EVALUATING APPROACHES TO PARTICIPATION IN DESIGN: THE PARTICIPANTS' PERSPECTIVE

by

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ABSTRACT

Landscape architects and other designers rely on users for feedback about their needs, concerns, and reactions to potential solutions. While these well-intended efforts often fail to meet their goals, evaluations of the effectiveness of design participation from the participants' perspective is lacking. Drawing on the Reasonable Person Model as a conceptual framework, the three studies reported here evaluated participants' understanding of design options, engagement, and sense of meaningful participation. The first two studies, in the context of a design project for nature trails at a medical campus in Midwest U.S., used design sessions and a photoquestionnaire. The third study followed a more systematic approach to compare the effectiveness of different types of design drawings.

Participants found the design sessions engaging and their input meaningful. However, the differences in understandability for the different designs are attributable to presentation format, organization, and design graphics. Furthermore, the more difficulty participants had understanding the design presentation, the less they liked the design option presented. This study also found that the photoquestionnaire compared favorably to the design presentations.

The photoquestionnaire, the focus of the second study, showed that this approach performed particularly well in promoting a sense of meaningful participation for the participating visitors and employees. It also revealed the importance of offering multiple avenues for people to express their concerns so they feel that they have been heard.

The third study found photorealistic and perspective drawings to be more understandable and engaging and to promote greater confidence in discussing the design than plans and sections. Notably, some plans and sections, characterized as simple, neat, coherent, legible, and using colors that matched common perceptions, performed better than some photorealistic and perspective drawings. Simplification

in the representation of design features also enhanced understandability in some cases.

This research reveals ways designers can facilitate a participation process that meets the cognitive and psychological needs of participants and leads to reliable, useful feedback. It empowers designers by helping them see they *can* make a difference in creating an effective participation process.

CHAPTER 1

INTRODUCTION

Landscape design projects almost always involve some form of participation from laypeople. Landscape architects seek feedback on their design ideas from clients, and less often, from potential users. Input may also be sought from local citizens, a process that has become increasingly common as more local governments mandate public participation in planning and design decisions. Participation can take many different forms, such as commenting on a design presented at a public meeting, brainstorming ideas with other community members in a design session, or rating one's preferences in a survey.

People develop strong attachments to the environments in which they live, work, and play. When proposed changes to these environments are made, having the opportunity to provide input can make a substantial difference in people's reactions, cooperation, and support for the project. People seek opportunities to make a difference, share their knowledge, use their skills, and gain the respect of others. They appreciate being asked for their input on matters that affect them. Without these opportunities, feelings of helplessness, anger, and frustration can overtake them. Participation in the design process can provide an opportunity for people to contribute to something meaningful and feel they can make a difference. As a result, it can have a significant impact on people's satisfaction and quality of life.

Participation from potential users in the design process can benefit the design of the setting as well. Participants can provide valuable information about day-to-day operations, potential uses, and maintenance issues. As a result, the design can better meet the needs and preferences of the users and increase the likelihood that the setting will be used and cared for in the long run.

Participants typically come from a wide range of disciplines and may have little to no design experience. Yet in order to provide useful and informed input, they must be able to interpret the design drawings, visualize the alternatives, and anticipate consequences of the various options. If the information presented is too complex, then it can preclude participation for many people. Difficulties understanding the design drawings and terminology used in design presentations contribute to these problems. Also, the approach used to gather people's input impacts who is able to participate. For example, many people may not be able to attend a design session or public meeting, thereby excluding them from the process.

Landscape architects play a critical role in inviting feedback and helping laypeople envision the future landscape so they can consider various design alternatives, yet they rarely receive training on how to communicate their ideas to laypeople and seek their input in a meaningful way. In fact, little is known about the effectiveness of different participatory design methods in sharing information and supporting participants' ability to provide useful input. In addition, despite the fact that landscape designers rely heavily on design drawings to communicate design ideas, little research exists on how understandable and engaging different types of design drawings are from the layperson's perspective. Filling these knowledge gaps in order to find ways to enhance the effectiveness of participation efforts in landscape design is the main goal of this research. It also aims to empower the designer with the knowledge and tools necessary to create a participatory process that meets the cognitive and psychological needs of all involved.

This dissertation evaluates several methods for gathering people's input on the design of small-scale nature settings and assesses visualization tools commonly used in such efforts. Two participatory methods, the design session and photoquestionnaire, are evaluated in the context of a design project for nature trails at a medical campus in Midwest U.S. In a subsequent study, a more systematic approach was used to compare the effectiveness of different types of design drawings. In all cases, the design projects represent small-scale nature settings, as opposed to regional or large-scale planning and design projects. A significant portion of projects in landscape architecture are small in scale, yet they have received little attention in the literature. Evaluation criteria were chosen primarily with the participant in mind, seeking their perspective on issues of understandability, engagement, and participation.

At the same time, this research contributes to environmental psychology research intended to learn more about the kinds of environments that bring out the best in people. A theory of these supportive environments is provided in Kaplan and Kaplan's Reasonable Person Model (RPM) (2003; 2009). RPM is grounded in years of cognitive and environmental psychology research revealing the significant role that information and the environment play in people's behavior. In this context, the environment refers broadly to people's surroundings, situations, or conditions under which they must function or operate. It could be the physical surroundings, people with whom they interact, or the mode or method of interaction. While the model, described in more detail in the next section, has been supported by anecdotal evidence and makes intuitive sense, it has never been tested empirically. This dissertation presents an application of RPM and tests the predictions of the model in the context of participation in design. The evaluation criteria chosen in the study are derived from the three main components of the model, thereby allowing the relationships predicted by RPM to be tested.

A number of factors are expected to play a role in creating a supportive environment for participation in design. One factor expected to influence the participants' experience is the method of participation or structure of the participatory process, including the presentation format, visual materials used, task asked of the participants, and the forum provided for sharing input. These issues are the focus of this research. Many other physical and social aspects of the environment, such as the number of people involved, size and layout of the space, and presence of plants and windows also are likely to affect the interactions that take place; however, these characteristics of the environment are not addressed in this research.

Guiding framework: The Reasonable Person Model

It is easy to think of examples where participation did not turn out to be as effective, engaging, or informative as it was hoped to be. Think of the typical public meeting where people are invited to share their opinions about a public project. Often attracting the most passionate or irate citizens, these public meetings can fail to provide an environment conducive to two-way information sharing and feeling that one has been heard. The interactions that take place rarely result in a deeper understanding of the mental models underlying people's perspectives. Also, participants may feel they cannot affect the outcome since most meetings are conducted late in the design process when most decisions about the design have already been made. Public meetings like these leave much to be desired and typically result in frustration for both the designer and participant (R. Kaplan, Kaplan, & Ryan, 1998).

On the other hand, participation is more likely to be satisfying when people are able to share their perspectives in a setting that supports feeling that one has been heard and at a time when their input can make a difference. An example is a design project where doctors and parents of hospitalized children were invited early in the design process to share their input on a park design in an arboretum next to the hospital. The design was intended to encourage patients and families to visit the arboretum to take advantage of the benefits of spending time in nature. Doctors and parents were asked about the needs of the children and constraints facing them in using the nature setting. Their perceptions were radically different; the doctors focused on the impediments and risks associated with such activities for sick children, whereas the parents identified needs for their children to be able to act like children and take risks within some limits. The opportunity for both stakeholders to hear how their perceptions differed was critical in helping them understand the design problem and choosing a design that met the children's needs and desires. Doing so in a way that encouraged feelings of being heard and that demonstrated their ability to affect the outcome are believed to have contributed to the success of this participation project *(personal communication, R. Grese)*.

The Reasonable Person Model (RPM) (S. Kaplan & Kaplan, 2003, 2009) offers a framework for thinking about why some participation efforts may be more successful than others. The model was developed to offer an alternative to the widespread theory that people's behavior is primarily driven by their motivation to maximize self-gain. It points to the important role that information and the environment play in the way people act. It also speaks to the strong motivation people have to make a difference and be involved. Finally, it recognizes people's limitations in dealing with new information and emphasizes the significant effect their attention and competence have on their ability to do what is asked of them. These concepts are represented in three main components of RPM: mental model-building, meaningful action, and being effective, all of which play a significant role in people's quality of life.

RPM posits that people's behavior often can be explained by their innate desire to test and expand their understanding of the way things work and to share their skills and knowledge with others. This desire to understand and explore is captured in the **mental model-building** component of RPM. People's knowledge and experiences are stored and organized in their mind in what are called mental models. These mental models develop over time through many, varied experiences. They are critical in everyday functioning; they are used in making decisions, predicting what might happen next, and choosing how to act (S. Kaplan & Kaplan, 1982). People are motivated to test their mental models and adapt them to better fit the way they see the world; thus, providing opportunities for exploration is critical for model-building.

A number of challenges that arise in the participatory design process are related to expertise, or differences in the mental models of designers and laypeople. First, designers and participants may lack a common language in discussing the designs. Designers may use jargon or design drawings that participants have trouble understanding, most often without the designer realizing it (R. Kaplan, et al., 1998). As an expert's mental model changes with newly acquired knowledge and experiences, old ways of seeing are adapted (Chase & Simon, 1973; de Groot, 1965). This makes it difficult for designers to remember what it was like before achieving their expertise and may lead to inappropriate decisions if they attempt to put themselves in the participant's shoes. In order to connect with their audience, designers thus need to make a concerted effort to find out where the participants are at in terms of their knowledge and skills. Part of this research is intended to provide insight into the different perceptions of experts and laypeople, particularly related to different types of design drawings.

Participation offers **meaningful action** when the activity affords the participants the sense that their input matters and that they have been heard. It is more than the simple act of asking for input. Active listening, acknowledging the receipt of feedback, and demonstrating respect are important components of meaningful action (S. Kaplan & Kaplan, 2009). RPM suggests participation efforts that address these needs and capitalize on the human desires to make a difference and gain the respect of others can lead to a more satisfying experience. It also may lead to greater project support (Phalen 2009).

Anecdotes of participatory design projects have revealed that participants sometimes perceive designers to be arrogant (*Putting our heads together: Diverse ways to bring out the best in people*, 2010). They feel that experts speak to them in a condescending way and fail to recognize the knowledge and skills that the participants bring to the design table. Participants can offer valuable perspectives given their expertise in their community and in their role as citizens. Like designers, their mental models are informed by many years of experience. While this problem very well could be considered a failure in sharing mental models, the crux of the issue seems to be respect. Experts who proactively recognize and seek the participants' knowledge and perspectives demonstrate that they highly value the participants. These actions promote the participants' feelings of being heard and respected.

Being effective refers to maintaining mental clarity and gaining the competence necessary to achieve one's goals. Participation efforts can support being effective by asking participants to complete tasks that they are capable of doing or helping them develop the skills needed to carry out the task. Increasing designers' competence in facilitating the design process also can lead to a smoother, more effective participation process.

The other component of being effective, clear-headedness, relates to the idea that people have limited attention capacity. Directed attention, which requires mental effort and is susceptible to fatigue, is integral to functioning since it is needed to resist distractions, attend to important details, and regulate behavior. When people are attentionally fatigued, they may lack the ability to focus, have trouble listening to others, become irritable, or act in other unpleasant ways (S. Kaplan, 1995; Kuo & Sullivan, 2001). Recognizing this limited capacity when sharing new information with participants, choosing activities that are innately fascinating (e.g., story-telling, playing with or manipulating a physical model), and providing opportunities to restore their attention beforehand or rest after prolonged mental effort can promote clear-headedness.

According to RPM, people will be better able to provide useful feedback and will be more satisfied with the participation process when their needs for understanding and exploration, meaningful action, and being effective are met. The three components of the model are highly interrelated rather than stand-alone concepts (S. Kaplan & Kaplan, 2003, 2009). The following examples of these relationships in the context of participation in design are labeled in Figure 1.1:

> (A) Participants' ability to provide useful input will rely heavily on their ability to build a mental model of the design problem and visualize design possibilities.
>
> (B) An expert's effort to learn about the participants' mental models is not only a critical step in understanding their perspectives, but also in demonstrating respect and promoting participants' feelings of being heard. This can help build trust between the designer and participants, in addition to promoting meaningful action.
>
> (C) Meaningful action can lead to model-building since engaging participants in activities they find meaningful can provide opportunities for them to expand their mental models.
>
> (D) Understanding where the participants are at in terms of their knowledge and skills allows experts to choose effective methods for sharing information and to match tasks to the participants' interests and skills.
>
> (E) People have an easier time paying attention and concentrating on information or tasks that are relevant to their concerns and interests. Conserving limited attention can increase the attention available for other important tasks needed for model-building.

(F) Greater competence and knowledge may increase support and ownership of the project, leading to more meaningful action (e.g., becoming an advocate for the park, sharing stories with others, or maintaining the park).

(G) When designers see that their choices of approaches and visual graphics make a difference in helping participants understand, be engaged, and provide useful input, designers' competence in facilitating the participation process can increase.

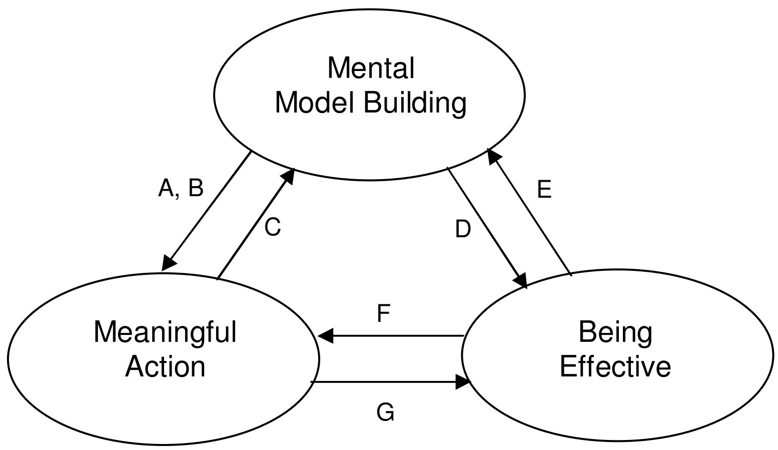

Figure 1.1 Interrelationships among RPM components.
(Examples A-G from the text are labeled in this diagram.)

Overview of chapters

The overarching goal of this dissertation is to provide insight into ways participatory approaches can provide a supportive environment for participants to share their input on the design of small-scale nature settings. The research addresses key issues in creating a participatory process that takes into account the cognitive and psychological needs of the participants, as identified in the Reasonable Person Model. It also assesses the effectiveness of visualization tools commonly used in design projects involving laypeople's participation.

Three main empirical studies were carried out for this research. The first two studies were conducted in the context of a design project for nature trails at a medical campus. The third study used a more controlled, experimental research design to assess specific types of design drawings traditionally used in communicating design ideas to laypeople. In all three studies, evaluation criteria were chosen based on the three components of the Reasonable Person Model: mental model-building, meaningful action, and being effective.

Study I: Design Session for Nature Trails

This part of the dissertation is based on a study involving a design session for a proposed nature trail at a medical campus. The design session was planned with two purposes in mind. It provided a venue where employees could share their preferences, interests, and concerns related to the nature trails to inform the design of the trails. Also, it sought their feedback on the approaches used to gather their input.

Chapter 2: Participants' Feedback on the Participatory Design Process

The first study compares two approaches for gathering feedback on design options. One approach involved three design presentations (using PowerPoint) and time for comments. The second approach was a photoquestionnaire where participants were asked to rate a series of 16 nature scenes in terms of their preference. In addition to rating their preferences for the design presentations and nature scenes, employees evaluated each design presentation and the photoquestionnaire on measures of understandability, engagement, and meaningful participation. Results are based on responses from 28 participants.

This chapter explores whether some design presentations and visual media are more effective than others in helping participants understand design possibilities and provide their input. It tests how the presentation format, organization of the PowerPoint slides, and graphics impact people's understanding, engagement, and sense of participation. Finally, it assesses how the photoquestionnaire compares to the more traditional design presentation approach in terms of understanding and engagement.

