experiences and develop projects that match the needs of the community. Bettencourt (2015, p. 473) states that there is a three-way service-learning partnership made up of the student, the faculty member and the community partner. However, student learning is sometimes vaguely defined, often simply assumed to occur, and usually only indirectly assessed. She proposes four methods to evaluate experiential learning outcomes: oral reflective journals, surveys, focus group responses and interviews. “Learning is accomplished by practice during the experience; thoughtful and context-sensitive infusion of theory, evaluation and feedback during and after the experience; and ongoing and subsequent reflection on and conversation about values and actions” (Bilimoria, 1998, p. 266). This study employed similar methods of experiential learning through reflection, review, critique, survey, evaluation and feedback during the students’ design process.

The client-professional interaction approach aimed to create hybrid “third spaces” (Gomez, et al., 2015, p. 162) between schools and communities, where teachers and students contributed professional services to communities. In a teaching position with an Extension appointment, service-learning is a natural venue for service to needy communities; in addition, service-learning also provides an opportunity for aspiring teachers to bring their professional knowledge to fruition. This community-teacher interaction, or in landscape architecture terms, “client-professional integration,” creates hybrid “third spaces” linking communities and schools (Gomez et al., 2015, p. 162). It is within this hybrid third space that academic learning, civic learning and personal growth converge; fully integrating service-learning into core educational and civic missions. According to Weigert (1998, p. 5), service-learning can be divided into two sides. On the community side, the students provide some meaningful service that meets the needs of a community. On the campus side, the course objectives and project assignments dictate the students’ service, which is presented and evaluated by the faculty and the clients. Thus, teachers and students contribute their professional knowledge and service to benefit a community in need.

The community service awareness approach aimed to develop philanthropic values and behaviors in students that could influence their postgraduate years. Students were able to learn to serve their communities by being involved in community activities. Students who participate in service-learning have the proper environment to develop “philanthropic values and behaviors that can influence their postgraduate years through careers, civic activities and family life. Service-learning extends beyond ‘serving to learn,’ to ‘learning to serve’ through being involved in community activities” (Hatcher and Studer, 2015, p. 15). In this study, service-learning projects provided opportunities for students to build their academic knowledge and technical skills while developing a keen awareness of contemporary social and environmental issues; in return, students developed philanthropic values and behaviors from the community they served.

4.4 Design process in landscape architecture design education

For design curricula in landscape architecture, bringing real-life projects into teaching fits particularly well. As Loon (2010, p. 24) pointed out, in a landscape architecture program, there are interactive design studio classes where service-learning projects naturally fit better than in traditional lecturing classes. In addition, real-world projects help students engage with the people who own or use the project space. The design process can be grossly classified into four steps: “Generate, Develop, Evaluate, and Communicate” (Gottfredson, 2014, p. 23). In the Generate step, designers compile research, develop a program, select a site, and prepare a site inventory. In the Develop step, designers complete a site analysis, develop a concept, evaluate criteria, and apply a schematic design. In the Evaluate step, designers complete a synthesis, select a concept, prepare a master plan, and execute site planning. In the Communicate step, designers prepare contract documents, execute detailed site designs, and prepare construction documents. At OSU, landscape architecture design education adds a few touches to the design process with four steps: “Real-world, Concept and Form, Schematic, and Master Plan” (Hsu, 2015, p. 48). In the Real-world step, inventory, analysis and thoughts are applied. In the Concept and Form step, idea, theory and program are applied. In the Schematic step, design solutions, criteria and details are applied. In the Master Plan step, site plan, layout plan and construction details are applied. These four steps fit comfortably with the service-learning projects this study employed.

5 METHODS

The lead faculty assigned 27 Oklahoma State University (OSU) landscape architecture students a
selection of three different types of service-learning projects from three different communities. Students gained service-learning real-world project experiences through observation, participation and collaboration in three thematic projects:

1. A Water Conservation Garden on a university campus (designed by 7 students).
2. A Memorial Garden in a retirement community (designed by 9 students).
3. A Public Teaching Garden in a city park (designed by 11 students).

A rigorous design process with four steps: Real-world, Concept and Form, Schematic, and Master Plan was introduced in each service project. These four steps guided the service-learning projects and allowed students the opportunity to interact with physical project sites, meet clients, develop programs, propose design solutions, and present their master plans for review and evaluation.

To gather data, this study used post-workshop surveys, participants’ comments and on-site observations. Qualitative attributes gathered from observation and written comments were assessed to gain an understanding of the underlying reasons, opinions and motivations. Quantitative data were entered into an Excel spreadsheet for statistical analysis. The results are presented in bar charts, line charts and tables to simplify the data and its summation. Variables are presented as percentages for categorical data.

6 THE CASE STUDIES

6.1 Project 1: Water Conservation Garden

The Water Conservation Garden project is located on the branch campus of OSU in Oklahoma City (OKC). It is a one-acre vacant site; however, its surrounding context is complex, including campus office / classroom buildings, greenhouses, a farmers’ market, parking lots, gardens, a storm water retention pond, numerous roads and a five-hole public golf course. The project is a collaboration among OSU teaching and Extension faculty, OSU-OKC faculty and the OSU-OKC groundskeeper. The project’s program is focused on sustainable storm water management and low impact development. Faculty chose the Landscape Architectural Construction II: Sustainable Sites Design class for this service-learning assignment.

6.2 Project 2: Concordia Memorial Design

Concordia is a retirement community owned by a non-profit organization in OKC, and administrators hope to use their courtyard space as a memorial site. Concordia’s request for design assistance matched the OSU Extension’s mission, and subsequently Concordia began the process of working with OSU on the memorial project. The site conditions, aspect, size, location and proximity to the community’s residential buildings made the site suitable for a memorial design project. The central element of this project was a memorial feature that commemorates the loved ones of the residents in the community. Because Concordia is a retirement community, the design of all site elements needed to be senior-friendly, and accessible for those with disabilities. It needed to function as a therapeutic garden which could give visitors physical and psychological benefits. After careful consideration, the faculty assigned the project to the Site Design Studio class.

6.3 Project 3: The Teaching Gardens at Will Rogers Park

This is a project located in a well-known public park, Will Rogers Park, in Claremore, OK. The Master Gardeners Association of Rogers County (MGARC) previously reached an agreement to build a portion of the Park as a teaching garden for the public and decided to work with OSU to design it. The project site has varying topography, numerous shade trees, a parking area, a tool shed, a shade structure, a recently-built splash pad and a historical feature that requires protection. MGARC’s vision was a teaching garden that would teach a wide range of sustainability topics to the public, incorporating sustainability, plants, storm water management, hardscape materials and renewable energy applications. Faculty assigned the project to the Construction II: Sustainable Sites class.

6.4 Projects in action

Before the three real-world projects were announced, students requested an alternative to the typical “made-up” design studio project (i.e., a project without a plan for construction). A “made-up” project may appear to students to be fabricated, but OSU faculty carefully planned every speculative project, embedding it with intentional theoretical, conjectural, and academic learning outcomes. Once the faculty
announced the three real-world projects, the students were highly motivated to move on to the real-world problem, becoming more engaged in the design process from the start.

Real project-centered learning approach: The curriculum was structured like a professional design office. Students carried out typical design project steps that included a site visit, site inventory, client interview, on-site observations and documentation, program assessment, site sketches, site notes, photos and videos. A shared electronic folder to store photos, videos and design drawings was set up for the entire class to access. The studio class then went through the following steps of the design process: site analysis, preliminary concept design and interim review (with client and invited local professionals). In-studio collaboration, active participation, client input, student output and professional critique and feedback were the norm. The students’ applied design process included conceptual diagrams, brainstorming, posting thumbnails, programming, preparing schematic design, receiving teacher’s desk critique, and preparing written reports. The project then went into the final design phase, producing the design package, and final presentation. After each presentation, jury members asked questions, critiqued students’ design and presentation style, and made comments and suggestions.

The experiential learning experience approach: Each project was planned for students to maximize their exposure to the client’s expectations, on-site observations, design-build reality, project schedule management and professional-in-training strategies. These strategies guided student engagement activities throughout the five-week design process. Faculty planned a combination of field-based and classroom-based experiences to facilitate the students’ exposure to the landscape architecture design process. For the field-based experiences, students conducted site visits, identified site opportunities and constraints, thought through a preliminary site analysis, interacted with clients on site, and determined the client’s requirements. For the classroom-based experiences, the students prepared the physical site analysis, preliminary design, and final design while interacting with clients for interim review and final critique. The project timeline was organized to guide students to take control of their own design pace and deliver the product by the deadline. The teacher acted as the project source to both the clients and students throughout the design process (e.g., providing suggestions to clients and design direction to students). The teacher was a professional adviser who helped students build confidence. Students were treated as landscape architects-in-training in a professional setting throughout the experiential process. By completing the project, students applied the course lecture material to the project, and reflected on class theories and the project design process.