Chapter 3: The Reasonable Person Model and the Role of Understanding, Engagement, and Participation in Preference

The Reasonable Person Model purports that the three main domains of the model are interrelated (S. Kaplan & Kaplan, 2003, 2009). This chapter tests the relationships among understandability, engagement, and participation in the context of presenting design ideas and requesting feedback. It also explores the role that understanding, engagement, and participation play in people's preferences for design options. In other words, it investigates whether people's preferences for a design are influenced by the way in which the design is presented.

Study II: Photoquestionnaire (widely-distributed)

The second main study is an expansion of the first study. It collected feedback from a larger, more diverse population of potential users of the trails, including patients, visitors, and employees. The same photoquestionnaire used in the first study was used in this second study. In addition to rating preferences for the nature scenes, the participants evaluated the effectiveness of the photoquestionnaire as a tool for gathering their feedback on design options.

Chapter 4: Evaluating the Photoquestionnaire

This chapter presents findings from the participants' evaluation of the photoquestionnaire in terms of its understandability, engagement, and sense of participation. It discusses the strengths and weaknesses of the photoquestionnaire as an alternative method for acquiring feedback. The findings from this second study are based on 154 responses to the survey.

Study III: Effectiveness of Different Types of Landscape Design Drawings

The third study provides a more systematic approach to evaluating different design drawings in terms of their effectiveness in communicating design ideas. A literature review was conducted to determine the current state of knowledge in this area and to inform the choice of evaluation criteria used in the third study. The study, which was carried out using an online survey, compares four types of design drawings in particular: plans, sections, perspective drawings, and photorealistic drawings.

Chapter 5: A Review of Evaluation Criteria and Empirical Findings on the Effectiveness of Design Drawings in the Participation Process

This chapter presents a literature review that explored what is already known about the effectiveness of different types of design drawings in communicating design ideas, particularly from the layperson's perspective. The search was limited to studies on static visual simulations, since these simulations (particularly drawings) are the most commonly used tool for depicting small-scale, nature-oriented settings that do not yet exist. The review first identifies frameworks and criteria for evaluating visual simulations using two approaches. In one approach, the Reasonable Person Model is applied to questions on the effectiveness of visual simulations. The second approach presents literature-based standards and criteria developed for evaluating visual simulations. Empirical findings on the effectiveness of static visual simulations are then presented in terms of understanding, engagement, and participation. The role of realism in the effectiveness of visual simulations is also discussed. Findings from this review informed the design of the online survey used to evaluate drawings traditionally used in landscape design.

Chapter 6: Laypeople's Evaluation of the Effectiveness of Traditional Landscape Design Drawings

This chapter presents results from an online survey that consisted of a series of design drawings representing four different types: plans, sections, perspective drawings, and photorealistic drawings. People were asked to evaluate how understandable, engaging, and abstract the drawing was. They also indicated how confident they would be in discussing the design with the designer based on their level of comfort with the drawing. Comparisons across and within drawing type are provided on these measures. While survey respondents included people with varying levels of expertise in landscape architectural drawings and computer-generated drawings, the results presented in this chapter are based on laypeople's responses only (n=404).

Chapter 7: Role of Expertise in Perceptions of Design Drawings

This chapter discusses the role of expertise in understanding design drawings. It compares laypeople's and experts' perceptions of the effectiveness of different types of design drawings. Separate comparisons were conducted for understandability, engagement, confidence, and abstraction to assess differences between experts and laypeople for each of the drawing types. In addition, ratings by experts and laypeople were examined independently to determine how the drawing types compared to one another with respect to the outcome variables (understandability, engagement, and confidence) and perceptions of abstractness. Possible explanations for the findings are provided. The results are based on 495 survey responses, including 91 experts and 404 laypeople.

Conclusion

Chapter 8: Evidence-based Approaches to Participation in Design

The conclusion chapter highlights the usefulness of the Reasonable Person Model (RPM) in evaluating approaches to participation in design. It summarizes the findings from the three studies and discusses implications for creating a people-friendly participation process. The chapter also provides additional imagery of RPM by describing the usefulness of the studies' findings in terms of the three components of RPM - mental model building, being effective, and meaningful action. Each component is considered from the perspectives of both the designer and participant. The value of this research for educators and researchers is also discussed.

CHAPTER 2

PARTICIPANTS' FEEDBACK ON THE PARTICIPATORY DESIGN PROCESS

Gathering feedback from potential users is a critical step in designing outdoor spaces at the workplace that will meet the users' needs. However, the method one chooses to gain user input can make a substantial difference. Although participants' ability to provide useful feedback potentially depends on their ability to visualize design possibilities, be engaged in the process, and feel they can make a difference, there has been little research to address these concerns. This study compares a variety of participatory design approaches in terms of their expected usefulness in informing participants of design possibilities and gathering valuable feedback for the designer.

A design project for a park-like setting with nature trails provides the context for this study. The nature setting was proposed in the master plan for a university medical campus to provide opportunities for patients and staff to experience the outdoors and enjoy the site's natural features. A landscape architecture class at the university took on the project as an exercise in presenting design ideas to potential users and acquiring their feedback on the designs. Employees of the medical campus were invited to participate, thereby creating a useful match for a number of research goals. First, the study provides information to the designers about the needs and preferences of potential users of the trails. Second, it presented an opportunity to ask participants to assess the effectiveness of the approaches used to gather their input on the design. Third, it contributes to environmental psychology research by testing the predictions of a model that addresses how to create environments that bring out the best in people, called the Reasonable Person Model (Chapter 3).

Background

In order to better understand the vision and needs of the client, designers traditionally meet with an administrator or possibly a team of administrators and perhaps a few representatives of different user groups. Attempts to gather feedback from a wider range of potential users are uncommon, yet such broader user participation may have important benefits. First, by taking their concerns and preferences into account, the design is likely to better meet the needs of potential users and increase the likelihood that they will use the outdoor space. Second, user participation can increase their cooperation in the project, since people greatly appreciate being asked for their input in design projects that affect them (S. Kaplan & Kaplan, 1978, 1982). Also, because people often fear change that affects them, participation can help decrease their anxiety about anticipated changes by reducing some of the unknowns and offering them an opportunity to share their views (Carpman & Grant, 1993). Finally, participation can create a sense of community by bringing together people who may not normally work together to solve a common problem. This can open the lines of communication and provide opportunities to discuss organizational policies and other issues (Carpman & Grant, 1993).

While including user participation in the design process may require some additional effort, the added benefits of participation can far outweigh the costs. In fact, not including users could be more costly, time-consuming, and emotionally fatiguing in the end. An uninformed and unsupported design can result in project delays, requested changes during or after construction, and lost productivity for users of the space (Dewulf & van Meel, 2002).

Extensive literature exists on methods for incorporating participation in design. The International Association of Public Participation (2006) provides a long list of ways to acquire feedback, along with possible ways in which they can go right or wrong. Traditional approaches include information sessions and design meetings with a select group. Depending on the type and number of people involved, these meetings may be called workshops or design charettes. Sanoff (2000) provides an in depth discussion of these as well as other approaches, including walking tours, surveys, game simulation, and interactive computer programs simulating the site.

Design ideas are most often presented with perspective drawings, photomontages, plans, sections, and photorealistic drawings. Small-scale models with moveable parts also have been used in architecture, though less frequently. These models have been shown to be useful in helping participants, including children, share their ideas (Boyd & Chan, 2002; Carpman & Grant, 1993; S. Kaplan & Kaplan, 1982, 1989; Spohn, 2007). Carpman and Grant (1993) discuss this technique, as well as life-size simulations, in the context of hospital design. Simulating natural settings, however, presents different challenges than architectural designs. Research on the effectiveness of physical models in landscape design would be valuable.

The photoquestionnaire, on the other hand, has been used successfully in landscape design projects (Carpman & Grant, 1993; R. Kaplan, 1977, 1993; S. Kaplan & Kaplan, 1989; Marans, 1993). This type of survey asks participants to rate their preference for photographs depicting different design options. Researchers and designers used a photoquestionnaire in the design process for an outdoor courtyard at a hospital and received valuable information regarding users' preferences, particularly related to seating preferences and nature content (Carpman & Grant, 1993).

Although a variety of formats has been used for conveying design ideas and inviting feedback, there has been little effort to assess their effectiveness from the participants' perspective. Anecdotal evidence would suggest that different approaches vary substantially in terms of the information exchange they generate, as well as participants' cooperation and enthusiasm. Beyond the anecdotal, there are conceptual reasons as well that support the idea that the choice of methods used to acquire user input matters. According to the Reasonable Person Model (RPM) (S. Kaplan & Kaplan, 2003, 2009), people are better able to provide useful feedback and are more satisfied in the process when their needs for mental model building (including understanding and exploration), being effective, and meaningful action are met. These notions can be applied to participation in design in a number of ways. Participants' feedback is expected to depend on their ability to visualize and understand the design possibilities. Their enthusiasm and engagement in the process are anticipated to be closely linked to their ability to explore the options or play with different ideas. If they feel their input can make a difference, then they are more likely to participate as well.

While the benefits and challenges of public participation are well documented, few studies have addressed participants' ability to envision design options, actively engage in the process, and participate in a meaningful way. The importance of these three needs – understanding, exploration, and participation - though intuitively sensible is often overlooked in real world applications and their efficacy in enhancing participation has never been tested directly. The evaluation criteria chosen in this study are based on the Reasonable Person Model, thereby allowing the relationships predicted by RPM to be tested. (The relationships are investigated in the next chapter, Chapter 3.)

Method

Study site

The study took place on a medical campus associated with a large research university in the Midwest, U.S. The site is approximately 200 acres with an elevation ranging from 830 to 890 feet. The medical campus consists of four buildings where a variety of outpatient medical services are provided.

The landscape consists of woodlands (with areas of dense woods, open woods, and mixture of shrubs and trees), wetlands, an open field, detention pond, and abandoned quarry site. Two main roads run along the north and west sides of the complex. A residential subdivision is adjacent to the east, and a corporate research facility is located to the south. A few unmarked trails stem from the residential subdivision. Nearby residents are presumed to have formed these trails by walking and mountain biking in the area. These existing trails are not easily accessible from the medical facility.

Procedure

The Executive Director of one of the health centers on campus invited all employees on the medical campus to attend the design sessions. The email included a description of the project and stated that their participation was voluntary and their survey responses would be anonymous.

To accommodate as many employees and their schedules as possible, the designs were presented at two sessions, one in the morning and one in the afternoon, in two different locations on campus. Ten employees attended the morning session and 18 employees attended the afternoon session. Although each team's presentation was the same in the two design sessions, the order of the presentations and the people presenting for each team differed in the two sessions. Each session lasted one hour.

Following an introduction to the project and a basic description of the site, attendees viewed three PowerPoint presentations (later referred to as W, S, and E) showing alternative designs for the nature trail system. Immediately following each presentation and before the next presentation began, participants completed a survey both to rate their preference for the design option and to evaluate the presentation in terms of their understanding, engagement, and sense of participation. After each presentation, participants also had a chance to ask questions and share comments verbally or in the space provided on the survey. After viewing all three presentations, the attendees also completed a photoquestionnaire that consisted of 16 scenes depicting nature settings and possible design features for the nature trail system.

Main independent variable: Participatory design approach

The main independent variable in this study is the approach used to gather participants' input on the design of a small-scale nature setting. It compares three design presentations each of which use a combination of different visual graphics to depict design options for the nature trails. It also compares these presentations to an alternative method for gathering feedback – the photoquestionnaire. The photoquestionnaire has been shown to be a useful way to inquire about the concerns and preferences of a wide range of citizens or potential users (Carpman & Grant, 1993; R. Kaplan, 1993; Marans, 1993). However, its effectiveness in terms of enhancing participants' understandability of design options, and their engagement in and ease of completing it, have never been tested.

Design presentations

The design presentations were developed and presented by three teams of landscape architecture students. Prior to the design session and as part of the class curriculum, the landscape architecture students were involved in discussions related to the role of participation in design. They practiced presenting their ideas and were coached (by their instructor, another professional designer, and a researcher in environmental psychology) on how to make a presentation comprehendible, engaging, and receptive to comments. A combination of different visual graphics was used in each presentation. The three presentations differed in style and visual media.

W – Walk in the White Oak Woods

The "W" design featured a 2.5 mile trail system with a boardwalk over the wetlands and a central gathering area (Appendix 2.A). The presentation consisted of nine PowerPoint slides, most of which had the same format (Figure 2.1). The site plan was used as the background for most of the slides. Three to four short bullet points were included on each slide. Visual graphics included plan drawings,

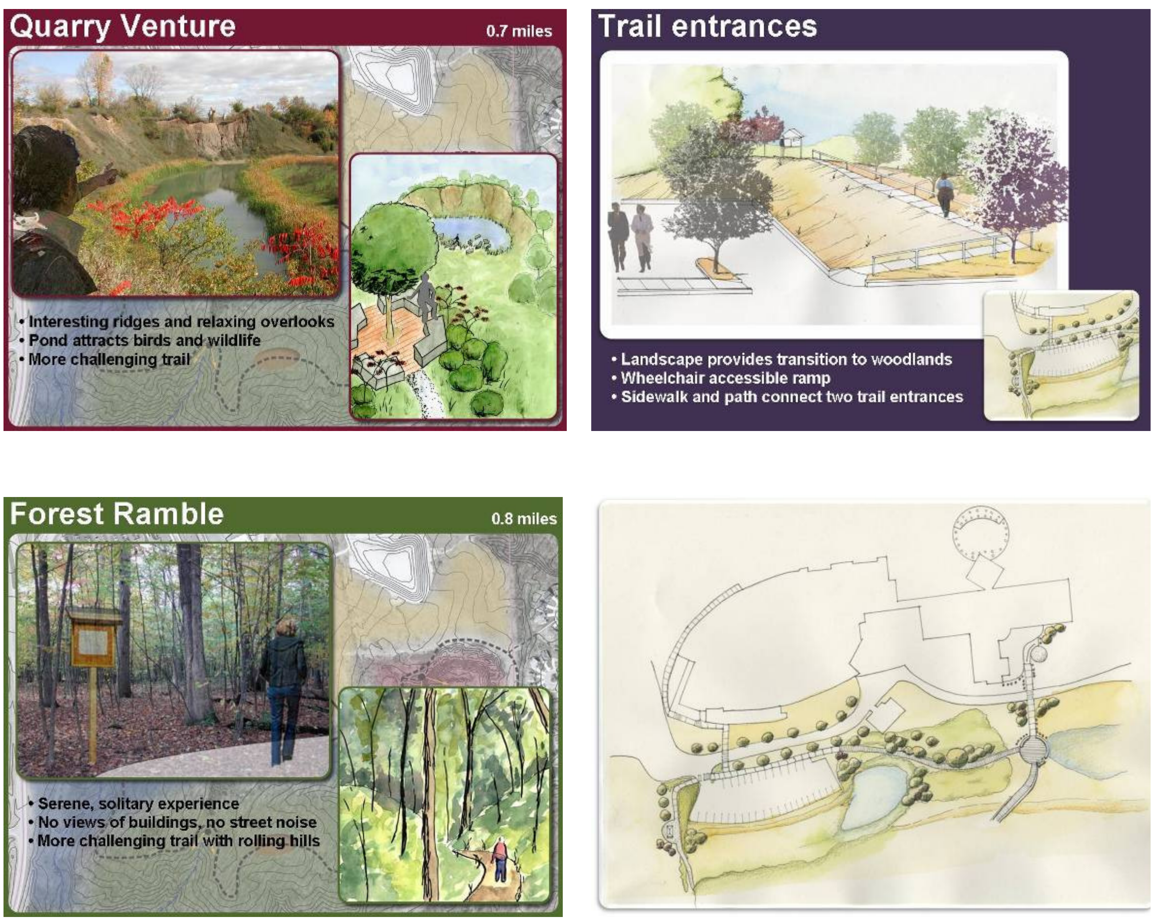

Figure 2.1 Example slides and graphics from presentation "W"

perspective drawings, and photomontages. Various landscape types were represented on the plan drawing using different colors. A plan view of the buildings and trail entrances also was provided. Perspective drawings (ink and watercolor) and photomontages depicted trail entrances and points along the trails. People were depicted in all drawings except the plan drawings. They were represented in a variety of ways, including photographs superimposed into a landscape, silhouettes, and simple figures.

E - Engaging Nature's Restorative Properties

The "E" design presented five trails with several gathering places and gardens along the way (Appendix 2.A). The presentation was comprised of 17 slides. Many slides had a small font and substantial amount of text and arrows. As shown in Figure 2.2, one slide (top left) displayed five trail placards with trail descriptions for three of them. The placards included a paragraph of text on a patterned background. A contour site plan was displayed multiple times throughout the

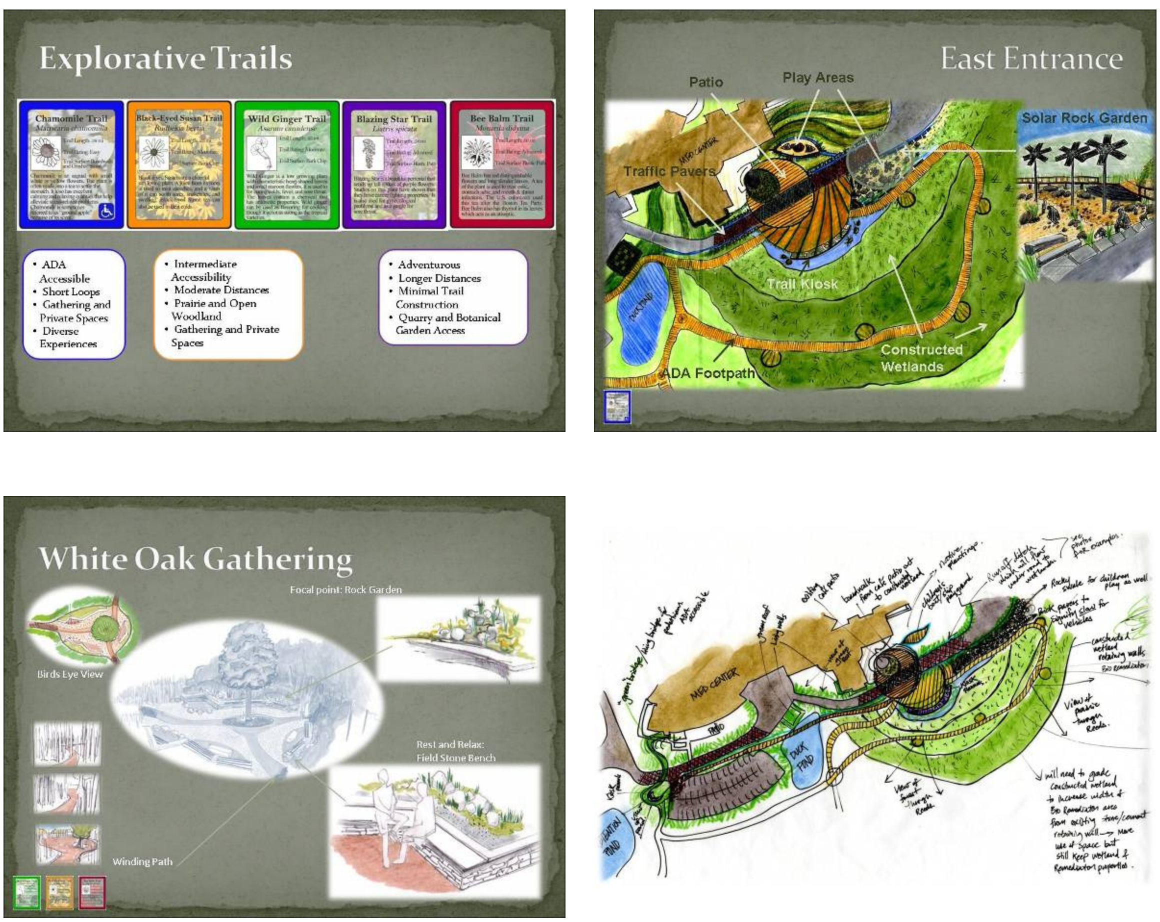

Figure 2.2 Example slides and graphics from presentation "E"

presentation to orient the viewer to the trail entrances, gardens, and gathering spaces being described. Visual graphics used to detail these features included planning sketches, plan views in watercolor and pen, and perspective drawings in marker, pen, and watercolor. People were depicted in only a few drawings – approximately half of the perspective drawings – and were represented most often as silhouettes or simple figures.

S - Spectrum

The "S" design was characterized by a park located close to the building, sculptures, and five trails, the shortest of which spanned four different types of landscapes (Appendix 2.A). The presentation was made up of 23 slides. The same format was used for some of the slides, such as those describing the different landscape types (Figure 2.3, top left). The first two drawings presented were rough sketches of the design concept (Figure 2.3, bottom right). Other visual graphics

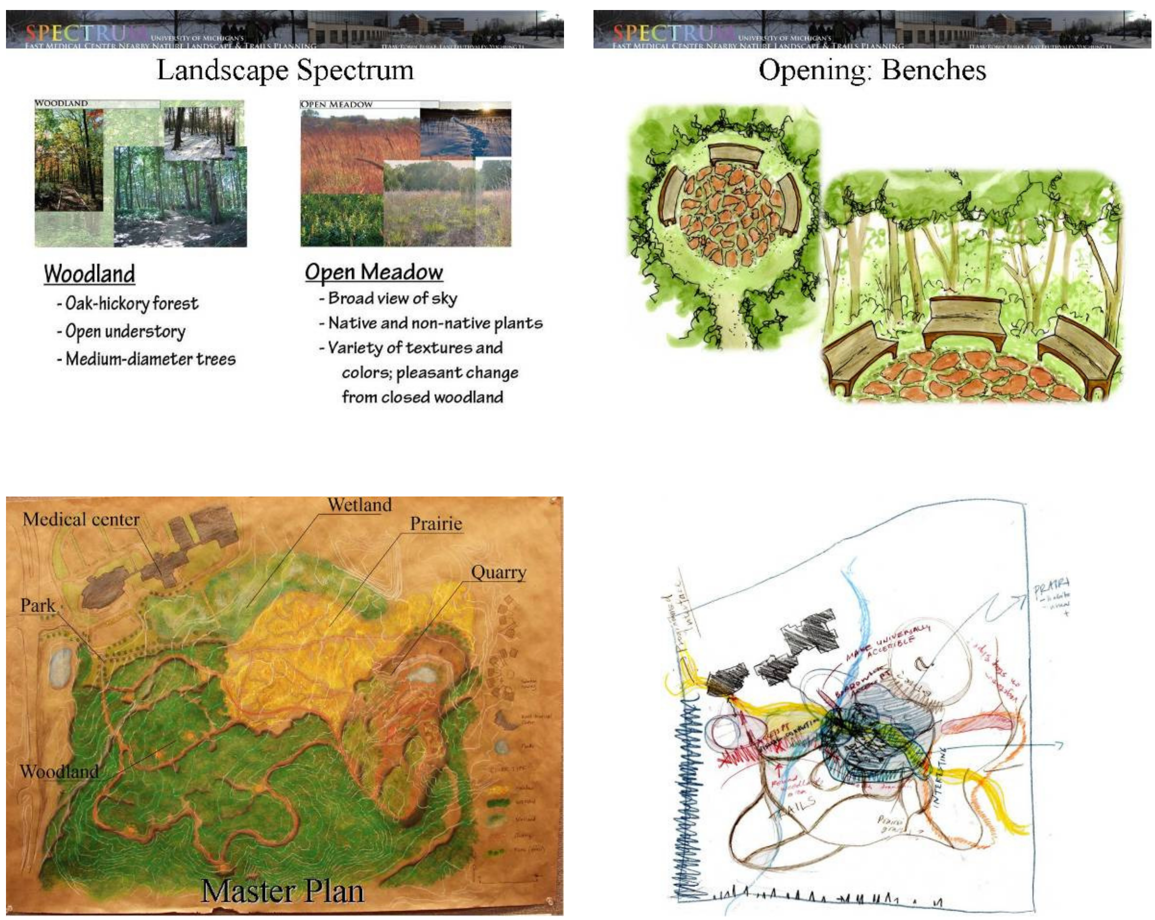

Figure 2.3 Example slides and graphics from presentation "S"

used in the presentation included a physical model with detachable pieces, digital collages (i.e., overlapping photographs), plans, sections, and perspective drawings. The model could be manipulated to show different park and parking lot options. A master plan drawn in pastels was shown multiple times throughout the presentation to mark the areas represented by the model and section drawings. People were included in three of the drawings -- as silhouettes in one section drawing and photorealistic figures in two perspective drawings.

Photoquestionnaire

Criteria for selection

The 16 photographs in the photoquestionnaire were chosen from a collection of images of small-scale nature settings depicting a variety of paths, seating arrangements, and views (Figure 2.4). Only photographs representing landscapes and design features possible at the site of the proposed nature trail were selected. The majority of the selected photographs were taken in early fall at parks located in the Midwest, U.S. Four of the photographs were taken at the site. None of the photographs included people or cars.

Figure 2.4 Example photos from Photoquestionnaire

The photographs were chosen to provide imagery of the landscape and examples of options available for the nature trails. Five photographs depicted natural paths of dirt or grass with varying widths through the woods, prairie, and manicured fields. Because of the existing wetland on site, four photographs of man-made bridges were selected to present alternative designs, materials (e.g., wood, concrete), and railing options. Three photographs, all taken at the site, showed views of various water bodies that could be featured along the trails. The final four photographs showed different types of benches and seating arrangements.

All of the photographs were presented in full color in the survey. They were arranged on two sides of one page with eight photographs on each side. The order of the photographs was random other than interspersing them based on content (trails, seating, bridges, etc.).

Dependent variables

Participants rated each of the three presentations and the photoquestionnaire on a series of items intended to measure the effectiveness of the approach in facilitating understanding of the design options, engaging participants, and promoting a sense of participation (Appendix 2.B and 2.C). Each item was rated using a 5-point scale (from 1, "not at all" to 5, "very well/easy").

- **Understandability** encompasses both the knowledge gained regarding the range of design possibilities and the ability to make sense of the visual graphics and the kinds of places they depict. A person with a good understanding of the proposed nature setting would be able to envision it from multiple perspectives, imagine movement through the setting, and have a sense of what it would be like to be there. (Included 8 items.)

- **Engagement** refers to the extent to which the participatory design approach and visual media held the participants' attention, encouraged exploration of design possibilities, and addressed their interests and concerns. (5 items)

- **Participation** refers to the participants' perception of the ease in providing their input and the sense that their involvement was meaningful. Participation is more likely perceived as meaningful when participants feel their concerns were heard, their input was needed, and their participation made a difference. (4 items)

Participants

Participants in the study were employees of the medical center where the nature trail project was proposed. A total of 28 employees attended the design sessions and completed the survey. As shown in Table 2.1, three quarters of the participants were staff, and the remaining quarter was faculty. The majority of participants (86%) worked five days a week at the medical center, and 79% of the participants worked full days. 89% of participants were very interested in having access to nature trails at the workplace.

Table 2.1
Respondent Demographics for Design Session

	Respondents (% of total)
Affiliation	
Faculty	7 (25%)
Staff	21 (75%)
Frequency at facility	
4 times/week or less	4 (14%)
Daily	24 (86%)
Time spent at facility in day	
Less than 7 hours	3 (11%)
7-9 hours	22 (79%)
More than 9 hours	2 (7%)
Interest in having access to nature trails	
Not at all	0
A little	1 (4%)
Somewhat	0
Quite a bit	2 (7%)
Very much	25 (89%)
Experience with landscape or architectural design	
None	9 (32%)
Very Little	10 (36%)
Some	7 (25%)
Quite a bit	1 (4%)
A great deal	1 (4%)
Total # of Participants	**28**

Participants also rated their level of experience with landscape design or architectural design. Sixty-eight percent of the attendees had very little to no experience with landscape or architectural design. An additional twenty-five percent had some experience. Only two attendees had quite a bit or a great deal of design experience.

Results

A major goal of the study was to gain the participants' perspective on the participatory design process – particularly in terms of how understandable and engaging the participatory approach was and whether it promoted participation. Statistical analyses were performed to determine whether the participants' understanding, engagement, and sense of participation differed across the presentations and whether the photoquestionnaire was as effective as the presentations on these measures.[1] Before turning to these results, however, we first discuss the results of a test of internal consistency for the items used to measure the main dependent variables.

1. Testing the fit of the effectiveness measures

Cronbach's alpha was calculated to determine the fit or coherence of the group of items used to measure the dependent variables - understandability, engagement, and participation. The analysis was conducted for each of the three presentations and the photoquestionnaire.[2]

The analyses led to the exclusion of two items based on marked improvements in the alpha coefficients when the items were deleted, despite reversing the scale for these items: "The visual media were overwhelming" and "I found the session/photoquestionnaire frustrating." These terms may have been too general, thereby not correlating highly with the other understandability and participation items. There are many reasons why one might be frustrated or overwhelmed that may not be related to understanding or participation. Overall, very few participants found the participatory approaches overwhelming or

[1] Statistical analysis using a linear mixed model was performed to test whether session time had an effect on the participants' assessment of the presentations. Results indicated that session did not have a significant effect (at $p<.01$) on any of the dependent variables. Therefore, participants from the morning and afternoon sessions were combined for all subsequent analyses.

[2] Factor analyses also were performed to identify possible groupings (other than those hypothesized) for further reliability analyses. Due to the small sample size, factor analyses were used for descriptive purposes only.

frustrating. For these reasons, these two items were excluded from further analyses.

Table 2.2 presents the alpha coefficients for the final set of items for each dependent variable. A coefficient of 0.70 or higher is often used as an indication of sufficient internal consistency (de Vaus, 2002; Nunnally, 1978). As shown in the table, only *participation* did not meet the standard, with one alpha coefficient (presentation "E") just below .70 and another (photoquestionnaire) substantially below .70. Regarding the photoquestionnaire, the wording for one of the items was different than that for the presentations. The participants rated how well the photoquestionnaire captured their comments versus how attentive the presenters were to comments. They may have had difficulty imagining the photoquestionnaire was capturing their comments.

Table 2.2
Effectiveness Measures Used in Design Session

	Cronbach's Alpha coefficients			
	W	**E**	**S**	**P**
Understandability	**.86**	**.92**	**.88**	**.90**
The visual media were effective.				
I have a greater awareness of the range of choices for nearby nature settings.				
[Ease of performing the following tasks:]				
Visualize alternative nature settings				
Imagine movement through the space				
Feel you could find your way				
Feel what it would be like to be in the space				
Think of the space from multiple perspectives				
Engagement	**.76**	**.79**	**.73**	**.82**
I was actively engaged.				
I found the presentation/photoquestionnaire interesting.				
Info presented was relevant to my concerns.				
I was able to explore different possibilities.				
The presentation/photoquestionnaire held my attention.				
Participation	**.79**	**.69**	**.76**	**.35**
The presenters were attentive to comments. / The photoquestionnaire captured my comments.				
I appreciated being asked for my input.				
Ease of providing your input				

Other than the exceptions noted above, the effectiveness variables show a moderate to high internal consistency for all four participatory approaches. Thus, average means across items were calculated for each dependent variable, and the averages were used in the comparative analyses. The analyses for participation excluded the photoquestionnaire due to the low alpha for these items.

2. Comparing the effectiveness of participatory design approaches

Statistical analyses were performed to determine whether the participants' understanding, engagement, and sense of participation differed across the presentations and whether the photoquestionnaire was as effective as the presentations on these measures. Interpretations of the findings were aided by an examination of participants' verbal and written comments.

Statistically, these analyses need to take into account that each participant rated all participatory approaches. A linear mixed model procedure (SPSS Inc., 2009) was used to account for the repeated measure design. The repeated covariance type used in the analysis was compound symmetry. Bonferroni adjustments were made for multiple comparisons of the estimated means.