The client-professional interaction approach: Faculty planned three client-class design studio interactions throughout the project, one of the most unique aspects of a real-world project compared to a speculative project. The first interaction occurred when students and faculty met the client during a site visit at the beginning of the project. Clients guided the students through the site; and introduced the project background, surrounding context, site inventory information, culture, history, and the client’s vision and concerns. The second interaction occurred during the interim review. The third client-class interaction occurred at the final presentation. During these three interactions, a unique situation was created for the students, client and faculty to communicate, discuss, and cooperate; students asked thorough questions, presented their design concepts, responded to the client’s questions, and received the client’s comments and feedback. In advance of the three client-class interactions, faculty conducted a site visit with the client to pre-evaluate site conditions. After the final presentation, faculty composed a final design report for the client.

The community service awareness approach: Faculty introduced each project to students with an emphasis on community service. For example, safety and usability were the key concerns for the Concordia Memorial Design project, and students complied with the design guidelines of the Americans with Disabilities Act. Through this process, students used design tools to fulfill their vision of not only a beautiful design but also a safe and functional place for the retirement community. For the teaching gardens at Will Rogers Park, students created varied spaces to facilitate interaction between the Master Gardeners group and the public, including children’s learning areas, a Native American cultural space and loop routes for those with mobility issues. Students began to understand that the most important aspect of community service is an authentic awareness of the community’s needs. These are valuable philanthropic values that landscape architecture students need to comprehend, which will help them go a long way in their future professional development.

6.5 Case studies outcomes

All four service-learning approaches were interwoven throughout the project. They formed an
organic web to guide and support students going through the design process; whereby students felt more engaged, motivated, responsible, respected as professionals-in-training; and experienced a deeper cognitive learning experience. In addition, the clients were very satisfied in the process. All the serviced communities have received design ideas that could be implemented and felt that their communities were supported by the university. The survey results from the students' preferences in the Results section proved that there was a positive influence of the service-learning with real-world projects in landscape architecture design education.

7 RESULTS
The Real Project Experience survey posed ten questions to determine how well students performed on a real project versus a speculative project in their design classes:

Q1. The real-world service project interests me more.
Q2. I am more engaged and committed in the design process of the real-world service project as I felt I had real responsibilities.
Q3. I have learned how to treat real site constraints and solve real problems through the real-world service project.
Q4. I gained more hand-on design skills from the real-world public project.
Q5. I gained experience how to interact with clients from the real-world service project.
Q6. I gained valuable experience on how to present my design in front of real clients.
Q7. I was valued as a professional by the client, and I felt I made a contribution to the community.
Q8. The service project satisfied my urge towards public service and helping communities.
Q9. I learned more when I am working on a real-life project comparing to a "made up" project.
Q10. The real-world service project has helped you to see how classroom knowledge can be applied in real-world practice.

Author structured questionnaires on a 7-point scale for the respondents to evaluate, where 7 signified "strongly agree" and 1 signified "strongly disagree" while 4 served as the neutral point. The 7-point scale is commonly called a Likert scale; when responding to the survey questionnaire, respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of questions. The neutral point is set at 4, and each increased or decreased equal-interval, numerical point reflects the intensity of the respondents' feelings for a given question. The participants' perceptions to each point of scale was treated as ordinal data with equal intensity between adjacent levels (Likert, 1932, p. 15). (Table 1)

Table 1. The example of a 7-point scale question for the real project experience survey.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

7.1 The bar charts
The survey data from the three projects were combined to plot the bar charts and the survey outcomes affirmed the interesting impacts of the author's approach. A low percentage of respondents who expressed the preference of "neutral" to questions 3, 4, 7, and 10 at 4%; to questions 8 and 9 at 19% and 15%. None of the participants expressed any "disagree" preferences. Nineteen percent of the students held positive attitudes towards public service and helping communities (Q8). Fifteen percent of the students did not believe that they could learn more by working on a real-world project than they could by working on a speculative project (Q9). Respondents' comments that the clients did not provide an accurate project budget and that the service-learning project stopped at the schematic design phase indicated one drawback of service-learning projects in this study and reinforced the above survey results. Questions 1, 2, 5, 6, and 10 received high marks: for each question, more than 60% of students indicated "strongly agree"; when "strongly agree", "agree" and "somewhat agree" were combined the total score was nearly 100%. This signified that students did favor the real-world service project, felt more engaged in its design process, and gained experience in client interaction and presenting design solutions. Students learned to apply classroom knowledge in real-world project practice (Q1, 2, 5, 6, 10). Both of the bar charts exhibited an interesting
phenomenon: there was a group of respondents who expressed the preferences of “strongly agree”, “agree” and “somewhat agree” in the survey (depicted in the distribution of the skewed-right bar). These results confirmed that using real projects in design class helped students on multiple levels of service-learning, including real project-centered learning, experiential learning experience, client-professional interaction and community service awareness. (Figure 2 and Figure 3)

![Figure 2. Service-learning projects Q1-5 survey results.](image1)

![Figure 3. Service-learning projects Q6-10 survey results.](image2)

7.2 The Mean and the STDEV
The overall Means of respondents to the survey questions were on the agreement side of the scale. The Means of Questions 1 to 10 ranged from a low of 5.56 to a high of 6.42, both far away from the neutral point of 4.0. Other than Question 3 which has a mode of 6, the remainder of the questions had a mode of 7, signifying that most of the respondents were toward the “strongly agree” preference. Standard deviations of Questions 8 and 9 stood out at 1.13 and 1.11; this corresponded to their somewhat lower Means of 5.56 and 5.82. This result reconfirmed that some students (19%) held positive attitudes towards public service and helping communities (Q8), while some students (15%) did not believe that they could learn more by working on a real-world project than they could by working on a speculative project (Q9). With all the data considered, the service-learning projects were effective and worthy of inclusion in landscape architecture.
design education. (Table 2)

Table 2. The end results of Means and STDEVs for all 10 questions in the survey.

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
<th>Q9</th>
<th>Q10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.42</td>
<td>6.25</td>
<td>6.21</td>
<td>5.88</td>
<td>6.37</td>
<td>6.36</td>
<td>6.14</td>
<td>5.56</td>
<td>5.82</td>
<td>6.36</td>
</tr>
<tr>
<td>Mode</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>STDEV</td>
<td>0.75</td>
<td>0.74</td>
<td>0.87</td>
<td>0.76</td>
<td>0.71</td>
<td>0.73</td>
<td>0.85</td>
<td>1.13</td>
<td>1.11</td>
<td>0.72</td>
</tr>
</tbody>
</table>

7.3 The respondents’ preference distribution

The overall preferences of the students to the survey questions were plotted in a distribution curve. The curve had a skewness of -1.25, which is a negative skew in which the left tail of the curve is longer than the right tail; the mass of the distribution was concentrated on the right side of the figure. This result indicated that a majority of respondents’ preferences were on the positive agreement side while a few respondents with extreme disagreement preferences dragged out the left tail of the curve. One could compare the service-learning respondents’ preference distribution curve with a normal distribution curve (hypothetically created) and see the effects. There were 40.35% of the respondents whose preferences resided within SD 0 to +1 and 40.5% whose preferences resided within SD 0 to -1. Results revealed a great concentration of positive responses towards the service-learning methods and approaches (Table 3 and Figure 4).

Table 3. The respondents’ preference distribution for all questions.

<table>
<thead>
<tr>
<th></th>
<th>Descriptive Statistics</th>
<th>Zone</th>
<th>Area</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean 6.14</td>
<td>SD 0</td>
<td>SD 0 to +1</td>
<td>2.0181</td>
<td>40.35%</td>
</tr>
<tr>
<td></td>
<td>SD-1</td>
<td>SD -1 to 0</td>
<td>2.0258</td>
<td>40.50%</td>
</tr>
<tr>
<td></td>
<td>SD-2</td>
<td>SD -2 to -1</td>
<td>0.8278</td>
<td>16.55%</td>
</tr>
<tr>
<td>Skewness -1.25</td>
<td>SD-3</td>
<td>SD -3 to -2</td>
<td>0.1299</td>
<td>2.60%</td>
</tr>
<tr>
<td></td>
<td>sum</td>
<td></td>
<td>5.0016</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Figure 4. The respondents’ preference distribution for all questions.

7.4 T-test results

This study further conducted a sequence of statistic tests (f-test and t-test). The Mean score for Project 1: Water Conservation Garden (P1) had no significant difference to the Mean scores for Project 2: Concordia Memorial Design (P2) and Project 3: The Teaching Gardens at Will Rogers Park (P3) using the two-sample t-test for equal variances, p = 0.41 > 0.05 (P1 & P2) and p = 0.63 > 0.05 (P1 & P3). The Mean scores for Project 2 (P2) had no significant difference to the Mean score for Project 3 (P3) using the two-sample t-test for equal variances, p = 0.15 > 0.05 (P2 & P3). Although the study engaged in three different
types of project for service-learning, the t-test results demonstrated that all three projects received high Means of 6.02 to 6.14 with no significant difference. Based on this result, this study determined that different types of service project did not affect the outcomes of the service-learning experiences (Table 5).