Understandability

Participants were able to understand the design options across all participatory methods, as indicated by the range of mean ratings from 4.0 to 4.5 on a five point scale (from 1, "not at all," to 5, "very well.") (Table 2.3). However, results of the linear mixed model analysis revealed that the participatory approach had a significant effect (p=.002) on the participants' understandability. Presentation

Table 2.3
Mean Ratings for Understandability

Particip. Approach	N	Mean	Std. Dev.
E	26	4.02 [a]	0.78
S	24	4.07 [b]	0.66
PQ	22	4.37	0.58
W	27	4.48 [a,b]	0.50

Comparison based on estimated marginal means.
[a] Significantly different at p<.01 (p=.007).
[b] Significantly different at p<.05 (p=.023).

"W" was significantly more understandable than both of the other two presentations. Participants found the photoquestionnaire as understandable as the three presentations.

Participants' comments provide insight into the factors that contributed to understandability. Presentation "W" was described as being "very clear" both in terms of the verbal description and visual representations of the design. Regarding presentation "S," one participant said the planning sketches were unclear (Figure 2.3, bottom right), and another participant expressed confusion about the scale of the physical model and which areas were included in it. Presentation "E" received comments about there being too much information on a slide, a font that was difficult to read, and hand drawn designs that were hard to follow (Figure 2.2). Also, there was confusion about terminology used (e.g., "what is a traffic paver?") and the types of plants found on site.

A comparison of the three presentations points to the important role that presentation format, organization, and graphics play in understandability. Presentation "W" had the fewest number of slides with three to four short bullet points per slide. Presentation "E", on the other hand, had a great deal of information on a slide in a small font. More emphasis was placed on drawings with a plan view in presentations "E" and "S" than in presentation "W."

Engagement

Participants found the three design presentations and photoquestionnaire to be engaging with ratings ranging from 4.2 to 4.5 on a five point scale (Table 2.4). The participatory approach did not have a significant effect on engagement

Table 2.4
Mean Ratings for Engagement

Particip. Approach	N	Mean	Std. Dev.
E	26	4.23	0.64
S	24	4.29	0.51
PQ	22	4.45	0.55
W	27	4.48	0.45

Comparisons are based on estimated marginal means. No significant differences found at $p<.05$.

(p=.127). No significant differences were found among the design presentations. Also, the photoquestionnaire was considered as engaging as each of the design presentations.

Participation

Participants found the three design presentations to be supportive of participation in terms of feeling heard, ease of providing input, and appreciation of being asked. Ratings ranged from 4.3 to 4.5 on a five point scale. No significant differences were found among the presentations at p<.05, although the difference between presentations "S" and "W" just missed that level (p=.051) (Table 2.5).

Table 2.5
Mean Ratings for Participation*

Particip. Approach	N	Mean	Std. Dev.
S	24	4.34	0.62
E	26	4.50	0.56
W	27	4.54	0.52

*Excludes photoquestionnaire. Comparisons are based on estimated marginal means. No significant differences at p<.05.

The photoquestionnaire was not included in this analysis, since the internal consistency of the items measuring participation was poor. However, to get a sense of the participants' perception of their ability to provide their input, the photoquestionnaire was compared to the design presentations using one of the participation items (i.e., ability to provide input). No significant differences were found; participants found it easy to provide their input for all four participatory approaches, as indicated by ratings between 4.0 and 4.4 (Table 2.6). The

Table 2.6
Mean Ratings for Ability to Provide Input

Particip. Approach	N	Mean	Std. Dev.
S	21	4.02	0.84
PQ	22	4.25	0.83
E	23	4.31	0.88
W	25	4.41	0.76

Comparisons are based on estimated marginal means. No significant differences at p<.05.

photoquestionnaire was as effective as each of the design presentations in supporting participants' ability to provide their input.

Discussion and Conclusion

Additional research is needed to confirm and further investigate the findings of this study. Because each design presentation included a combination of drawings, it was difficult to discern which drawings were more effective than others. Based on the comparison of presentations and participants' comments, there are some indications that people may have more trouble with sketches and plan drawings than other drawings, but more research is needed. Also, factors including the designers' personalities, communication skills, and presentation style may have affected participants' understanding, engagement, and participation. A controlled, systematic study aimed at investigating the effectiveness of specific types of drawings traditionally used in the participatory design process was carried out to address this research need (Chapter 6). Finally, regarding the photoquestionnaire, the fact that it came last in the design session may have had an effect on its evaluation. The novelty of this format after listening to three presentations may have impacted participants' assessment of it. Another study evaluating the photoquestionnaire is discussed in Chapter 4.

Landscape architects rarely have the opportunity to try out and assess alternative approaches for getting feedback on their designs in terms of understandability, engagement, and participation. There has been little empirical attention given to this topic in the literature as well; yet the effectiveness of participatory approaches, particularly from the participants' perspective, can have a substantial impact on the usefulness and satisfaction of the participatory process. This study contributes to closing this knowledge gap by comparing traditional and alternative approaches for incorporating the needs and preferences of potential users in the design of small-scale nature settings.

The difference in understandability between two of the design presentations suggest that visual graphics and presentation style matter in achieving effective information-sharing. From a cognitive psychology perspective, it is not surprising that the amount of information and how it is presented play a role in people's ability to build mental models of the design options and visualize design alternatives.

Presenting a great deal of information in an incoherent manner or without an overarching structure can easily overwhelm participants and make it easy to miss important points. Recognizing the limited capacity of people's attention by organizing the information into three or four main points and using consistent formatting can enhance understandability. Also, an obvious quality that is too often lacking in presentations and drawings is legible text, both in terms of size and writing style.

Another key finding from the study is the usefulness of the photoquestionnaire as a participatory approach. The photoquestionnaire was as effective as design presentations in facilitating understanding of design options, engaging participants, and providing an avenue for people to share their input. Yet the photoquestionnaire is rarely used in participatory design. As a result of the findings in this study (and the study described in Chapter 4), designers are encouraged to try this alternative method for gathering people's input. It can be an informative and meaningful way for people to participate. Participants have found it enjoyable to complete as well.

The study provides valuable information to designers about how to acquire feedback in a way that benefits both participants and designers. By expanding the designers' toolkit on methods of promoting meaningful participation, participation in design can lead to more useful and satisfying outcomes. It also can lead to nature settings that better meet the needs of its users.

Appendix 2.A
Detailed Descriptions of Proposed Designs

Presentation W - A Walk in the White Oak Woods – (1st in a.m. session, 2nd in p.m. session)

The "W" design proposed 2.5 miles of trails with 4 overlapping loop trails varying in distance (0.5 to 1.2 miles) and level of difficulty. Key features included a boardwalk over the wetlands to help transition from the built to natural environment and a central point at a large oak tree where all trails meet, which served as an orienting landmark and transition point. Information kiosks and clear visibility from the buildings to the trails were provided. Two of the trails were wheelchair accessible – one through the woodlands (closest to the medical buildings) and one through the prairie. The other two trails were more challenging with rolling hills and ridges. Other features along the trails included overlooks of the quarry, a seating area, a pond to attract wildlife, and possible art installations showing seasonal changes in the prairie. A variety of experiences were provided, ranging from wide views in the prairie to a more solitary experience in the forest where there would be no views of buildings nor street noise.

Presentation E - Engaging Nature's Restorative Properties (2nd in a.m. session and 3rd p.m. session)

The "E" design consisted of five trails named after different medicinal plants native to the region. The goals of the designers were to provide spaces for gathering and reflection, highlight the site's natural features, be ADA compliant, and provide a variety of trail lengths and difficulties. The trails spanned various landscape types and were made of such materials as crushed concrete, woodchip, and dirt. Key features included a "Duck Pond" seating area, herb garden retreat, solar rock garden, peaceful garden, and quarry overlook. A potential swimming area at the water's edge in the quarry also was proposed. Characteristics of the trail entrances included information kiosks, traffic pavers, bridge, play area, and ADA compliant ramp and footpath. The design provided several gathering spaces along the trails featuring different seating options and levels of privacy.

Presentation S - Spectrum (3rd in a.m. session and 1st in p.m. session)

The “S” design presented five trails through five landscape types- woodland, open meadow, wetland, parkland, and quarry. The trails were intended to accommodate users with various physical abilities and time to explore. They provided a variety of views, textures, and feelings. Views back to the building were maintained to aid orientation. Key features included a short trail that accessed four landscape types (park, woodland, wetland, and prairie), a quarry area with flower beds and sculptures, and eight small seating areas along the trails with different seating arrangements (e.g., adjacent, semicircle, full circle) and materials (e.g., benches, large rocks). A park also was proposed to provide a safe and open environment to help transition from the buildings into the nature trails. The goals of the park were to provide a sense of being away, familiarize users with the diversity of ecosystems at their own pace and comfort, create a visual and experiential transition between parking lot and woodland, and provide an inviting environment that encourages further exploration into nature. A physical model was provided to show different options for the location of the park. Options included replacing some or all of the parking lot with the park or locating the park adjacent to the current parking lot.

Appendix 2.B

Design Session Survey

Evaluation of Design Presentation (as an approach for gaining users' input)

In this section, we ask you to evaluate the design presentation and associated visual media. This information will help us identify the advantages and disadvantages of the methods used for presenting ideas and gaining people's input on design options.

Please rate how well each of these statements describes how you feel.

1 2 3 4 5 I was actively engaged.
1 2 3 4 5 The presenters were attentive to comments.
1 2 3 4 5 The visual media were effective.
1 2 3 4 5 I found the presentation interesting.

1 2 3 4 5 I appreciated being asked for my input.
1 2 3 4 5 Info presented was relevant to my concerns.
1 2 3 4 5 The visual media were overwhelming.
1 2 3 4 5 I was able to explore different possibilities.

1 2 3 4 5 The presentation held my attention.
1 2 3 4 5 I found the session frustrating.
1 2 3 4 5 I have a greater awareness of the range of choices for nearby nature settings.

1	Not at all
2	A little
3	Somewhat
4	Quite a bit
5	Very well

Comments:

Please rate how easy it was for you to perform the following tasks.

1 2 3 4 5 Visualize alternative nature settings
1 2 3 4 5 Provide your input during the design session
1 2 3 4 5 Imagine movement through the space

1 2 3 4 5 Feel you could find your way
1 2 3 4 5 Feel what it would be like to be in the space
1 2 3 4 5 Think of the space from multiple perspectives

1	Not at all
2	A little
3	Somewhat
4	Quite a bit
5	Very easy

Comments:

Appendix 2.C

Survey items organized by dependent variable (as hypothesized)

Understandability (8 items)

[Please rate how well each of these statements describes how you feel.]

- The visual media were effective.
- The visual media were overwhelming.*
- I have a greater awareness of the range of choices for nearby nature settings.

[Please rate how easy it was for you to perform the following tasks.]

- Visualize alternative nature settings
- Imagine movement through the space
- Feel you could find your way
- Feel what it would be like to be in the space
- Think of the space from multiple perspectives

Engagement (5 items)

[Please rate how well each of these statements describes how you feel.]

- I was actively engaged.
- I found the presentation interesting.
- Info presented was relevant to my concerns.
- The presentation held my attention.
- I was able to explore different possibilities.

Participation (4 items)

[Please rate how well each of these statements describes how you feel.]

- The presenters were attentive to comments.
- I appreciated being asked for my input.
- I found the session frustrating.*

[Please rate how easy it was for you to perform the following tasks.]

- Provide your input during the design session

*These items were dropped based on results of the analysis of internal consistency. See Table 2.2 for the final set of items.

CHAPTER 3

THE REASONABLE PERSON MODEL AND THE ROLE OF UNDERSTANDING, ENGAGEMENT, AND PARTICIPATION IN PREFERENCE

This chapter explores the relationships among the domains of the Reasonable Person Model (RPM). As discussed in the Introductory chapter, RPM (S. Kaplan & Kaplan, 2009) views humans as highly motivated to understand and explore, to use their knowledge and skills, and to participate in meaningful activities. Providing opportunities for people to act on these natural inclinations is hypothesized to lead to improved outcomes in a great variety of situations. The context for the study discussed in this chapter is the participation process in the design of nature settings, an area that is assumed to benefit from the implementation of RPM.

The work presented in this chapter expands on the study presented in Chapter 2, which used RPM-based measures to evaluate the effectiveness of different participatory approaches for gathering participants' feedback on the design of nature settings. Participants rated each design presentation in terms of how understandable and engaging it was, how easy it was to provide input, and their sense that their participation was meaningful. In the RPM framework, these qualities are interrelated (S. Kaplan & Kaplan, 2003, 2009). However, RPM has never been tested empirically. This chapter addresses this research need by exploring the relationships among understandability, engagement, and participation in the context of presenting design ideas and acquiring feedback.

A major purpose of seeking the public's input in the design process is to gauge preferences for possible design solutions. As such, the study presented in Chapter 2 also included participants' ratings of their preference for each of the three design alternatives. Designers rely on this feedback to design settings that will meet the needs of potential users. The relation between preference and the RPM-based domains of understandability, engagement, and participation is the second major focus of the analyses presented in this chapter. In other words, does the effectiveness of the design presentation affect how much people like the design option presented? This information can be valuable to designers in interpreting their audience's reactions and choosing presentation methods that will lead to reliable, useful feedback.

This chapter thus addresses two main issues: (1) The relationship among the RPM domains, and (2) the relationship of preference to these domains. In the context of the present study, the expectation is that understandability, engagement, and participation will be highly correlated. For example, participants' understanding of the design presentations is predicted to be positively related to participation, since the ability to provide input depends on being able to make sense of the design. Also, an engaged audience is more likely to participate than a bored, uninterested audience. Engagement in the presentation also is expected to positively relate to one's ability to build an understanding of the design alternatives.

With respect to the effect of understanding, engagement and participation on preference, the prediction is that difficulty understanding or engaging in a presentation will lead to lower preferences for the design. Confusion and boredom can have strong psychological effects that could negatively taint one's perception of the design. Participation is not expected to play as strong of a role in preference as understandability and engagement. In this study, all of the design presentations provided the opportunity for participants to share their input. A stronger relationship between preference and participation would be expected if some presentations allowed for feedback and other presentations did not.

Method

Study site

The study took place on a medical campus associated with a large research university in the Midwest, U.S. The site is approximately 200 acres with an elevation ranging from 830 to 890 feet. The medical campus consists of four buildings where a variety of outpatient medical services are provided.

The landscape consists of woodlands (with areas of dense woods, open woods, and mixture of shrubs and trees), wetlands, an open field, detention pond, and abandoned quarry site. Two main roads run along the north and west sides of the complex. A residential subdivision is adjacent to the east, and a corporate research facility is located to the south. A few unmarked trails stem from the residential subdivision. Nearby residents are presumed to have formed these trails by walking and mountain biking in the area. These existing trails are not easily accessible from the medical facility.

Procedure

The Executive Director of one of the health centers on campus invited all employees on the medical campus to attend the design sessions. The email included a description of the project and stated that their participation was voluntary and their survey responses would be anonymous.

To accommodate as many employees and their schedules as possible, the designs were presented at two sessions, one in the morning and one in the afternoon, in two different locations on campus. Ten employees attended the morning session and 18 employees attended the afternoon session. Although each team's presentation was the same in the two design sessions, the order of the presentations and the people presenting for each team differed in the two sessions. Each session lasted one hour.

Following an introduction to the project and a basic description of the site, attendees viewed three PowerPoint presentations (later referred to as W, S, and E) showing alternative designs for the nature trail system. Immediately following each presentation and before the next presentation began, participants completed a survey both to rate their preference for the design option and to evaluate the presentation in terms of their understanding, engagement, and sense of participation. After each presentation, participants also had a chance to ask questions and share comments verbally or in the space provided on the survey.

After viewing all three presentations, the attendees also completed a photoquestionnaire that consisted of 16 scenes depicting nature settings and possible design features for the nature trail system. This aspect of the study, however, is not relevant to the present study. Since each scene received a separate preference rating, it is not meaningful to compare these ratings to the RPM-based effectiveness measures which were rated for the approach as a whole. Furthermore, the questions used for the participation measure provided a better fit to the design presentations since these presentations permitted time for participation. In the case of the photoquestionnaire, by contrast, there was no discussion or other visible form of participation.

Main independent variables

This study includes two sets of independent variables: the design presentation and the perceived effectiveness of the design presentation measured in terms of understandability, engagement, and participation.

Design presentation

The study analyzes three design presentations that use a combination of different visual graphics to depict design options for the nature trails. The presentations were developed and presented by three teams of landscape architecture students. Prior to the design session and as part of the class curriculum, the landscape architecture students were involved in discussions related to the role of participation in design. They practiced presenting their ideas and were coached (by their instructor, another professional designer, and a researcher in environmental psychology) on how to make a presentation comprehendible, engaging, and receptive to comments. The three presentations differed in style and visual media.

W – Walk in the White Oak Woods

The "W" design featured a 2.5 mile trail system with a boardwalk over the wetlands to provide a direct route to the nature area from the buildings (Figure 3.1). Information kiosks and clear visibility from the buildings to the trails were provided. The trails varied in distance (0.5 to 1.2 miles) and level of difficulty. Two of the trails were wheelchair accessible – one through the woodlands (closest to the medical buildings) and one through the prairie. The other two trails were more challenging with rolling hills and ridges. All trails led to a central gathering place at a large oak tree, a landmark intended to help orient people. Other features along the trails included overlooks of the quarry, a seating area, a pond to attract wildlife, and art installations showing seasonal changes in the prairie. A variety of experiences were provided, ranging from wide views in the prairie to a more solitary experience in the forest where the buildings could not be seen and street noise could not be heard.

The presentation consisted of nine PowerPoint slides, most of which had the same format. The site plan was used as the background for most of the slides. Three to four short bullet points were included on each slide. Visual graphics included plan drawings, perspective drawings, and photomontages. Various landscape types were represented on the plan drawing using different colors. A plan view of the buildings and trail entrances also was provided. Perspective drawings (ink and watercolor) and photomontages depicted trail entrances and points along the trails. People were depicted in all drawings except the plan drawings. They were represented in a variety of ways, including photographs superimposed into a landscape, silhouettes, and simple figures.

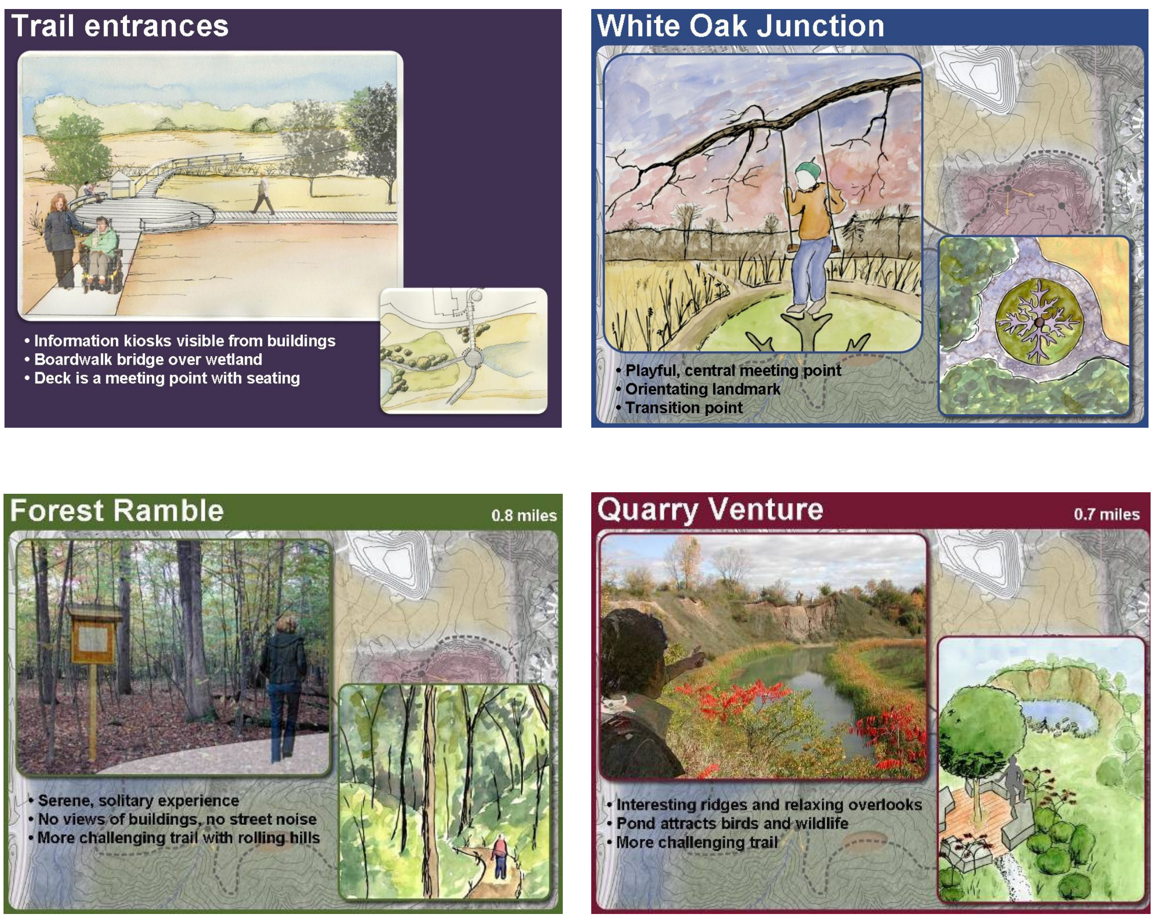

Figure 3.1 Examples of design features presented in “W”

E - Engaging Nature's Restorative Properties

The "E" design consisted of five trails of different lengths and levels of difficulty (Figure 3.2). The trails took advantage of the variety of landscape types on the site, and were made of materials such as crushed concrete, woodchip, and dirt. The trails were named after different medicinal plants native to the state. Features of the trail entrances included information kiosks, a bridge, play area, and ADA compliant ramp and footpath. Several seating areas and gardens were located along the trails to provide places for gathering and reflection. They included the "Duck Pond" seating area, herb garden retreat, solar rock garden, peaceful garden, and quarry overlook. They offered a variety of seating options and levels of privacy. A potential swimming area at the water's edge in the quarry also was proposed.

Figure 3.2 Examples of design features presented in "E"

The "E" presentation was comprised of 17 slides. Many slides had a small font and substantial amount of text and arrows. As shown in Chapter 2, Figure 2.2, one slide (top left) displayed five trail placards with trail descriptions for three of them. The placards included a paragraph of text on a patterned background. A contour site plan was displayed multiple times throughout the presentation to orient the viewer to the trail entrances, gardens, and gathering spaces being described. Visual graphics used to detail these features included planning sketches, plan views in watercolor and pen, and perspective drawings in marker, pen, and watercolor. People were depicted in only a few drawings – approximately half of the perspective drawings – and were represented most often as silhouettes or simple figures.

S - Spectrum

The "S" design presented five trails through five landscape types- woodland, open meadow, wetland, parkland, and quarry (Figure 3.3). The trails were intended to accommodate users with various physical abilities and time to explore. They provided a variety of views, textures, and experiences. Views of the medical facility were maintained to aid orientation. Key features included a short trail that accessed four landscape types (park, woodland, wetland, and prairie), a quarry area with flower beds and sculptures, and eight small seating areas along the trails with different seating arrangements (e.g., adjacent, semicircle, full circle) and materials (e.g., benches, large rocks). A park also was proposed to provide an inviting, safe, and open environment that would draw people into the nature setting and encourage further exploration of the trails. A physical model was provided to show different options for the location of the park. Options included replacing some or all of the parking lot with the park or locating the park adjacent to the current parking lot.

The "S" presentation was made up of 23 slides. The same format was used for some of the slides, such as those describing the different landscape types (Chapter 2, Figure 2.3, top left). The first two drawings presented were rough sketches of the design concept (Chapter 2, Figure 2.3, bottom right). Other visual graphics used in the presentation included a physical model with detachable pieces, digital collages (i.e., overlapping photographs), plans, sections, and perspective drawings. The model could be manipulated to show different park and parking lot options. A master plan drawn in pastels was shown multiple times throughout the presentation to mark the areas represented by the model and section drawings. People were included in three of the drawings -- as silhouettes in one section drawing and photorealistic figures in two perspective drawings.

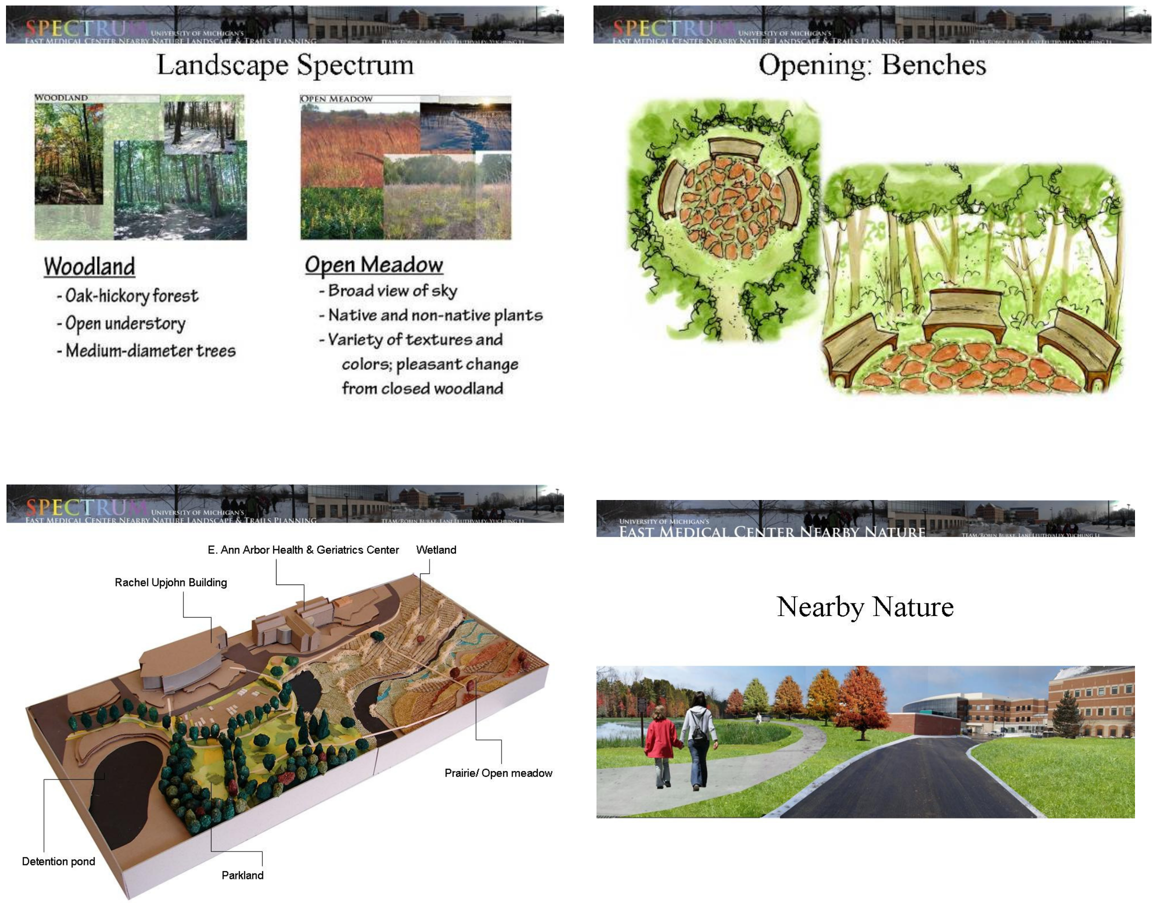

Figure 3.3 Examples of design features presented in “S”

Perceived effectiveness of presentation

The second independent variable is the effectiveness of the presentation. As discussed in Chapter 2, participants evaluated each of the three design presentation in terms of its effectiveness in communicating the design options, engaging participants, and fostering participation. They rated a series of items intended to measure the presentations’ understandability, their engagement in the presentation, and their sense of participation (Appendix 3.A and 3.B). Each item was rated using a 5-point scale (from 1, “not at all” to 5, “very well/easy”).

- **Understandability** encompasses both the knowledge gained regarding the range of design possibilities and the ability to make sense of the visual graphics and the kinds of places they depict. A person with a good understanding of the proposed nature setting would be able to envision it from multiple perspectives, imagine movement through the setting, and have a sense of what it would be like to be there. (Included 8 items, see Appendix 3.B.)

- **Engagement** refers to the extent to which the participatory design approach and visual media held the participants' attention, encouraged exploration of design possibilities, and addressed their interests and concerns. (Included 5 items, see Appendix 3.B.)

- **Participation** refers to the participants' perception of the ease in providing their input and the sense that their involvement was meaningful. Participation is more likely perceived as meaningful when participants feel their concerns were heard, their input was needed, and their participation made a difference. (Included 4 items, see Appendix 3.B.)

Dependent variable: Preference

The main dependent variable in the study is the participants' preference for the design options presented. Participants rated how much they liked the design on a 5-point scale (from 1, "not at all" to 5, "very much"). They also had the opportunity to provide comments in a space provided on the survey.

Participants

Participants in the study were employees of the medical center where the nature trail project was proposed. A total of 28 employees attended the design sessions and completed the survey. As shown in Table 3.1, three quarters of the participants were staff, and the remaining quarter was faculty. The majority of participants (86%) worked five days a week at the medical center, and 79% of the participants worked full days. 89% of participants were very interested in having access to nature trails at the workplace.

Participants also rated their level of experience with landscape design or architectural design. Sixty-eight percent of the attendees had very little to no experience with landscape or architectural design. An additional twenty-five percent had some experience. Only two attendees had quite a bit or a great deal of design experience.

Table 3.1 Respondent Demographics for Design Session	
Affiliation	**Respondents (% of total)**
Faculty	7 (25%)
Staff	21 (75%)
Frequency at facility	
4 times/week or less	4 (14%)
Daily	24 (86%)
Time spent at facility in day	
Less than 7 hours	3 (11%)
7-9 hours	22 (79%)
More than 9 hours	2 (7%)
Interest in having access to nature trails	
Not at all	0
A little	1 (4%)
Somewhat	0
Quite a bit	2 (7%)
Very much	25 (89%)
Experience with landscape or architectural design	
None	9 (32%)
Very Little	10 (36%)
Some	7 (25%)
Quite a bit	1 (4%)
A great deal	1 (4%)
Total # of Participants	**28**

Results

The main goal of the study is to explore the relationships among the variables with two objectives in mind. The first objective is to test the predictions of the Reasonable Person Model by examining the relationships among the effectiveness variables – understandability, engagement, and participation. The second objective is to investigate the role that the presentation's effectiveness plays in the participants' preference for the design options presented. Before turning to these results, however, it is important to test the internal consistency for the items used to measure the effectiveness variables.[3]

[3] Statistical analysis using a linear mixed model was performed to test whether session time had an effect on the participants' assessment of the presentations. Results indicated that session did not have a

1. Testing the fit of the effectiveness measures

Cronbach's alpha was calculated to determine the fit or coherence of the group of items used to measure the effectiveness variables - understandability, engagement, and participation. The analysis was conducted for each of the three presentations.[4]

The analyses led to the exclusion of two items based on marked improvements in the alpha coefficients when the items were deleted, despite reversing the scale for these items: "The visual media were overwhelming" and "I found the session frustrating." These terms may have been too general, thereby not correlating highly with the other understandability and participation items. There are many reasons why one might be frustrated or overwhelmed that may not be related to understanding or participation. Overall, very few participants found the participatory approaches overwhelming or frustrating. For these reasons, these two items were excluded from further analyses.