Table 5. t-test results for P1, 2, & 3 and the significant relationship of their Mean scores.

<table>
<thead>
<tr>
<th></th>
<th>P1 &amp; P2</th>
<th>P2 &amp; P3</th>
<th>P1 &amp; P3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.14</td>
<td>6.02</td>
<td>6.14</td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.41</td>
<td>0.15</td>
<td>0.63</td>
</tr>
<tr>
<td>Significance</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

8 FINDINGS AND DISCUSSION

The overall Means of respondents to the survey questions were on the agreement side of the scale, around 6.0 (far away from the neutral point of 4.0). This signified that service-learning with real-world projects was a positive influence on landscape architecture design education. The real-world projects and service-learning approaches were effective tools for landscape architecture studio teaching and learning pedagogy. The t-test results signified that different types of service projects did not affect the outcomes of the service-learning experiences. However, the survey results indicated that some students held positive attitudes towards public service and helping communities, while some students did not believe that they could learn more by working on a real-world project than they could learn by working on a speculative project. Although a typical real-world project includes phases of bid documents and construction (LATC, 2016, p. 4), students noted that a real-world service project without a realistic budget limited the service-learning project within the schematic design phase. This drawback of service-learning projects limited the benefits of a real-world exposure, and somehow limited the differences between a real-world based project and a totally speculative project. Therefore, a service-learning style project that coexists with a traditional teaching style project would balance the teacher’s and students’ interests and learning outcomes.

This service-learning with real-world projects applied various strategies and theories similar to those pointed out earlier in the literature search. They included a real project-centered learning approach aimed to create a real-world learning environment where students do a site analysis, site concept, report writing and schematic design solution for the applicable solution in a real-world (Loon, 2010, pp. 23-32; Govekar & Rishi, 2007, p. 3; Kinloch et al., 2015, p. 39). The experiential learning experience approach allowed students the opportunity to ascertain the client’s expectations; and learn through on-site experiences, the design-build reality, office time line control and professional-in-training strategies (Gallagher and McGorry, 2015, p. 467; Knecht and Fischer, 2015, p. 378; Bettencourt, 2015, p. 473). The client-professional interaction approach allowed the interaction of communities, students and universities to provide professional service to the community via teachers’ and students’ contribution of knowledge (Gomez et al., 2015, p. 162; Harkavy and Hartley, 2010, pp. 418-9). And, students were able to learn to serve their communities through involvement in community projects, broadening their perspective of the professional ethic and civic responsibility (Seider et al., 2010, p. 485; Hatcher and Studer, 2015, p. 15).

Each service-learning project has unique physical, social and political characteristics, and the potential to influence students’ learning experience varies by project. Cauley et al. (2001, p. 176) suggests that educators “develop a reflection component in which students have an opportunity to integrate the service and learning aspects of their experience”; this would strengthen the partnership established between faculty and clients, and influence students’ learning experience. Although the survey results were overwhelmingly positive, during the design process students were focused on preparing the graphic presentation for their proposed designs versus writing. In hindsight, this study could have gone further by asking students to write a reflection paper to gain further insight into their learning experiences. One researcher points out that, in order to restore the public university’s role in safeguarding American democracy, service-learning will need “transformative strategies of cumulative exposures, comprehensive experiences, capstone experiences, immersion experiences, interdisciplinary experiences and community participation and long-term community investment” (Sutton, 2012, pp. 70-71).

This study observed several positive trends: service-learning using real-world service projects enhanced students’ interest in the course material, their engagement during the design process, their experience in interacting with clients and presenting design solutions, and their positive attitudes towards public service and helping communities. However, this study also had its limitations: a service-learning
project lacked the reality of billable hours, budget constraints and school schedule limits; and participants indicated that some clients couldn’t provide timely feedback or a definitive budget for design. Moreover, service-learning practitioners in the design and planning fields have a tremendous amount of work ahead. In order to prepare students “to sustain the cultural and ecological integrity of the places they inhabit; smart growth as a means of achieving regional equity and environmental justice; and just sustainability as a means of living within limits, locally and globally” (Sutton, 2012, p. 72).

9 CONCLUSION
Through this study, real-world service-learning projects benefited students’ experiential learning. Real-world projects that will be built motivated students and encouraged students’ engagement in the landscape architecture design process. Students were able to think critically about their community’s needs. With real clients, students practiced interacting with clients and better understanding clients’ requirements. Students gained valuable experience in presenting proposed design solutions before clients. Finally, the collaborative design process strengthened the connection among the community, faculty and students.

While service-learning can provide many benefits in student learning, faculty need more administrative support to bring service learning into the classroom, such as rigorous recognition and “continuing education credit for faculty development” (Cauley et al., 2001, p. 180). Coordinating a service learning opportunity requires more hours of work than coordinating a speculative project. To coordinate a service learning project, faculty spend many hours initiating contact with clients, making a preliminary site visit, evaluating a project’s appropriateness, signing a contract with the clients, finding a usable site base plan, taking students on a site visit, leading and guiding students’ design, cheering students, coordinating all meetings, delivering a successful design package and preparing a post-design report. Service learning opportunities require instructors to act not only as landscape architecture faculty, but also as principals-in-charge and project managers, ensuring that every step in the design process flows smoothly to deliver a successful design product.

Once a faculty member has prepared a speculative project, it can be re-used many times in future courses. In contrast, a real-world project can only be used once in the current teaching year, because all the coordination efforts towards each project are unique, and each project has a different client. With so much additional effort invested in a real-world project, university administrators should prioritize real-world projects and provide more financial support to interested faculty. There are many educational and civic benefits arising from participation in real-world projects, and service learning should be encouraged to be part of the core design curriculum. Academic administration should commit to consistent term-to-term real-world projects. Faculty should develop a mechanism for assessing learning outcomes, such as feedback from students, faculty and community partners; and faculty should not only develop community partnerships to continue educational opportunities for students, but should also strengthen relationships with the community for future service learning (Voss et al., 2015, p. 400; Cauley et al., 2001, p. 180).

10 REFERENCES
Theme Track
BRIDGING

Edited by Xiaodi Zheng & Zhifang Wang

TANG, HONGBING
Boston Architectural College, School of Landscape Architecture, hongbing.tang@the-bac.edu

1 ABSTRACT
The collaboration between the Lushan Botanical Garden and the Arnold Arboretum of Harvard University formed a botanical bridge between China and the U.S. in the early 20th century. Founded in 1934, the Lushan Botanical Garden is China’s first modern botanical garden, modeled after the Arnold Arboretum in several respects. The Arnold Arboretum played an important role in training the first generation of Chinese botanists, including the core founder of the Lushan Botanical Garden. From the early 1930s through the late 1940s, active engagement between the two institutions enabled the botanists in China and the U.S. to collaborate across cultures and borders, despite successive years of wars. However, the two lost contact after China’s regime change in 1949, and only reestablished the connection 55 years later. Although some initial collaborative efforts were made, active collaboration between them is lacking at the present day. This paper traces the long relationship between the Lushan Botanical Garden and the Arnold Arboretum. It celebrates their inspiring teamwork in the past, and emphasizes the importance of strengthening the bonds and carrying the collaborative endeavor by the Chinese pioneers in botany, and their American mentors and colleagues into the future. Historical connections and current challenges are examined through literature reviews, observations, and dialogues with the researchers at both institutions. Recommendations are put forward as key strategies in order to fortify long-term collaboration between the Lushan Botanical Garden and the Arnold Arboretum - a botanical bridge between China and the U.S.

1.1 Keywords
Lushan Botanical Garden, Arnold Arboretum, Dr. Hsen-Hsu Hu, botanical bridge, collaboration
INTRODUCTION

The Lushan Botanical Garden (LBG) has a long relationship with the Arnold Arboretum of Harvard University since its inception, and even before it was officially founded in August 1934. The Arnold Arboretum played an important role in training the first generation of Chinese botanists, including Dr. Hsien-Hsu Hu (1894-1968), the core founder of the Lushan Botanical Garden. While studying at Harvard University in the 1920s, Dr. Hu formed close personal ties with Professors C. S. Sargent and J. G. Jack at the Arboretum. In several respects, the Arnold Arboretum, especially its extensive research collections, served as a model for the Lushan Botanical Garden (Del Tredici, 2005). The collaboration between the Lushan Botanical Garden and the Arnold Arboretum formed a botanical bridge between China and the U.S. in the early 20th century. However, the two institutions lost contact after China's regime change in 1949. Collaboration was interrupted and eventually ceased for over half a century due to political, social and physical barriers.