Table 3.2 presents the alpha coefficients for the final set of items for each dependent variable. A coefficient of 0.70 or higher is often used as an indication of sufficient internal consistency (de Vaus, 2002; Nunnally, 1978). As shown in the table, only *participation* did not meet the standard, with one alpha coefficient (presentation "E") just below .70. The effectiveness variables show a moderate to high internal consistency for all three presentations. Thus, average means across items were calculated for each dependent variable, and the averages were used in the regression analyses.

2. Relationships among the effectiveness variables

The relationships among understandability, engagement, and participation were analyzed by using bivariate correlation coefficients. (See Appendix 3.C for a summary of the comparison of presentations for the dependent variables, which aided in the interpretation of the results for the current correlation analysis.)

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significant effect (at $p<.01$) on any of the variables. Therefore, participants from the morning and afternoon sessions were combined for all subsequent analyses.

[4] Factor analyses also were performed to identify possible groupings (other than those hypothesized) for further reliability analyses. Due to the small sample size, factor analyses were used for descriptive purposes only.

Table 3.2
Effectiveness Measures Used in Design Session

	Cronbach's Alpha coefficients		
	W	**E**	**S**
Understandability	**.86**	**.92**	**.88**
The visual media were effective.			
I have a greater awareness of the range of choices for nearby nature settings.			
[Ease of performing the following tasks:]			
Visualize alternative nature settings			
Imagine movement through the space			
Feel you could find your way			
Feel what it would be like to be in the space			
Think of the space from multiple perspectives			
Engagement	**.76**	**.79**	**.73**
I was actively engaged.			
I found the presentation interesting.			
Info presented was relevant to my concerns.			
I was able to explore different possibilities.			
The presentation held my attention.			
Participation	**.79**	**.69**	**.76**
The presenters were attentive to comments.			
I appreciated being asked for my input.			
Ease of providing your input			

As shown in Table 3.3, all but one of the correlations is statistically significant, thus supporting the hypothesized relationship among understandability, engagement, and participation in the RPM framework. However, the magnitudes of the correlations differ substantially. The most consistent and highest correlations are shown in the first column of results (i.e., understandability x engagement). For the three design presentations the correlation coefficients ranged from 0.74 to 0.80. In

Table 3.3
Relationships among the Effectiveness Variables:
Correlation Coefficients

Design Presentation	Understandability x Engagement	Participation x Understandability	Participation x Engagement
E	0.77	0.36[1]	0.56
S	0.80	0.72	0.73
W	0.74	0.49	0.60

Correlations are significant at p<.01 for all except the one marked with a numeric superscript, which was not significant at p<.05.

other words, participants who were able to visualize the design options and understand the visual graphics also found the presentation engaging. Their ability to explore different design possibilities was linked to understandability. This is consistent with RPM, which emphasizes the important role that understanding and exploration play in building mental models.

The patterns of correlations in the latter two columns of Table 3.3 are more variable. Both of these columns have in common that they relate to participants' assessments of the ease of providing their input and sense that their involvement was meaningful. For presentation "S", the relationship of participation to each of the other effectiveness variables is high indicating congruence between participants' sense of participation, engagement, and understandability. For the other two design alternatives, however, the correlations in the latter two columns are notably lower.

Based on RPM, understandability and participation should be positively correlated since being able to make sense of the design options is expected to enhance people's ability to provide their input. This was, in fact, the case for two of the three design presentations. However, for presentation "E", which received a relatively lower understandability rating (see Appendix 3.C), the correlation (.36) between understandability and participation did not reach statistical significance. Participants' sense that they were meaningfully participating in the process was relatively unrelated to their sense that they understood the design. It is possible that their ability to provide their input was not inhibited by some confusing aspects of an otherwise well understood presentation. For example, some participants said the hand drawn sketches were hard to follow. Also, there was some confusion about terminology used (e.g., "what is a traffic paver?") The opportunity to ask questions during the comment period following each presentation may have contributed to the high participation ratings despite some difficulty understanding or visualizing some aspects of the design.

Participation and engagement are significantly related ($p<.01$) in all cases, although the strength of this relationship depends on the design presentation. Correlation coefficients ranged from 0.56 (E) to 0.73 (S). The results provide support for RPM's prediction that participants who are engaged in the process are more inclined to provide their input and feel heard. Also, the opportunity to provide input, and the form this participation takes, may be engaging in and of itself.

Engagement and understandability had the strongest relationship across all presentations with similar coefficients for each. In contrast, the relationships between participation and the other two variables varied across presentations. The correlations between participation and the other two variables were notably higher for presentation “S” than for the other two presentations. A distinguishing feature of this presentation was the opportunity for participants to interact with a physical model that could be manipulated to show design alternatives. In this case, the model may have impacted participation in a manner similar to its impact on understandability and engagement, thereby strengthening the relationships among these variables. Because presentation “S” included a number of visual graphics, some of which were harder to understand than others, it is difficult to determine the effect that the physical model, in particular, had on this presentation’s effectiveness. It is possible that the interactions provided through the model had a positive effect on the participants’ engagement in the process, understandability, and their perceived ease of providing input, but this cannot be assessed with the data collected. More research is needed to investigate the role that physical models play in the effectiveness of design presentations.

3. Is preference influenced by the effectiveness of the presentations?

Statistical analysis was performed using a linear mixed model procedure (SPSS Inc., 2009) to determine whether participants’ preferences differed across the three designs presented. As shown in Table 3.4, participants’ preferences for the design options ranged from 3.6 to 4.4, with the two extreme means (presentations “E” and “W”) differing significantly.

Table 3.4
Mean Ratings for Preference

Presentation	N	Mean	Std. Dev.
E	24	3.63 [a]	0.88
S	23	4.00	0.67
W	27	4.37 [a]	0.63

Comparison based on estimated marginal means.
[a] Significantly different at $p<.01$ ($p=.002$).

The difference in preference among the presentations is likely to be related to the participants' attraction to particular features in the design. However, a major goal of the study is to determine whether a presentation's effectiveness played a role in the participants' preference for that design. A regression analysis was conducted for each presentation to explore these relationships. The analysis tests whether understandability, engagement, and participation predict preference for the design presentation. The "Backwards" method was used to test a model with all three predictor variables, followed by subsequent models eliminating the least influential predictor. The strength of this method lies in its use of all information available to determine the least influential predictor in each model, which is then removed in the subsequent model. Table 3.5 includes the models at each step, first including all three predictors, then eliminating the least influential predictor among the three (represented by hatching in Model 2), and so on until only the most influential predictor remains (Model 3).

Table 3.5
Role of Understandability, Engagement, and Participation in Preference

		E		S		W	
		Beta	p*	Beta	p*	Beta	p*
Model 1	Understanding	.890	.000	-.277	--	.324	--
	Engagement	-.037	--	.109	--	.149	--
	Participation	-.160	--	.709	.023	.156	--
	R^2	.670		.366		.300	
Model 2	Understanding	.866	.000	-.214	--	.410	.049
	Engagement						
	Participation	-.171	--	.741	.011	.202	--
	R^2	.669		.362		.291	
Model 3	Understanding	.803	.000			.510	.007
	Engagement						
	Participation			.584	.003		
	R^2	.644		.341		.260	

*Shows only p values that are significant at p<.05.
Note: None of the differences in R^2 from one model to the next (as measured by changes in the F statistic) were significant at p<.05.
Hatch mark indicates variable removed.

The role that the effectiveness variables - understandability, engagement, and participation – played in preference differed across the presentations. As shown in Table 3.5, the combination of all three variables accounted for 67 percent of the variation in participants' preference for presentation "E," 37 percent for "S," and 30 percent for "W." Understandability was the most influential predictor for presentation "E" and "W," whereas participation was most influential for "S." These predictors had positive slopes that were significantly different than zero.

The results indicate that the understandability of the presentation played a strong role in how much participants' liked the designs presented in "E" and "W." As shown in Table 3.5 (Model 3), understandability accounted for 64 percent of the variation in preference for "E," and 26 percent of the variation in preference for "W." Recall that presentation "E" was rated significantly less understandable than presentation "W" (Appendix 3.C.) "E" also received significantly lower preference ratings than "W" (Table 3.4.) The more difficulty participants had understanding the presentation, the less they reported liking the proposed design.

The participants' ability to provide input and their sense that their participation was meaningful played the strongest role (34%) in explaining the preference rating for presentation "S." As previously noted, this presentation was unique in providing a physical model of the design. Participants were given the opportunity to play with the model, which had detachable pieces to show alternative options for the park. Besides the physical model and presenters, the method of participation, i.e., survey and comment period, was the same across presentations.

The evaluation of the presentations' effectiveness may provide some insight into the role that participation played in preference for presentation "S." First, participation was ranked the highest of the three effectiveness variables for this presentation with a score of 4.3 out of 5 (Appendix 3.C). However, this score represented the lowest mean participation rating of the three presentations with the difference between "S" and "W" on the verge of being significant. Thus, it is unclear whether the opportunity to play with the physical model enhanced participation. It is possible that the participants' interaction with the model – a form of participation - influenced their attraction to the design.

Conclusion

The Reasonable Person Model is a useful tool for thinking about ways to enhance communication, engage people, make the most of people's knowledge and skills, and foster participation in meaningful activities. It has been applied in a number of contexts, including teaching, nursing, natural resource management, business management, and parenting, although it has not been tested empirically (*Putting our heads together: Diverse ways to bring out the best in people*, 2010). This study provides empirical support for the usefulness of RPM in evaluating the participation process in the design of nature settings and reveals relationships among factors that influence the participants' experiences and the design outcomes.

Findings indicate that participants' understanding, engagement, and participation in design presentations are generally interrelated as the Reasonable Person Model predicts. Understandability and engagement had the strongest relationship in this context. The more understandable the presentation, the better it held the participants' attention. Being able to visualize and explore the design possibilities was highly related to understandability.

The strength of the relationship between participation and the other two effectiveness variables (understanding and engagement) varied across presentations. In this design context, participation may not be as sensitive to understandability and engagement as it might be in other situations. There is some indication in the present study that presentations that are generally well understood but have some confusing aspects may not greatly hinder participation, which is hopeful. All of the presentations used the same basic approach for gathering participants' feedback – a comment period and survey. Offering the opportunity to ask questions may be an important factor in offsetting the negative impacts of confusion on participation. Providing a couple of methods for participating - one for the more outspoken participant (e.g., verbal comment period, discussion with the designer) and one for the more reticent participant (e.g., preference rating, survey) also might be important. In addition to exploring ways to enhance understandability, finding ways to ensure open, two-way communication between the designer and participants is critical for reducing confusion and fostering participation.

Another critical finding of the study is the role that understandability plays in people's preferences for a design option. For the least understandable and least preferred design, understandability accounted for a substantial portion of the variability in the participants' preference. This was true despite the fact that this presentation was generally well understood. This has important implications for designers. Even a modest amount of confusion might greatly impact participants' assessment of the design ideas. Sense of participation also may be influential in people's preferences, but more research is needed to better understand these cases.

The Reasonable Person Model has the potential to empower designers to create a participatory design process that meets the cognitive and psychological needs of their participants. Doing so has shown to be critical in getting reliable, useful feedback from participants on design ideas. The positive effects of such interactions can be far-reaching for the success of the project and relationships between designers and participants.

Appendix 3.A

Survey for Design Session

Design Presentation #1

Please answer the questions on this page immediately following Design Presentation #1. You will have the opportunity to respond to the same questions for EACH presentation.

Preference for Design Option

Please indicate how much you like the *design option* that was presented.

___ Not at all ___ A little ___ Somewhat ___ Quite a bit ___ Very much

Comments:

Evaluation of Design Presentation (as an approach for gaining users' input)

In this section, we ask you to evaluate the design presentation and associated visual media. This information will help us identify the advantages and disadvantages of the methods used for presenting ideas and gaining people's input on design options.

Please rate how well each of these statements describes how you feel.

1 2 3 4 5 I was actively engaged.
1 2 3 4 5 The presenters were attentive to comments.
1 2 3 4 5 The visual media were effective.
1 2 3 4 5 I found the presentation interesting.

1 2 3 4 5 I appreciated being asked for my input.
1 2 3 4 5 Info presented was relevant to my concerns.
1 2 3 4 5 The visual media were overwhelming.
1 2 3 4 5 I was able to explore different possibilities.

1 2 3 4 5 The presentation held my attention.
1 2 3 4 5 I found the session frustrating.
1 2 3 4 5 I have a greater awareness of the range of choices for nearby nature settings.

1	Not at all
2	A little
3	Somewhat
4	Quite a bit
5	Very well

Comments:

Please rate how easy it was for you to perform the following tasks.

1 2 3 4 5 Visualize alternative nature settings
1 2 3 4 5 Provide your input during the design session
1 2 3 4 5 Imagine movement through the space

1 2 3 4 5 Feel you could find your way
1 2 3 4 5 Feel what it would be like to be in the space
1 2 3 4 5 Think of the space from multiple perspectives

1	Not at all
2	A little
3	Somewhat
4	Quite a bit
5	Very easy

Comments:

Appendix 3.B

Survey items for effectiveness variables (as hypothesized)

<u>Understandability</u> (8 items)

[Please rate how well each of these statements describes how you feel.]
- The visual media were effective.
- The visual media were overwhelming.*
- I have a greater awareness of the range of choices for nearby nature settings.

[Please rate how easy it was for you to perform the following tasks.]
- Visualize alternative nature settings
- Imagine movement through the space
- Feel you could find your way
- Feel what it would be like to be in the space
- Think of the space from multiple perspectives

<u>Engagement</u> (5 items)

[Please rate how well each of these statements describes how you feel.]
- I was actively engaged.
- I found the presentation interesting.
- Info presented was relevant to my concerns.
- The presentation held my attention.
- I was able to explore different possibilities.

<u>Participation</u> (4 items)

[Please rate how well each of these statements describes how you feel.]
- The presenters were attentive to comments.
- I appreciated being asked for my input.
- I found the session frustrating.*

[Please rate how easy it was for you to perform the following tasks.]
- Provide your input during the design session

*These items were dropped based on results of the analysis of internal consistency. See Table 3.2 for the final set of items.

Appendix 3.C

As shown in the table below, the mean ratings for each of the presentations were relatively high and statistically similar with respect to each of the effectiveness variables.[5] For presentation "W", however, ratings of understandability were significantly greater than for the other two design presentations. Furthermore, presentation "S" received marginally lower rating with respect to participation than the other two design alternatives. (See Chapter 2 for more details.)

Table
Mean Ratings for Effectiveness Variables

		Understandability		**Engagement**		**Participation**	
Present -ation	N	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
E	26	4.02 [a]	0.78	4.23	0.64	4.50	0.56
S	24	4.07 [b]	0.66	4.29	0.51	4.34[1]	0.62
W	27	4.48 [a,b]	0.50	4.48	0.45	4.54[1]	0.52

Comparison based on estimated marginal means. No significant differences found at p<.05, except pairs sharing an alphabetic superscript:
[a] Significantly different at p<.01 (p=.007).
[b] Significantly different at p<.05 (p=.023).
[1]The difference between this pair was close to being significant (p=.051.)

[5] The comparisons are based on statistical analyses that take into account that each participant rated all three presentations. A linear mixed model procedure (SPSS Inc., 2009) was used to account for the repeated measure design. The repeated covariance type used in the analysis was compound symmetry. Bonferroni adjustments were made for multiple comparisons of the estimated means.

CHAPTER 4

EVALUATING THE PHOTOQUESTIONNAIRE

Public meetings and information sessions are the most common forums for public participation in the design and planning process. There are times, however, when it would be useful to have citizen input without requiring individuals to come to a particular place at a particular time. The photoquestionnaire offers an alternative method for getting the public's input on design and planning projects. This type of survey instrument asks participants to rate their preference for photographs depicting design or planning options. In addition to determining which design alternatives are preferred, the ratings can provide information about participants' perceptions underlying their preferences and highlight differences in the needs and concerns of different groups of potential users.