The broken link was resumed in 2003 after two Boston-based landscape architects (including the author) from Carol R. Johnson Associates, Inc. (CRJA) visited the Lushan Botanical Garden during a business trip to China. The Garden was put in touch with the Arnold Arboretum soon after they returned to Boston. Following the steps, the Arnold Arboretum sent out two scientists to Lushan in the following year on the LBG's 70th anniversary to participate in an international conference in botany, and officially reestablished the connections. Although the lost ties were restored and initial collaborative efforts were made over a decade ago, active collaboration between the two institutions is lacking at the present day.

This paper intends to examine the long relationship between the Lushan Botanical Garden and the Arnold Arboretum, emphasize the importance of strengthening the bonds, and explore effective ways to fortify a long-term partnership to carry the inspiring collaborative endeavors by the Chinese and American botanists from the past decades into the 21st century.

BACKGROUND / LITERATURE REVIEW

3.1 The Lushan Botanical Garden

The Lushan Botanical Garden is situated at the famous Hanpo Pass scenic area in Jiangxi Province in Central China. It is part of the Lushan National Park - a UNESCO World Heritage Site.
Founded on August 20, 1934 by Hsen-Hsu Hu (1894-1968), Ren-Chang Ching (1898-1986) and Feng-Hwai Chen (1900-1993), the Lushan Botanical Garden is China’s first subtropical forest botanical garden, formerly named Lushan Arboretum and Botanical Garden (Lushan Botanical Garden website, 2017). The Lushan mountain area’s complex topography and unique microclimate provide a heterogeneous environment for plant genetic diversity (LBG Report, 2009).

Currently under the dual leadership of the Chinese Academy of Sciences and Jiangxi Province Science and Technology Bureau, the LBG is a well-known research center as well as a popular tourist destination, attracting 800,000 visitors each year. Covering over 815 acres in area (see Figure 1 site map), the Garden’s live collection consists of over 5,500 plant species, including 157 endangered species (Lushan Botanical Garden website, 2017). The introduction and preservation of gymnosperms, ferns and Rhododendron species is especially noteworthy, becoming the three salient features of the Garden (Lushan Postal Bureau, 2003).

The Lushan Botanical Garden’s new branch, the Poyang Lake Botanical Garden was established in June 2011, covering an area of 89 acres in the north of the Lushan Mountain. With diverse terrains of mountains, plains and wetlands, the Poyang Lake branch encompasses a wide range of vegetation and ecosystems, especially aquatic and wetland flora resources (Lushan Botanical Garden website, 2017).

As a member of BGCI (Botanic Gardens Conservation International), the Lushan Botanical Garden has established working relationships for scientific research with 271 institutions in 69 countries (Lushan Botanical Garden website, 2017). The institution has been actively engaged in the introduction, conservation and exploitation of wild plant resources in the subtropical zone, playing an important role in conserving the biodiversity of China (Lushan Postal Bureau, 2003).

3.2 The Arnold Arboretum of Harvard University

The Arnold Arboretum is the oldest public arboretum in North America, managed through a unique partnership between Harvard University and the City of Boston. The Arboretum was planned and designed in collaboration with Frederick Law Olmsted (1822-1903), the father of American landscape architecture, as part of Boston’s Emerald Necklace (Arnold Arboretum website, 2017).

Established in 1872, the Arnold Arboretum is justifiably famous for its contributions to the scientific study of trees, including aspects of their taxonomy, ecology and biogeography (Del Tredici, 2007). Occupying approximately 281 acres (see Figure 2 site map), the Arboretum’s living collection of some 15,000 accessioned woody plants, representing almost 4,000 unique taxa with 2,100 species, is recognized as one of the most comprehensive and best documented of its kind in the world (Friedman et.al. 2016).

The Arboretum’s research and education activities in Asia began over 120 years ago, led by its founding director, Prof. C. S. Sargent (1841-1927). It advanced dramatically in 1905 when Sargent hired E. H. Wilson (1876–1930) to explore central China on behalf of the Arboretum. The Explorers Garden and Chinese Path located along the Bussey Hill Road showcased many plants brought back by Wilson, who went to China for two long expeditions at the beginning of last century. Through a variety of means, the Arboretum has led or supported more than 150 discrete collecting events in over 70 countries since the late 1800s (Arnold Arboretum website, 2017).

Today the Arnold Arboretum is launching a new era of discovery, focused on collecting exceptional representatives of botanical variation from a rapidly changing world. A plant collection plan in spring 2016 aims to secure the collections’ scientific importance for the next century. The agenda is spurred by widespread destruction of native plant habitats due to global development, as well as threats to the diversity of plant populations caused by rapid changes in prevailing climatic conditions (Shaw, 2016). According to the 10-year collection plan, China, with temperate zones not unlike Boston’s, will be the single most important source of acquisitions from the wild (Shaw, 2016). Collaboration between the US and China is key to the Arboretum’s goal to strengthen the conservation and study of plants (Friedman et.al. 2016).
4 METHODS

The findings of this paper are largely based on a review of publications and unpublished written documents in both English and Chinese closely related to the research topic, following an inductive research approach. Historical connections between the two institutions and current challenges are examined through literature reviews, observations, and interviews with the researchers on both sides.

Figure 2. Map of the Arnold Arboretum (Image source: Arnold Arboretum website, 2017).
5  HISTORIC STUDY

5.1 Dr. Hsen-Hsu Hu and the Arnold Arboretum’s influence

The Arnold Arboretum of Harvard University is deemed as an origin of Chinese plant science (Luo & Li, 2011). It played an important role in training the first generation of Chinese botanists who became founders of modern plant taxonomy in China. The author’s recent literature research reveals that Dr. Hsen-Hsu Hu (Figure 3) was the core founder of the Lushan Botanical Garden established in 1934. Among all the Chinese botanists who studied in the U.S. in the early 20th century, Dr. Hu was mostly influenced by the Arnold Arboretum (Luo & Li, 2011).

Figure 3. Hsen-Hsu Hu’s Harvard University portrait, taken in 1925
(Image source: The Archives of the Arnold Arboretum; Del Tredici, 2007).

Dr. Hsen-Hsu Hu was a scientist, a poet, a political thinker, a father, a teacher, and a builder of great institutions (Ma & Barringer, 2005). As a founding father of modern plant taxonomy in China, he was best known in the West for the role he played in identifying Metasequoia glyptostroboides Hu & Cheng, the dawn red wood, and facilitating its distribution throughout the world (Del Tredici, 2007). The discovery and distribution of Metasequoia, a living fossil species, is considered one of the greatest contributions in botany of the 20th century.

A native of Jiangxi Province in China and a child prodigy in his day (Shi, 2017), Hu was sent to University of California, Berkeley to study botany and earned a Bachelor’s degree in 1916. He returned to the U.S. in 1923 to study for a doctorate in botany, and became the first Chinese National who received a Doctor of Science degree from Harvard University in 1925 (Ma & Barringer, 2005). Hu was strongly influenced by the Arnold Arboretum’s staff members, including C. S. Sargent, Alfred Rehder, J. G. Jack, E. D. Merrill (Del Tredici, 2007) and E. H. Wilson (Luo & Li, 2011).

While studying at Harvard University, Hu took four forestry courses from Prof. J. G. Jack (1861-1949) at the Arnold Arboretum and became his good friend and confidant (Del Tredici, 2007). An enthusiastic and effective teacher, Jack (see Figure 4) went out of his way to help his Chinese students, often paying their wages for work at the Arboretum out of his own pocket or arranging Harvard loans for them. He helped them classify their plant specimens and prepare their manuscripts for publication (Madsen, 1998). After returning to China, Dr. Hu honored Jack (and his relationship to Chinese botany) in the name of a new genus, Sinojackia (Madsen, 1998). A Chinese tree, commonly called Jacktree (Sinojackia rehderiana), was named to honor both Jack and Arnold Arboretum’s dendrologist Alfred Rehder (1863-1949) (Missouri Botanical Garden website, 2017).

Dr. Hu’s dream of building a botanical garden in China began while he studied at Harvard University. In his Chinese poem “The Song of the Arnold Arboretum” written in 1925, Hu wrote a prologue in old style Chinese, translated as “The Arnold Arboretum has the most flourishing trees and flowers in North America.
Flowers bloom endlessly in spring and summer, attracting many tourists to enjoy and wonder all day long. This poem is created to express my appreciation and also show my country an example in order to follow the path of this Arboretum.” (Hu, 1925; Luo and Li, 2011; Hu, ed. 2014).

5.2 Collaboration in the early years
The earliest collaborative effect can be traced to 1926, when Prof. Sargent, the first director of the Arnold Arboretum, initiated a plan to establish an arboretum together with Dr. Hu in China. Due to the various wars and Prof. Sargent passing away in 1927, this plan was never implemented (Hu, ed. 2009).

Eight years later, China’s first botanical garden was founded in Lushan. From 1934 to 1949, the Lushan Botanical Garden was under the dual leadership of the Agricultural Institute of Jiangxi Province and the Fan Memorial Institute of Biology in Beijing, where Dr. Hu served as the director for 17 years. The collaboration between the Lushan Botanical Garden and the Arnold Arboretum was led by Dr. Hu, as part of the Fan Memorial Institute of Biology’s exchange program (Hu, 2017). The LBG’s annual reports reveal that the Lushan Botanical Garden gained good support and help from the Arnold Arboretum from the very beginning. Table 1 shows the amount of seeds LBG received from the Arnold Arboretum from 1934 to 1937. The information was compiled by the author based on the historic documents from the book of Recollections on the Occasion of 80th Anniversary of the Lushan Botanical Garden (Hu, ed.) published in 2014 by the Lushan Botanical Garden of Chinese Academy of Sciences.

<table>
<thead>
<tr>
<th>Report No.</th>
<th>Year</th>
<th>Receiving Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial work report</td>
<td>Aug. - Dec.1934</td>
<td>7 varieties of Aesculus seeds</td>
</tr>
<tr>
<td>2nd annual report</td>
<td>1935</td>
<td>72 packages of seeds</td>
</tr>
<tr>
<td>3rd annual report</td>
<td>1936</td>
<td>20 packages of seeds</td>
</tr>
<tr>
<td>4th annual report</td>
<td>1937</td>
<td>254 packages of seeds</td>
</tr>
</tbody>
</table>
In exchange, the Lushan Botanical Garden also sent out seeds to the Arnold Arboretum. The Arnold Arboretum maintains a detailed list of plants originated as seeds from Lushan, with total 128 living and dead plants. The following is a list of living plants as in 2004, provided by Dr. Del Tredici.

- Stewartia sinensis (AA #769-36 = S. rostrata)
- Albizzia julibrissin (AA #125-35)
- Lonicera modesta lushanensis (AA #765-36)
- Viburnum hirsutulum (AA #708-37 = V. hirtulum)
- Deutzia ningpoensis (AA #709-37)
- Hamamelis mollis (AA #362-76)
- Pinus hwangshanensis (AA #368-76)
- Stewartia sinensis (AA #373-76)

The Lushan Botanical Garden and the Arnold Arboretum also collaborated in many plant-collecting expeditions in different parts of China. Despite the war with Japan beginning in 1931 and causing many upheavals, Dr. Hu directed a five-year investigation of Yunnan Province, southwest of China that began in 1933 and by 1936 had harvested 30,000 specimens (Madsen, 1989). The Lushan Botanical Garden participated in the expeditions and provided financial support as documented in the LBG’s annual report in 1937. In 1938 the Arnold Arboretum joined the investigation and provided USD $600 financial support (Hu, ed. 2005). On a collaborative seed-collecting trip to the Burma-Yunnan border, many herbarium specimens and rare seeds were collected. New plants were discovered, named, and studied (Madsen, 1989). Like in many collections, the results were shared among the Fan Memorial Institute of Biology, the Lushan Botanical Garden and the Arnold Arboretum.

The Lushan Botanical Garden made remarkable achievements within the first 4 years from its inception. However, further development of the institution was interrupted by Japan’s invasion and occupation of Jiangxi Province in August 1938 (Hu, ed., 2009). The Botanical Garden had to relocate to Yunnan Province. A branch office of the LBG was set up in Lijiang, Yunnan Province, where the botanists continued their research and specimen collections until after the World War II (Hu, ed. 2014).

In 1946, Dr. Hu appointed F. H. Chen, his former student as the director returning to Lushan to reestablish the Botanical Garden, which was largely destroyed by the Japanese invaders. The institution suffered severe funding shortages between 1946 and 1949, during the Chinese Civil War period. The botanists and staff at Lushan overcame great difficulties in rebuilding the institution and its collection during this time. The funding from the Agricultural Institute of Jiangxi Province was extremely unreliable and insufficient. The Fan Institute of Biology, led by Dr. Hu continued supporting the Lushan Botanical Garden despite itself also being short of funds (Hu, ed. 2014).

At this very difficult time, in 1948 the Lushan Botanical Garden received USD $500 from Harvard University for a collaborative project to investigate the forests at the borders of Jiangxi, Hubei and Hunan provinces (LBG Annual Report, 1948; Hu, ed. 2009; Hu, ed. 2014; Hu, 2017). Expeditions were organized in 1947-1948 at the three-province borders with total distance travelled over 1,000 km (2,000 Chinese li), passing 12 counties north of Jiangxi Province, with a total of 1,538 specimens collected including 32 types of tree specimens, 1,100 bulb specimens and 71 types of seeds. There were a few new species and new records among these (Hu, 2009, Hu, 2014). After the Harvard fund was received in the fall of 1948, the Lushan team planned two more expeditions in the following year. However, due to the regime change in 1949, the collaboration stopped and the field work results may have never been sent to the Arnold Arboretum (Hu, 2017). According to the meeting notes dated Dec. 14, 1949, Dr. Hu said: “Harvard University provided a lot of financial support to the expeditions in Yunnan Province. We still owe 30,000 to 40,000 specimens to Harvard University, which should be mailed back to the university” (Hu, ed. 2005).

It is worth mentioning that in 1947, Dr. E. D. Merrill (1876-1956), former director at the Arnold Arboretum provided USD $250 to Dr. Hu from “the Arnold Arboretum restricted Chinese exploration fund” (Merrill, 1948; Del Tredici, 2007) for the Metasequoia seed collection. Due to the hyperinflation, USD $250 yielded 9,750,000 Old Chinese Yuan (estimated by Merrill). This gave some idea of the financial difficulties under which the Chinese botanists were carrying on their work. The money was sufficient to support the expedition in remote Sichuan Province from August through November, result in collecting roughly 2kg of
Metasequoia seeds, which were later distributed to over 600 different individuals and institutions across the world (Ma, 2003; Del Tredici, 2007).

On January 5, 1948, Prof. Merrill received the first seeds from Prof. W. C. Cheng (1908–1987) (Merrill, 1948), Dr. Hu’s former student and collaborator. The Lushan Botanical Garden also received 50g of Metasequoia seeds from Prof. Cheng (Wang, 1950; Hu, ed., 2014). During Lushan’s first growing season, about 3500 new seedlings germinated from 25g of Metasequoia seeds with an approximate 35% germination rate in 1948. Among them, about 2700 plants survived (Wang, 1950). According to Recollections on the Occasion of 80th Anniversary of the Lushan Botanical Garden, “The germination rate at Harvard University was terrific, but the Lushan Botanical Garden’s growth result was the best” (Hu, ed., 2014). It indicates information sharing among Chinese and American botanists, as part of the remarkable group efforts in redistributing and growing Metasequoia around the world.

5.3 Relationship in the new era

The three-province border forest cooperative investigation between the Lushan Botanical Garden and the Arnold Arboretum was disrupted and terminated after the Liberation of China in 1949. Criticized for his political writings and his ties to the West, Dr. Hsen-Hsu Hu’s final years were full of turbulence. He died in 1968, in the early years of the Cultural Revolution. Hu's charges were cleared in 1979 and his ashes were buried at the Lushan Botanical Garden in 1984 (Ma & Barringer, 2005, Hu, ed., 2014).

There was no collaboration between the Lushan Botanical Garden and the Arnold Arboretum for over 50 years until, in September 2004, Dr. Peter Del Tredici and Dr. Jianhua Li from the Arnold Arboretum traveled to China to participate in an international conference on the LBG’s 70th anniversary. During their visit to Lushan, the two scientists collected seeds and cones in the surrounding mountains, famous for a diverse flora that includes numerous conifers as well as deciduous trees (Del Tredici, 2005). One and half years later, Mr. Xiang Zheng, former Director of the LBG (2001-2005), then Director of Jiangxi Lushan Scenic Area Administration Bureau, visited the Arnold Arboretum in April 2006. In addition to visiting each other, the two institutions made the following three collaborative initiatives: 1) Dr. Del Tredici would work with the LBG to study the relationship between the Arnold Arboretum, Dr. Hsen-Hsu Hu, and other Chinese pioneers in botany; 2) The LBG would collaborate with the Arnold Arboretum to build the East Asian - North American disjunct plant gardens; 3) The two institutions would carry out plant diversity and systematic evolution research together (Bao, 2016).

On May 8, 2005, a memorandum of understanding (MOU) was signed by Dr. R. E. Cook and Mr. Xiang Zheng, then directors of the two institutions. “We, Arnold Arboretum and Lushan Botanical Garden, have reached an agreement to establish botanical gardens of disjunct plant genera between eastern Asia and eastern North America at both institutions. Both gardens will display closely related plant species that are naturally distributed at present in eastern Asia and eastern North America. Such gardens will function for both educational and research purposes. Over the next five years, we will collaborate closely on collecting germplasm of about 30 genera and 200 species and introducing them into both gardens. Lushan Botanical Garden will design and implement its specialty theme garden with accessories required to establish the garden at Zhu Quan Shan, and is financially responsible for such activities. Arnold Arboretum will incorporate such plants into its Leventritt Garden under the same conditions.