The photoquestionnaire has been used as a method for acquiring public input in a variety of contexts, including storm drain improvements (R. Kaplan, 1977), landscape design (R. Kaplan, 1977, 1993; S. Kaplan & Kaplan, 1989), land use planning (Ryan, 2002, 2006), design of outdoor spaces at a hospital (Carpman & Grant, 1993), and stream restoration (Schauman & Salisbury, 1998). Designers and researchers have reported success in using the photoquestionnaire to acquire useful information about the participants' perceptions of the scenes and differences between user groups. Also, on multiple occasions, participants who took the photo survey indicated their appreciation of having had the opportunity to participate (S. Kaplan & Kaplan, 1989). However, no empirical studies have directly tested the participants' evaluation of the photoquestionnaire as an approach for gathering their input. This chapter addresses this research need by asking participants to rate the photoquestionnaire in terms of their understanding of design options, engagement, and sense of participation. The study was carried out in the context of a design project for a nature setting at a medical campus.

Background

Some states require that citizens be given the opportunity to participate in planning projects. Research has shown that the choice of strategies used by planners to involve the public affects the level of public participation (Brody, Godschalk, & Burby, 2003; S. Kaplan, 1977). Brody et al. (2003) found that using multiple approaches for gathering citizen input significantly impacted participation. Formal public meetings were not as effective as informal meetings, visioning workshops, and forums (p.257).

From a cognitive and environmental psychology perspective, there are a number of reasons why information sessions and public meetings often fail to facilitate information-sharing between designers and participants (S. Kaplan & Kaplan, 1989; Phalen, 2009). First, these sessions typically occur late in the design process when the design is close to being finalized, if not already finalized. At this point, participants may feel their input will not make a difference in the outcome, thus they may not provide feedback at all or may react negatively because they feel slighted. The participants' potential reactions speak to the important role that meaningful action plays in people's behavior. Gaining the sense that their concerns are heard and that their input is valued are essential components of meaningful action (S. Kaplan & Kaplan, 2009).

Even design sessions that take place early in the design process can have negative outcomes in terms of participation. Designers might ask "what do you want?" or "what do you envision?" and receive little in response. People might have difficulty calling to mind features they find important or thinking of alternatives to the proposed design. Interpreting participants' preferences can sometimes be a challenge, particularly when participants know they like or dislike a design but have trouble articulating why. In other cases, their reactions might be driven by stereotypes about a concept rather than visual impressions of the same concept. Several studies have found differences in people's preferences for the same design option when presented verbally versus visually (R. Kaplan, 1977; Kearney, et al., 2008).

People might not participate in public meetings or design sessions if they have trouble interpreting the drawings used in design presentations. Research has shown that drawings vary considerably in how understandable they are to laypeople and how confident laypeople are in discussing the designs depicted in the drawings (Chapter 6). Being able to visualize the design alternatives and imagine what it would be like to be in the setting can have a significant effect on participants' ability to provide useful feedback.

The format in which participants provide their input also can make a difference in the amount and quality of the feedback. Inviting verbal comments may attract only the most outspoken, confident, or opinionated people in the audience. As a result, responses may fail to adequately represent the needs and concerns of all potential users.

It is easy to bring to mind examples where public meetings and information sessions led to feedback of low quality and frustration for both the participants and designer. Yet they continue to be the most common approaches for seeking feedback in design and planning. The low costs associated with these approaches in terms of money, time, and effort likely contribute to their widespread use. The photoquestionnaire addresses many of the limitations of public meetings and design sessions, and can be conducted at a relatively low cost using free survey instruments on the internet or hard copies with black and white photographs.

There are a number of advantages to using the photoquestionnaire to gather input from citizens or potential users:

1. The survey can be distributed widely to a large group of people, resulting in a more representative view of people's needs and concerns.
2. People typically have no trouble understanding photographs, and they find it easy to rate a scene for how much they like it.
3. The survey can provide information not readily available from participants' comments on design proposals.

Elaborating on the third point, the use of multiple photographs to represent a variety of design options can address a wider range of issues than those depicted in one or two design proposals. In addition, multiple examples can be provided for one design concept. Sampling of this kind strengthens confidence in the interpretation of the results, since inferences are based on several instances as opposed to one or two particular cases (R. Kaplan, 1977; S. Kaplan & Kaplan, 1989). Statistical tests can be performed to identify categories or clusters of photographs based on patterns in the participants' ratings. These categories can reveal participants' perceptions of the scenes, or how participants see the scenes relating to one another. The analysis can provide valuable information about reasons for participants' preferences, which participants might have trouble articulating. Differences in the perceptions of various groups of participants also can emerge from these analyses.

While the photoquestionnaire has not been studied systematically to determine its effectiveness, its use in a number of projects suggests it is a successful tool for acquiring valuable feedback from participants to inform design and planning. Theoretically, the photoquestionnaire has great potential in fostering participants' understanding of design options and facilitating meaningful participation. The purpose of this study is to empirically test this theory using the participants' evaluation of a photoquestionnaire.

Method

Study site

The context of the study is a design project for a park-like setting with nature trails as proposed in the master plan for a medical campus associated with a large research university in the Midwest, U.S. The proposed nature setting was intended to provide opportunities for patients and staff to experience the outdoors and enjoy the site's natural features.

The site is approximately 200 acres with an elevation ranging from 830 to 890 feet. The medical campus consists of four buildings where a variety of outpatient medical services are provided. The landscape consists of woodlands (with areas of dense woods, open woods, and mixture of shrubs and trees), wetlands, an open field, detention pond, and abandoned quarry site. Two main roads run along the north and west sides of the complex. A residential subdivision is adjacent to the east, and a corporate research facility is located to the south. A few unmarked trails stem from the residential subdivision. Nearby residents are presumed to have formed these trails by walking and mountain biking in the area. These existing trails are not easily accessible from the medical facility.

Procedure

Employees, patients, and visitors at the medical campus were invited to complete a photoquestionnaire that consisted of 16 scenes depicting nature settings and possible design features for the nature trail system. Faculty and staff in two of the three buildings on the medical campus received the survey in their office mailboxes and were asked to return the survey within two weeks. Receptionists of the clinics were instructed to distribute the survey upon check-in to adult patients, family members, or others accompanying the patients. Participants were allowed to complete the survey right then or take it with them to their appointment, fill it out while they waited, and return it at check-out. The survey was distributed to patients and visitors over a four week period.

An informed consent form was provided with the survey and included a description of the project and stated that their participation was voluntary and their survey responses would be anonymous.

Main independent variable: Photographs of nature scenes

The 16 photographs in the photoquestionnaire were chosen from a collection of images of small-scale nature settings depicting a variety of paths, seating arrangements, and views (Figure 4.1, Appendix 4.A). Only photographs representing landscapes and design features possible at the site of the proposed nature trail were selected. The majority of the selected photographs were taken in early fall at parks located in the Midwest, U.S. Four of the photographs were taken at the site. None of the photographs included people or cars.

The photographs were chosen to provide imagery of the landscape and examples of options available for the nature trails. Five photographs depicted natural paths of dirt or grass with varying widths through the woods, prairie, and manicured fields. Because of the existing wetland on site, four photographs of man-made bridges were selected to present alternative designs, materials (e.g., wood, concrete), and railing options. Three photographs, all taken at the site, showed views of various water bodies that could be featured along the trails. The final four photographs showed different types of benches and seating arrangements.

Figure 4.1 Example photos from Photoquestionnaire

All of the photographs were presented in full color in the survey. They were arranged on two sides of one page with eight photographs on each side. The order of the photographs was random other than interspersing them based on content (trails, seating, bridges, etc.).

Dependent variables

Participants rated the photoquestionnaire on a series of items intended to measure its effectiveness in facilitating understanding of the design options, engaging participants, and promoting a sense of participation (Appendix 4.A and 4.B). Each item was rated using a 5-point scale (from 1, "not at all" to 5, "very well/easy"). Participants also had the opportunity to provide comments in spaces provided on the survey.

- **Understandability** encompasses both the knowledge gained regarding the range of design possibilities and the ability to make sense of the photographs and the kinds of places they depict. A person with a good understanding of the proposed nature setting would be able to envision it from multiple perspectives, imagine movement through the setting, and have a sense of what it would be like to be there. (Included 9 items.)

- **Engagement** refers to the extent to which the photoquestionnaire held the participants' attention, encouraged exploration of design possibilities, and addressed their interests and concerns. (5 items)

- **Participation** refers to the participants' perception of the ease in providing their input and the sense that their involvement was meaningful. Participation is more likely perceived as meaningful when participants feel their concerns were heard, their input was needed, and their participation made a difference. (3 items)

Participants also indicated their preferences for the 16 scenes by rating how much they liked the design option shown on a 5-point scale (from 1, "not at all" to 5, "very much"). However, this aspect of the study is not addressed in this chapter.

Participants

Participants in the study were employees, patients, and visitors at the medical center where the nature trail project was proposed. A total of 171 people completed the survey. Responses from 154 participants were used in the analyses. (Seventeen participants were excluded because they did not provide responses to some of the evaluation items.)

As shown in Table 4.1, two thirds of the participants were employees and the remaining third were patients or visitors. Three quarters of the respondents expressed great interest in having access to the nature trails, as indicated by a rating of 4 or higher on a 5 point scale (from 1, "not at all" to 5, "very much").

Table 4.2 provides additional information about the employees who participated in the study. Two thirds of the employees (63%) worked five days a week at the medical center, and 82% of the employees worked full days.

Table 4.1
Respondent Demographics for Photoquestionnaire

Affiliation	**Respondents (% of total)**
Faculty	19 (12%)
Staff	79 (51%)
Patient or visitor	51 (33%)
Interest in having access to nature trails	
Not at all	7 (4.5%)
A little	6 (4%)
Somewhat	23 (15%)
Quite a bit	37 (24%)
Very much	80 (52%)
Total # of Participants	**154**

Table 4.2
Employee Demographics

Affiliation	**Employees (% of total)**
Faculty	19 (19%)
Staff	79 (81%)
Frequency at facility	
1-3 times a month	0
Once a week	4 (4%)
2-4 times/week	20 (20%)
5-7 times/week	62 (63%)
Time spent at facility in day	
Less than 7 hours	7 (7%)
7-9 hours	69 (70%)
More than 9 hours	12 (12%)
Total # of Employees	**98**

Results

1. Participants' evaluation of the photoquestionnaire

As shown in Table 4.3, the photoquestionnaire performed quite well as a tool for acquiring people's input on design options. Participants rated the majority of the evaluation items (82%) in the 4's on a 5-point scale (from 1, "not at all" to 5, "very well/easy".) Participants found it easy to get a sense of the settings depicted in the photographs. Also, the task of rating the photographs was engaging and easy to do.

Table 4.3
Participants' Evaluation of Photoquestionnaire:
Mean Ratings of All Items

Evaluation Item	Mean Rating	Standard Deviat.
I [did not find] the photoquestionnaire frustrating.*	4.64	0.87
I appreciate being asked for my input.	4.57	0.78
Ease of providing your input	4.53	0.73
The photographs were [not] overwhelming.*	4.51	1.01
The photoquestionnaire incorporated diverse settings.	4.43	2.38
Ease of visualizing alternative nature settings	4.39	0.82
The photographs were effective.	4.35	0.81
The photoquestionnaire held my attention.	4.31	0.86
Ease of imagining movement through the space	4.29	0.96
I was actively engaged.	4.29	0.92
I found the photoquestionnaire interesting.	4.28	0.88
Ease of feeling what it would be like to be in the space	4.27	0.89
Ease of feeling you could find your way	4.22	0.96
Ease of thinking of the space from multiple perspectives	4.07	0.98
I have a greater awareness of the range of choices for nearby nature settings.	3.89	1.05
I was able to explore different possibilities.	3.81	0.98
The material is relevant to my concerns.	3.76	1.11

All items were rated on a 5 point scale from 1, "not at all" to 5, "very well/easy."
* These items were originally affirmative statements in the survey, and the ratings were reversed for comparison purposes.

The photoquestionnaire particularly excelled in promoting meaningful participation. The items related to the participants' sense of participation had the highest mean ratings of all items. Participants appreciated being asked for their input and found it easy to provide their input.

The photoquestionnaire performed the lowest (3.76) on its relevance to the participants' concerns. This occurred despite participants being given the opportunity to add their own comments in space provided on the survey. Very few participants (4 of 154 or 3%) provided comments related to their concerns (e.g., accessibility for people with disabilities, desired uses, liability, funding). Also, participants seemed to have slightly more trouble getting a sense of the big picture for design options, as indicated by the ratings of the participants' understanding and exploration of the range of design options (3.8-3.9).

2. Comparison of participant groups

Another goal of the study is to determine whether the employees and patients assessed the effectiveness of the photoquestionnaire differently. Comparative analyses by affiliation were performed separately for each of the three dependent variables – understanding, engagement, and participation. Before turning to these results, however, we first test the fit of the items intended to measure these variables.

Testing the fit of the effectiveness measures

The measures used to evaluate the photoquestionnaire are based on a theory of human behavior called the Reasonable Person Model (S. Kaplan & Kaplan, 2009) (see Chapter 1). Since this is one of few studies that use these measures to evaluate a participatory design approach (Chapter 2 and 3), Cronbach's alpha was calculated to determine the fit or coherence of the hypothesized groups of items (Appendix 4.B) used to measure the dependent variables - understandability, engagement, and participation. Factor analyses also were conducted to identify possible groupings (other than those hypothesized) based on participants' perceptions (Appendix 4.C). They were performed using the Principal Components method with Varimax Rotation. Factors were extracted based on eigenvalues greater than one. Since this analysis was conducted for exploratory purposes, photographs with loading of 0.45 or higher were retained. For items that double-loaded on two factors, the item was grouped with the factor with the higher loading.

Based on results of the factor analysis, three items were excluded. The item related to the diversity of the settings incorporated in the photoquestionnaire did not group with any other items. The two negatively worded items, how overwhelming and frustrating the photoquestionnaire was, formed a group of their own (Appendix 4.C, first table of factor loadings).

After the three items were excluded, the factor analysis yielded two groupings that seemed to depend more on the wording of the items than their underlying meaning or purpose (Appendix 4.C, second table of factor loadings). The first group included the items in the section on "how well each statement describes how you feel." The second group corresponded to the set of items on "how easy it was for you to perform the following tasks."

The factor analysis results did not support the hypothesized factor structure. This may be because the concepts were interrelated. In light of these results, the groupings of items were established based on the initial conceptualization, and alpha coefficients were calculated to assess the strength of internal consistency. For this analysis, the three previously excluded items also were not included.

Table 4.4 presents the alpha coefficients for the final set of items for each dependent variable based on the hypothesized groupings and three exclusions. A coefficient of 0.70 or higher is often used as an indication of sufficient internal consistency (de Vaus, 2002; Nunnally, 1978). As shown in the table, only *participation* did not meet the standard, with an alpha coefficient of 0.62. This may be due in part to the fact that there were fewer items (two) for participation than for understandability and engagement. Understandability and engagement show a high internal consistency for the photoquestionnaire. Thus, average means across items were calculated for these two dependent variables and were used to compare groups of participants. The items for participation were analyzed independently.

Differences in the evaluation based on affiliation

One way Analyses of Variance (ANOVA) were conducted to compare the means across three participant groups – faculty, staff, and patients/visitors. They were run separately for each dependent variable – the groupings of items measuring understandability and engagement, and the two separate items measuring participation (i.e., ease of providing input, appreciation of being asked for input). Bonferroni adjustments were made for post hoc multiple comparisons.

Results indicated that the respondents' affiliation with the medical facility did not have a significant effect on their evaluation of the photoquestionnaire. There were no differences among groups for understandability, engagement, ease of providing input, nor appreciation of being asked for input (Table 4.5.)