Arnold Arboretum will provide funds (up to $5000 per year for germplasm collecting trips in China to be conducted solely by the staff of Lushan Botanical Garden, or jointly with the staff of Arnold Arboretum. Our annual goal is to collect germplasm as well as herbarium vouchers and desiccated leaf material from wild populations of 40 species. The areas selected for exploration each year will be reviewed and agreed upon by both parties in advance of the collecting season. The Arnold Arboretum will collect germplasm of eastern North American plants for shipment to Lushan. The germplasm and voucher specimens will be shared by both gardens…” (The Archives of the Lushan Botanical Garden).

In October 2005, only a few months after the memo was signed, Mr. Zheng was transferred to another job. The original signed documents were forgotten and could not be found until a signed copy in both Chinese and English was rediscovered in the archives of the Lushan Botanical Garden in 2017.

Among the three collaboration initiatives, Dr. Del Tredici completed the first one in 2006. His paper entitled “The Arnold Arboretum: A Botanical Bridge between the United States and China from 1915 through 1948” was published in Bulletin of the Peabody Museum of Natural History by Yale University in 2007. Regarding the second and third initiatives, in November 2005, the Chinese Academy of Sciences approved
a grant applied by the LBG to build the East Asian - North American disjunct plant garden. Covering an area of 2 acres, the project started in 2006 and was completed in 2009 after passing the inspection by the Chinese Academy of Sciences (Bao, 2016). The result was a new collection of 22 genera and 80 species, of which 44 species were native in China and 36 were foreign species, including 16 native in the U.S. (Gao, 2017). In the project report prepared by the LBG in 2009, an unsigned copy of the MOU between the two institutions was attached.

However, for some unknown reasons, the collaboration fell apart. The Arnold Arboretum was not involved to any significant degree in this project (Gao, 2017; Hu, 2017). No follow-ups and active collaborations were undertaken since their initial visits a decade ago. Both institutions went on building a disjunct plant garden without collaborating with each other. At the East Asian - North American disjunct plant garden in Lushan, among the 36 foreign species accessioned into the collection, some were from the west coast in the U.S., such as Torreya californica. Some were even from Europe (LBG report, 2009).

In July 2011, a delegation of Lushan Botanical Garden called "East Asian - North American plant investigation group" visited the U.S. led by the associate director of the LBG. Invited by the Hoyt Arboretum, the group visited the west coast including Hoyt Arboretum, World Forest Center, University of Oregon and other organizations in Portland, OR (Lushan Botanical Garden website, 2017). However, they did not stop by Boston to visit the Arnold Arboretum of Harvard University.

Presently all of the people involved with reestablishing the ties between the two have left their respective institutions including the directors and scientists from both sides.

6 RECOMMENDATIONS TO ADDRESS THE CHALLENGES

Historic study reveals the main obstacles between the Lushan Botanical Garden and the Arnold Arboretum in reestablishing a closer partnership lie in several aspects, including the political environment and control, organization systems, cultural differences, communication channels and physical barriers. Today, lack of time, funding, proper contacts and personal relationships are the major collaborative challenges in rebuilding the lost bond.

This paper puts forward the following recommendations as key strategies to address the challenges.

6.1 Establish common goals and objectives

Common goals and objectives should be established before the two institutions work together on any individual project. Working towards the same goals will encourage team leaders and team players with a strong sense of purpose. Goal setting can improve engagement and collaboration when people at both organizations realize the goals cannot be reached without teamwork.

6.2 Develop mutually beneficial, collaborative projects

Successful collaboration should be mutually beneficial and reciprocal to achieve a win-win outcome. Many projects in the botanical field can be mutually-beneficial, such as seed exchange programs, staff training and educational programs, joint botanical expeditions, collaborative studies on threatened or endangered species, and joint investigations on the impact of invasive species, etc. It is important to prioritize and carefully select such projects that everyone will be able to benefit from.

6.3 Improve organizational communications and information sharing

In today’s internet age, there are many channels for organizational communications compared to those in the old days. The effective way for communication is to send messages across multiple channels, such as face-to-face meetings, emails, faxes, phone conversations, skype and wechat (a social media application widely used in China). This paper suggests both institutions set up and maintain a collaborative website for information sharing.

6.4 Provide a staff exchange and training program

Regarding the collaboration between the LBG and the Arnold Arboretum, some of the biggest challenges lie in language barriers and cultural differences. Staff exchange is one of the most effective means of nurturing cross-cultural professional relationships while also expanding opportunities for other types of botanical exchanges (Seyler & Lyons, 2011).
6.5 Establish personal relationships at the leadership level
Establishing strong personal relationships among decision makers is essential to long-term successful collaboration. With an open mind, strong personal relationships can be built through effective communications with mutual respect, active networking and on-going relationship building.

6.6 Identify key coordinators for collaboration
Key coordinators are critical in developing collaborative projects, exchange of information and organizing events. The failure in the East Asian - North American disjunct plant garden collaboration was partially due to the fact that the scientists in charge of the project from both institutions changed jobs. Regarding the issue, this paper suggests the following - On the Arnold side, a staff member trained in the West with Chinese language proficiency and similar cultural background is recommended as the key coordinator. On the Lushan side, an experienced researcher with English language proficiency is recommended as the key coordinator. Both coordinators shall remain in contact with each other on a regular basis.

7 CONCLUSION
China has undergone tremendous changes over the past 40 years and has profound impact on the world’s natural environment and ecosystems. Biodiversity in many parts of China has been steadily degraded and forests are disappearing due to over-felling and land development.

International collaboration is increasingly pursued by botanic gardens, arboreta, and other scientific institutions around the world as we face more and more pressing challenges today, such as environmental degradation and global climate change. These issues are truly international in scope and require effective collaboration at all levels.

Researchers note that the most successful collaborations are ongoing and involve meaningful institutional commitments that last over time. A successful collaborative relationship goes beyond individual projects, outliving the founders, and significantly benefitting the participating institutions on a number of fronts. Nonetheless, engaging in a meaningful international partnership is easier said than done (Seyler & Lyons, 2011).

The collaboration between the LBG and the Arnold Arboretum will fulfil the missions set aside by both institutions. It will fit well in the Arboretum’s 10-year collection plan, with an emphasis on China as “the single most important source of acquisitions from the wild” (Shaw, 2016). As a world-leading botanical research institution, the Arnold Arboretum played an important role in training the first generation of Chinese botanists, who had made incredible contributions to China’s modern botany. The LBG still has a lot to learn from the Arnold Arboretum in today’s information era. Providing continuous training in botany and beyond in other interdisciplinary fields across countries is essential to build a better and sustainable future together.

The forests of Asia are among Earth’s most threatened ecosystems (The Arnold Arboretum website, 2017). The Lushan mountain region has extraordinary ecological resources and biodiversity despite the forest of Lushan has long been taken for granted and neglected. A fortified long-term partnership between the Lushan Botanical Garden and the Arnold Arboretum is imperative and should be restored without any delay. This partnership will have significant impacts and provide enormous contributions in preserving the biodiversity of the world’s forests and endangered ecosystems, via research, education, information exchange and mutual support - all of these forming a new botanical bridge between China and the U.S. in the 21st century.

8 ACKNOWLEDGMENTS
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CROSS-CULTURAL PARTICIPATORY DESIGN ASSESSMENT ACROSS DIFFERING INTERNATIONAL POLITICAL CONTEXTS

NASSAR, HALA
Professor of Landscape Architecture, Department of Landscape Architecture, Clemson University, hnassar@clemson.edu

HEWITT, ROBERT
Associate Professor of Landscape Architecture, Department of Landscape Architecture, Clemson University, hewitt@clemson.edu

1 ABSTRACT
The study utilizes areas of scholarship in cross-cultural settings and participatory design to develop assessment criteria for international design studios across varying political contexts (Hou 2010, Nassar & Hewitt 2010). As part of the study, two cross-cultural design courses between American/Egyptian students and American/Iranian students were used to establish baseline relative cultural/political differences utilizing Inglehart–Welzel cultural assessments, “EIU Political Index” assessments, and “Conflict Barometer” assessments. The American/Egyptian student groups and the American/Iranian student groups were observed and surveyed to assess the extent of their community design participation, student learning, listening openness, student group common purpose, individual actions, relative cultural awareness, and their means of collaboration in the United States, Egypt, and Iranian. The study evaluated meaningful work by students in both classes as a comparative metric for educational outcomes. Meaningful work included shared regional and local research; research related to planning for development; collaborative fieldwork for site inventory and analysis; community resident interviews and analysis; collaborative site analysis and conceptual development; group presentations; and presentations to government officials about fieldwork findings including community survey information. Findings suggest that: 1) the greater the cultural/political differences between the three student groups, the less meaningful work accomplished by the groups (largely as a result of perceived and imposed participation limitations); and 2) the more collaborative means of sharing knowledge, flexible ways of thinking, studying and learning, the greater the perceived influence of culture in stimulating creative thinking and mediating cultural/political differences.

1.1 Key Words
Multicultural, Participation, Design, Politics, Pedagogy


2 \textbf{INTRODUCTION}

While demand for participatory design within democratic cultures remains significant over the last four decades (Alinsky 1971, Hester 1990, Sanoff 2000), effective methods for cross-cultural international design education between members of fully democratic and less democratic societies is largely unaddressed. Landscape architecture education scholarship suggests that contemporary participatory design techniques can address both cross-cultural and global contexts (Hou 2010, Angotti 2017, Irazibal 2016). CELA Conference discourse concerning community participatory techniques (Hester & Hou 2015) has also recently addressed participatory cross-cultural design. This paper extends that discourse into contexts of differing cross-cultural political orientation: examining participatory design techniques for landscape architecture educators working across international contexts with distinctly different values related to community participation activities and with significant differences in the political philosophies of student home countries.

An examination of the intersection between design scholarship in cross-cultural political contexts and recent cross-cultural participatory design scholarship suggests several promising areas of research in international design education. Research in landscape architecture international education (Hewitt & Nassar 2005) identifies three topics closely associated with participatory design discourse relevant to this study: 1) course cultural context, 2) means of collaboration, and 3) global political context (Callan 2004; Zeszotarski 2001). International education discourse and participatory design discourse relevant to this study emphasize: 1) an enhanced sense of culture: 2) better participant understanding of place in the design context: and 3) the importance of shared cultural contexts at local/regional and international/global scales (Callan 2004; Haug and Race 1998; Zeszotarski 2001). Hou suggests that these areas of interest may be particularly challenging when impediments related to both language and culture effect communication and participant engagement (Hou 2013).

While Hou rightfully states that many of these challenges can be overcome through an acknowledgement of familiar community perceptions, existing organizations, social groups, and participatory activities (Hou 2011), Giroux stresses learning in cross-cultural settings, particularly in settings where official communication might be restricted, as can occur between societies with very different political systems (Giroux 1997). Friere makes note of the importance of listening openness for learning in such situations, especially where communication may be intermittent and mediated (Friere 2000). Taylor emphasizes the importance of common purpose and action to increase design process relevance during cultural geopolitical conflict and in the face of identity-based politics (Taylor 1992).

These notions of collaborative learning, listening openness, common purpose, recognition of place, and shared cultural context serve as common themes informing both participatory design in cross-cultural political contexts and participatory design in general. It is this sense of common themes between participatory design and international design education that informs our exploration of participatory design in cross-cultural political contexts, and particularly those aspects most amenable to working groups from very different cultural/political backgrounds. The paper draws on research related to student educational experience in collaborative urban design studios between American and Egyptian Universities (Nassar & Hewitt 2010), and in fieldwork courses between American and Iranian Universities evaluating the effects of globalization on the landscape in Tehran (Hewitt, Hekmatfar, Nassar, Mansouri & Eshrati 2009).

3 \textbf{METHODS}

Research methodology includes the use of pilot surveys administered to four groups of students in one landscape architecture studio and one field study course from three countries, each exhibiting considerably different cultural values and different political orientations. In the studio, Egyptian and American students were surveyed with identical instruments at the end of the analysis phase, the master plan phase, and at the conclusion of the studio. Collaborative studio methods and techniques addressing decision-making and design participation were recorded. The Iranian and American collaborative course on globalization and landscape change in Tehran included undergraduate, and graduate American students in landscape architecture and undergraduate students in landscape architecture at the University of Tehran. Both groups of students were surveyed with identical instruments at the conclusion of the course. Attention was paid to the collaborative transactions between and among student designers. Constituent community members were not available out of concern for adverse political ramifications.

Inglehart–Welzel cultural assessment maps (World Values Survey 2017) and a “Democracy Index” (Boudagga 2014) were used to approximate the relative cultural/political orientations associated of the student groups’ national societies. Inglehart–Welzel cultural assessment maps locate values of national
societies for analytical purposes along two perpendicular dimensions, based on a national society’s preferences related to traditional values and secular-rational values, and based on each national society’s preferences related to survival values and self-expression values. According to this assessment method, traditional value rankings correlate with levels of societal preferences for religion, traditional family values, and deference to authority, often including high levels of national pride and nationalistic outlooks. Secular-rational values, in turn, reflect opposing preferences to those associated with traditional value preferences. Similarly, survival values emphasize economic and physical security, indicate relative ethnocentricity, and include lower degrees of social trust and tolerance. Self-expression values prioritize environmentalism, tolerance of outsiders, gender and sexual equality, and often include individual decision-making in economics and governance.

Figure 1. Ingelhardt - Welzel cultural assessment map for Geography, Income, and Religion 2014, Public domain image from World Value Survey: Ingelhardt-Welzel cultural assessment map http://www.worldvaluessurvey.org/WVSContents.jsp.

In addition to mapping socio-cultural values, Inglehart–Welzel cultural assessment maps correlate well with designations reflecting political orientation and governance such as post-communist, liberal democratic, authoritarian, and traditional sovereignty. (See Figure 1) An analysis of the Inglehart–Welzel cultural assessment map identifies Egyptian relative cultural values as among the most traditional (-1.70 on a scale of -2.0 to +2.0) and moderately skewed towards survival values (-.50 on a scale of -2.0 to +2.0). Iranian relative cultural values are very traditional (-1.25 on a scale of -2.0 to +2.0) and moderately skewed towards survival values (-.50 on a scale of -2.0 to +2.0). American relative cultural values are moderately traditional (-.75 on a scale of -2.0 to +2.0) and are among the highest in self-expression (+1.75 on a scale of -2.0 to +2.0). These value assessments suggest a range of deference to authority and traditional values from most deferential in Egypt to very deferential in Iran and moderately deferential in the United States. They reflect relatively equivalent survival values in both Egypt and Iran with very high self-expression values in the United States.
Inglehart–Welzel cultural assessment maps correlate well with “EIU Democracy Index” designations reflecting political orientation. The Democracy Index, published by the U.K.-based Economist Intelligence Unit, is an assessment of national political orientation ranging from fully democratic to authoritarian. The index derives from 60 indicators grouped in five different categories measuring pluralism, civil liberties, and political culture. Countries are rated as Full Democracies (greens in Figure 2), Flawed Democracies (yellow in Figure 2), Hybrid Regimes (oranges in Figure 2), or Authoritarian Regimes (reds in Figure 2). In the context of our study, the Inglehart–Welzel cultural assessments correlate with “Democracy Index” assessments describing Egypt's political orientation as a “hybrid regime” (3-4 on a scale of 0-10). It describes Iran's political orientation as “authoritarian” (0-2 on a scale of 0-10), and the United States as “close to full democracy” (8-9 on a scale of 0-10). Please note that the Inglehart–Welzel assessments describe Egypt as relatively more culturally deferential to authority, while the “Democracy Index” identifies Iran as relatively more authoritarian politically. (See Figure 2)

![Figure 2. EIU Democracy Index map 2014 Adapted from public domain image "EIU Democracy Index 2014 green and red by Boudagga" from eiu.com. Licensed under CC BY-SA 4.0 via Commons.](image-url)

Observations throughout the two classes concerning student cultural values and political orientation occurred throughout the semester. For example, in the American/Iranian course, initial discussions among students and between professors identified concerns from both groups about the sensitive nature of the collaboration given the political climate between the United States and Iran. Fieldwork aspects of the course were limited because of travel restrictions imposed by the respective national governments. Both American university personnel and the professor of landscape architecture at Tehran voiced concern about potential political ramifications associated with official contact between American and Iranian universities. As a result, official communication was limited to informal communication through the internet, while community participation was not possible at that time.

A “Conflict Barometer” developed by the Heidelberg Institute for International Conflict Research (Heidelberg Institute 2009) informs deeper understandings of the relationship between Inglehart–Welzel cultural values, the “Democracy Index” assessments, and the American/Iranian students' sense of inhibiting political climates. The Institute’s “Conflict Barometer” cites continuing conflict between Iran and the United States during the time of the course related to Iran’s nuclear program, the finance and arming of various regional militia groups, and sporadic low-level diplomatic and military confrontation. The year of the studio, the U.S. President made several positive diplomatic overtures, reciprocated by the Iranian president, which in retrospect may have contributed to a political climate favorable to our informal collaborative work.

In contrast to the American/Iranian course, the American/Egyptian studio presented only modest concerns about cultural/political sensitivity, and few concerns about collaboration given political relations...
between the United States and Egypt. Fieldwork was modestly limited because of political instability within Egypt at the time. There was little apprehension about punitive actions by either government, or about official contact between American and Egyptian participants. While transactions occurred only between Iranian students and their constituent community members in Iran, transactions between both American and Egyptian students and their constituent community members in Egypt took place informally, and were not officially sanctioned.

The “Conflict Barometer” also informs deeper understandings of the relationship between Inglehart–Welzel cultural values, the “Democracy Index” assessments, and the American/Egyptian students’ inability to work officially with community participants. The “Conflict Barometer” cites a decades-long continuing conflict between the Egyptian government and several large banned opposition groups and a formal state of emergency in effect since 1981. It also notes Egyptian police detention and arrest of several political opposition groups for activities in support of Palestine, which upon retrospect may have increased the sense of domestic instability that limited official contact with the community.

3.1 The Participation Assessment Conceptual Model

Student and educator perceptions and activities, cultural assessment mapping, indices of national political orientation and metrics of national conflict between the three countries, taken as a whole, suggest an assessment model for cross-cultural/political orientation and participatory design. It suggests a preliminary scope of design participation that can range from: 1) (in re Iran) field work limited by travel restrictions, fear of political potential political ramifications due to official communication, and restricted community participation; to 2) (in re Egypt) concern about political instability, modestly limited field work, little apprehension of punitive actions for official contact, and some restricted community participation with supervised data collection and analysis; to 3) (in re United States) long-practiced community design participation, concern about best-practices for cultural inclusion, few limitations on fieldwork or data collection, but significant to modest concerns concerning contact and work with different countries related to US domestic and international political orientation.

3.2 Studio and Course Survey and Findings: The American/Iranian Course

Communication between the American/Iranian groups was facilitated by one student from each of the student groups acting as intermediaries to share information, to translate English and Farsi as needed, and to act as contact points for communication. The students in Tehran provided a website to post information, but the provision of a complimentary website at Clemson was perceived as too controversial given the political climate in the United States. Students shared the results of research findings over the course of the semester, and the results of fieldwork in Tehran throughout the semester with intermediaries and the Tehran website (Hewitt, Hekmatfar, Nassar, Mansouri & Eshrati 2009).

In addition to the Iranian-only fieldwork studies, surveys were distributed among all course participants. Six American students responded to the survey questions, as did twelve students in Tehran. The survey questions to the students addressed: 1) communication barriers and facilitating communication within the course; 2) student perception of official and unofficial communication; and 3) the learning and personal benefits of the cross-cultural course. Findings from the surveys suggest that: 1) both groups of students considered geopolitical distance most pressing while the Iranian students were more concerned with how to bridge the communication barriers; 2) both groups of students agreed that official communication between the two groups remained inhibiting, and that unofficial communication was critical to the course’s success; 3) both student groups emphasized the value of unique and collaborative ways of sharing knowledge, and the usefulness of the seminar’s communication techniques; and 4) both groups reported a greater understanding of people, ways of thinking, studying and learning, and their place in the larger world (Hewitt, Hekmatfar, Nassar, Mansouri, Eshrati 2009).

American student responses emphasized the value of “unique ways of sharing knowledge,” unique subject matter, and the usefulness of the course communication techniques. The students from Tehran were especially interested in the collaborative aspects of the course. Student comments noted the importance of “collaborative education between universities,” of comparative cultural experience, “understanding of life styles,” of “cooperative and individual learning,” the exchange of professional information, and the importance of these kinds of collaborations in a globalizing world. They also expressed greater personal appreciation for the role of education in interpreting and mediating the relationship between conflict, place and culture. The students from Tehran described the personal benefits of participation in terms of a greater understanding of people, of "ways of thinking," “studying and learning,”
and of their place in the larger world. Concern was voiced by Iranian students concerning the confidentiality of their participation in the course, (Hewitt, Hekmatfar, Nassar, Mansouri, Eshrati 2009).

Consideration of meaningful work by the two groups is particularly important in establishing value related to course educational outcomes in these contexts. Meaningful work in the form of specific findings related to globalization and landscape change in Tehran suggests that: 1) resistance to modernization in Tehran has been relatively consistent over the last fifty years; 2) global technological and economic forces nevertheless has prompted significant changes in the landscape of Tehran; 3) change included the loss of traditional urban/village forms like the city wall, streets with water channels, and heritage trees that contributed to local identity; and 4) the loss of these traditional forms is exacerbated by extensive urban growth with non-traditional forms of streets, residential blocks, and industrial areas (Hewitt, Hekmatfar, Nassar, Mansouri, Eshrati 2009).

3.3 Studio and Course Survey and Findings: The American/Egyptian Studio
Surveys were distributed to both groups of students. Fifteen American students responded to the survey questions, as did twenty Egyptian students. The survey questions addressed: 1) cultural navigation skills, 2) understanding cultural attitudes, 3) awareness of common global and local contexts, 4) differences in language and areas of knowledge, and 5) communication. Findings from the surveys suggest that cultural exchange in different cultural settings can increase the sense of cultural understanding, develop/enhance respect for other cultures, and grow with greater collaborative contact (Nassar & Hewitt 2010). In terms of the learning aspects, American/Egyptian student responses were similar to American/Iranian responses concerning the value of communication and sharing knowledge, and the value of both cooperative and individual learning. American/Egyptian students exhibited enhanced culturally related critical thinking; on-line communication skills to enhance face-to-face communication; awareness of the value of culture shock in stimulating creative thinking; and an increased awareness of common global and local phenomena (Nassar & Hewitt 2010).

In contrast to the American/Iranian course, the American Egyptian studio had fewer barriers for community participation. Meaningful work accomplished by the American/Egyptian students, included: shared regional and local context research, research related to planning for development, collaborative fieldwork in Egypt, community residents interviews and analysis, collaborative site analysis and conceptual development, and presentations to government officials that included resident survey information. While the American/Iranian course provided a preliminary baseline for minimum levels of participation and significant meaningful work, the American/Egyptian studio produced higher levels of participation and significant amounts of meaningful work despite greater difference in cultural values according to Inglehart–Welzel assessments. This is likely the influenced by relatively less American/Egyptian political conflict during the course period as noted in the “Conflict Barometer” assessment.

3.4 Discussion and Conclusions
In sum, the above examination assessing culture, political orientation, global context, and participation in landscape architecture education suggests: 1) the value of listening openness, common purpose, action, culture, and collaboration in course pedagogy across differing cross-cultural political contexts; and 2) the worth of predictive political and cultural assessment models to evaluate community participation course components in differing cultural/political contexts. Promising areas for further study might address: 1) methods of virtual community participation in cross-cultural landscape architecture pedagogy in the context of differing cultural/political orientation; 2) the effect of predictive models on community participation planning and development in cross-cultural political contexts; and 3) the effect of individual student and group cultural/political values on landscape architecture pedagogy in the context differing cross-cultural international landscape architecture education.

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APPENDIX
The Landscape Research Record publishes top quality articles selected from manuscripts submitted to the Council of Educators in Landscape Architecture (CELA) annual conference each year. The Record serves the mission of the CELA, that is, to encourage, support and further education in the field of landscape architecture specifically related to teaching, research, scholarship, and public service. The Record contains recent research and scholarship in all aspects of landscape architecture, distributed in the following tracks:

- Communication and Visualization
- Design Education and Pedagogy
- Design Implementation
- History, Theory and Culture
- Landscape Performance
- Landscape Planning & Ecology
- People-Environment Relationships
- Research & Methods
- Service-Learning and Community Engagement
- Sustainability
- Urban Design
- Film

The steps and typical timeline of the peer review are described below.

**Abstract Submittal: September**
Peer-reviewed article publication on the Record starts from the abstract submittal to the CELA annual conference. The CELA executive office sends out Call for Abstracts around August each year.

**Abstract Review: September-October**
The Vice President for Research leads the track chairs in the abstract review. Double blind review is used. Each abstract is reviewed by at least two reviewers.

**Paper Submittal: January 20-25**
Authors of accepted abstracts receive the invitation to submit a full paper in November. The deadline is in January of the following year. The papers submitted at this time are not peer reviewed but only edited to satisfy the conference standard. Papers that do not follow the template of the conference are rejected.

**The CELA Annual Conference: March-April**

**Paper Review: May-June**
Papers that are submitted in time in January and stratify the conference standard become eligible to enter the peer review for the publication in the Record. The track chairs manage the review for their tracks and select high quality papers based on the score of abstract review, grammar, completion of study, contribution of new knowledge, format quality, etc. The track chairs then send out selected papers to at least two reviewers.

**Review Result and Revision: July**
Track chairs collect review results and make recommendations on the manuscripts. Papers that are accepted with revision requirement will be sent back to the authors in July.

**Final Manuscript Submittal: August**
Authors submit final manuscripts by August 31st. All papers are published by December 31st.

**The Outstanding Paper Award: December-March**
The CELA Executive Committee has authorized The Outstanding Paper Award for published papers in the Record. The Vice President for Research and track chairs collectively select the winning paper. CELA notifies the winner(s) of the award, which is presented at the following CELA Annual Conference.