Table 4.4
Mean Ratings by Effectiveness Variable (n=154) & Cronbach's Alpha Coefficients

	Mean Rating	Standard Deviat.
Understandability: Cronbach Alpha = 0.87		
The photographs were effective.	4.35	0.81
I have a greater awareness of the range of choices for nearby nature settings.	3.89	1.05
[Ease of performing the following tasks:]		
Visualize alternative nature settings	4.39	0.82
Imagine movement through the space	4.29	0.96
Feel you could find your way	4.22	0.96
Feel what it would be like to be in the space	4.27	0.89
Think of the space from multiple perspectives	4.07	0.98
Engagement: Cronbach Alpha = 0.86		
I was actively engaged.	4.29	0.92
I found the photoquestionnaire interesting.	4.28	0.88
The material is relevant to my concerns.	3.76	1.11
I was able to explore different possibilities.	3.81	0.98
The photoquestionnaire held my attention.	4.31	0.86
Participation: Cronbach Alpha = 0.62		
I appreciate being asked for my input.	4.57	0.78
Ease of providing your input	4.53	0.73
Excluded:		
The photoquestionnaire incorporated diverse settings.[a]	4.43	2.38
The photographs were overwhelming. [a]	1.49	1.01
I found the photoquestionnaire frustrating.[b]	1.36	0.87

All items were rated on a 5 point scale from 1, "not at all" to 5, "very well/easy."
[a] These two items were hypothesized as measures of understandability for a total of nine items. Cronbach's alpha for the original nine items was 0.72.
[b] This item was hypothesized as a measure of participation for a total of three items. Cronbach's alpha for the original three items was 0.47.

Table 4.5
Mean Ratings for Effectiveness Variables by Affiliation

Affiliation	N	Understand-ability	Engage-ment	Ease of providing input	Appreciate being asked
Faculty	19	3.98	4.13	4.53	4.68
Staff	79	4.32	4.17	4.58	4.63
Patient / Visitor	51	4.18	3.97	4.47	4.43
Total	149	4.23	4.09	4.54	4.57

No significant differences between groups were found at $p<.05$.

Conclusion

Designers are accustomed to using design presentations to share and request feedback on design ideas. This process can be challenging for some designers, and can be equally frustrating for participants. If designers continue along the current path, the participation process is in danger of becoming a bothersome requirement rather than a welcomed opportunity. This study provides an alternative for designers interested in exploring other methods of getting feedback on their design ideas. It presents a promising tool for improving their experiences with the participation process, as well as those of participants.

The study is one of the first attempts to evaluate the photoquestionnaire as an alternative method in eliciting feedback on design alternatives (Chapter 2). Participants viewed the photoquestionnaire as highly effective in promoting a sense of participation. The photoquestionnaire also was successful in engaging participants and expanding their understanding of design options. In terms of the overall rate of participation, it reached many more people than would have provided input in meeting-based formats and involved a representative group of potential users, which is uncommon for many design sessions (Chapter 2).

A weakness of the photoquestionnaire in its current form was that the relevance of the photographs to the participants' concerns was rated the lowest of all evaluation items. An important component of meaningful participation is the feeling that one's concerns have been heard; thus, designers need to make a concerted effort to seek and demonstrate their understanding of the participants' needs. Participants may not easily make the connection between rating photographs and revealing their concerns and preferences, thus, more traditional means by which participants can directly share their concerns may be important for fostering feelings of being heard. This study indicates that a space in the survey for participants to add comments may not be enough. Very few participants (3%) provided written comments about their concerns and preferences.

There are a number of options available to enhance participants' feelings that their concerns have been heard. The photoquestionnaire could include verbal questions in addition to preference ratings of pictures. These questions could take the form of ratings of particular concerns or semi-structured, open-ended questions.

In previous studies, participants' responses to these types of questions revealed useful information when compared to their preference ratings of pictures of design concepts (R. Kaplan, 1977; Kearney, et al., 2008). Also, the photoquestionnaire could be combined with other more traditional approaches for people to share their needs and concerns, such as focus groups, design discussions, and interviews. Finally, designers could follow up with participants and provide feedback summarizing the key concerns that emerged from the participation process.

Finding ways to involve participants in a meaningful way has been a challenge in many design and planning projects. Participants can provide valuable information to designers if given the opportunity to build their understanding of design options, express their concerns, and provide feedback in a way that matches their skills. The photoquestionnaire offers a number of benefits not available through design sessions. Including this technique in the designer's toolkit could revolutionize the participatory process, making it more satisfying for all involved.

In addition to evaluating the photoquestionnaire, the study provides an assessment of a new tool for evaluating the effectiveness of participatory approaches. The evaluation items in this study were chosen to address three aspects of effectiveness - understandability, engagement, and participation. These measures were derived from a theory of human behavior called the Reasonable Person Model (RPM) (S. Kaplan & Kaplan, 2009). The factor analysis revealed that the items did not support the hypothesized RPM domains very well. This could be due to insufficient sampling of some domains and the interrelatedness of the concepts. Further development of these measures in terms of wording and item choice would be valuable.

Appendix 4.A

Photoquestionnaire (Visitor version)

Please complete the following items to help us better understand your needs and preferences related to the proposed nature trail at East Medical Campus and approaches for gaining your input.

Please take this survey only once. (Please do <u>not</u> complete this survey if you already completed the survey that was distributed at the design session for the nature trails on February 18, 2009.)

<u>Background</u>

1. How interested are you in having access to nature trails at this medical facility?

__ Not at all __ A little __ Somewhat __ Quite a bit __ Very much

2. Please indicate how often you take advantage of the following activities at this medical facility:

1 2 3 4 5	View nature from indoors
1 2 3 4 5	Take a break outside
1 2 3 4 5	Go for a walk outside
1 2 3 4 5	Eat outside
1 2 3 4 5	Use nature trails (near the medical facility)

1	Never
2	Rarely
3	Sometimes
4	Quite often
5	Very often

3. What is your affiliation with the medical facility?

__ Faculty __ Staff __ Visitor __ Patient __ Other: ________________

4. How frequently are you at this medical facility?

__ 1-3 times/month __Once a week __ 2-4 times/week __ 5-7 times/week

5. How much time do you typically spend at this facility in a day?

__ <2 hours __ 2-6 hours __7-9 hours __10 hours or more

[Next Page →]

<u>Photoquestionnaire</u>

The attached photographs represent a variety of options for the design of the nature trails at the medical facility. Please rate each image for how much you like the design option shown.

1	Not at all
2	A little
3	Somewhat
4	Quite a bit
5	Very much

Photo Page 1

1 2 3 4 5 **Picture 1** 1 2 3 4 5 **Picture 2**
1 2 3 4 5 **Picture 3** 1 2 3 4 5 **Picture 4**
1 2 3 4 5 **Picture 5** 1 2 3 4 5 **Picture 6**
1 2 3 4 5 **Picture 7** 1 2 3 4 5 **Picture 8**

Photo Page 2

1 2 3 4 5 **Picture 9** 1 2 3 4 5 **Picture 10**
1 2 3 4 5 **Picture 11** 1 2 3 4 5 **Picture 12**
1 2 3 4 5 **Picture 13** 1 2 3 4 5 **Picture 14**
1 2 3 4 5 **Picture 15** 1 2 3 4 5 **Picture 16**

Comments:

Evaluation of Photoquestionnaire

In this section, we ask you to evaluate the photoquestionnaire as an approach for getting your feedback. This information will help us identify the advantages and disadvantages of methods used for presenting ideas and gaining people's input on design options.

Please rate how well each of these statements describes how you feel about the photoquestionnaire that you just completed.

1 2 3 4 5 I was actively engaged.
1 2 3 4 5 The photoquestionnaire incorporated diverse settings.
1 2 3 4 5 The photographs were effective.
1 2 3 4 5 I found the photoquestionnaire interesting.

1 2 3 4 5 I appreciate being asked for my input.
1 2 3 4 5 The material is relevant to my concerns.
1 2 3 4 5 The photographs were overwhelming.
1 2 3 4 5 I was able to explore different possibilities.

1 2 3 4 5 The photoquestionnaire held my attention.
1 2 3 4 5 I found the photoquestionnaire frustrating.
1 2 3 4 5 I have a greater awareness of the range of choices for nearby nature settings.

1	Not at all
2	A little
3	Somewhat
4	Quite a bit
5	Very well

Comments:

Please rate how <u>easy</u> it was for you to perform the following tasks.

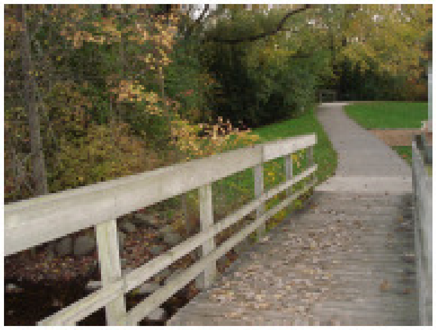
1 2 3 4 5 Visualize alternative nature settings
1 2 3 4 5 Provide your input
1 2 3 4 5 Imagine movement through the space

1 2 3 4 5 Feel you could find your way
1 2 3 4 5 Feel what it would be like to be in the space
1 2 3 4 5 Think of the space from multiple perspectives

1	Not at all
2	A little
3	Somewhat
4	Quite a bit
5	Very easy

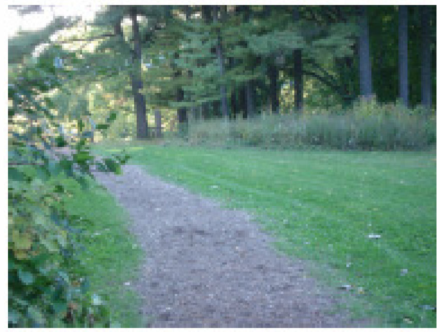
Comments:

1



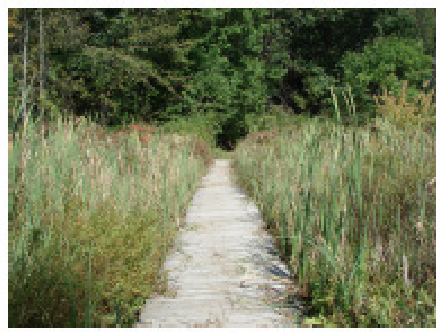
2

3



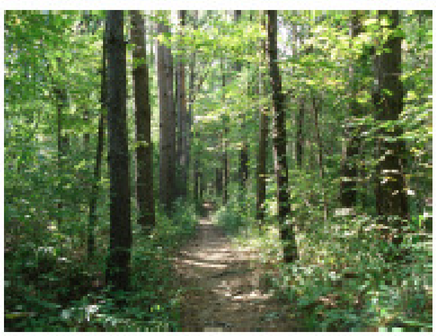
4

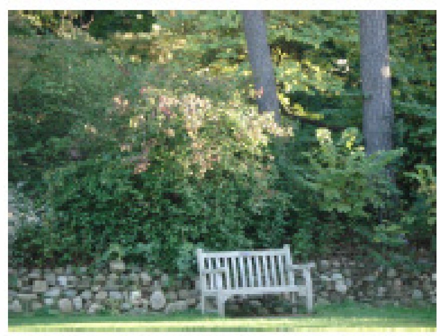
5



6

7





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9

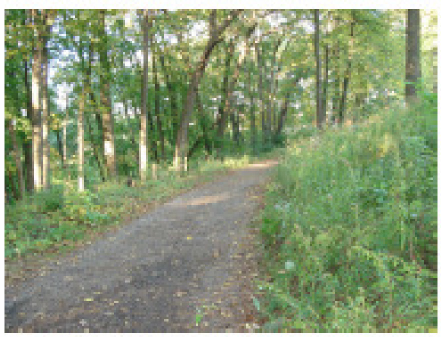


10

11



12

13
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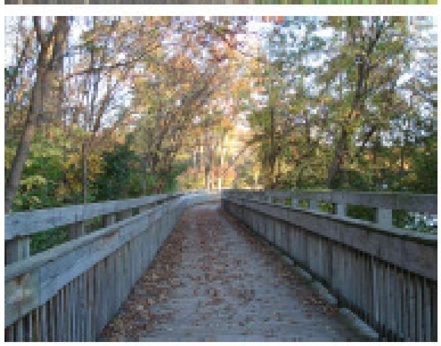
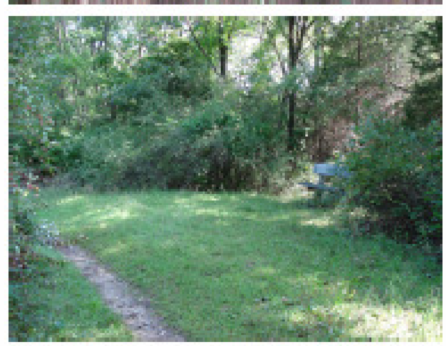
15



16

Appendix 4.B

Photoquestionnaire items organized by dependent variable (as hypothesized)

Understandability (9 items)

[Please rate how well each of these statements describes how you feel.]

- The photographs were effective.
- I have a greater awareness of the range of choices for nearby nature settings.
- The photoquestionnaire incorporated diverse settings.
- The photographs were overwhelming.

[Please rate how easy it was for you to perform the following tasks.]

- Visualize alternative nature settings
- Imagine movement through the space
- Feel you could find your way
- Feel what it would be like to be in the space
- Think of the space from multiple perspectives

Engagement (5 items)

[Please rate how well each of these statements describes how you feel.]

- I was actively engaged.
- I found the photoquestionnaire interesting.
- The material is relevant to my concerns.
- I was able to explore different possibilities.
- The photoquestionnaire held my attention.

Participation (3 items)

[Please rate how well each of these statements describes how you feel.]

- I appreciate being asked for my input.
- I found the photoquestionnaire frustrating.

[Please rate how easy it was for you to perform the following tasks.]

- Provide your input

Appendix 4.C

Factor Analysis Results

Table 1: All Items

Table 1
Rotated Component Matrix
(Eigenvalue >1)

	Component		
	1	2	3
Pinterest	.852		
Pheldatt	.805		
Pappask	.784		
Pengaged	.778		
Pviseffect	.714		
Pexplore	.619		
Prelevant	.611		
Pawchoice	.545		
Pdiverse			
Pfindway		.904	
Pmove		.855	
Pspace		.844	
Pmultiple		.795	
Pvisualize	.494	.604	
Pinput	.499	.508	
Pvoverwhelm_r			.842
Pfrustr_r			.789

Table 2: Excluding overwhelming (Pvoverwhelm_r), frustrating (Pfrustr_r), and diverse (Pdiverse)

Table 2
Rotated Component Matrix
(Eigenvalue >1)

	Component	
	1	2
Pinterest	.850	
Pheldatt	.800	
Pappask	.785	
Pengaged	.769	
Pviseffect	.708	
Prelevant	.632	
Pexplore	.623	
Pawchoice	.561	
Pfindway		.905
Pmove		.856
Pspace		.846
Pmultiple		.797
Pvisualize	.488	.609
Pinput	.487	.515

CHAPTER 5

A REVIEW OF EVALUATION CRITERIA AND EMPIRICAL FINDINGS ON THE EFFECTIVENESS OF DESIGN DRAWINGS IN THE PARTICIPATION PROCESS

Landscape architects rely on visual media to communicate design ideas to their clients and other participants in the design process. Plans, sketches, perspective drawings, and photorealistic digital drawings are a few examples of imagery commonly used to portray future landscapes. These images are intended to help people picture how a future setting might look so they can consider different design alternatives, provide feedback, and make decisions about them.

Given the prevalence of visual imagery in the participatory process, it is easy to assume that these tools are effective. A major purpose of this study was to determine what is known about the effectiveness of different types of drawings in achieving these goals, particularly from the layperson's perspective. Are some types of drawings easier to comprehend and more engaging than others? Do some types of drawings foster greater participation in design discussions? Knowing more about the effective use of visual graphics can enhance communication between designers and people invited to participate in design discussions. This can lead to more positive experiences for both designers and participants in design projects where the public is asked to provide their input.

Two parallel approaches were taken in seeking answers to these questions. One of these involved using a theoretical framework that addresses key issues in enabling people to understand and explore material. This framework, originally formulated in different contexts, is applied to questions of the effectiveness of visualization tools. The other approach was the more direct one of examining the literature with respect to visualization tools to learn about efforts that have addressed these questions. Thus both approaches share the goal of identifying frameworks and criteria for evaluating visualization tools, and both aim to inform future studies testing the effectiveness of visualization tools.

Background

Before elaborating on these two approaches it is appropriate to provide a brief description of the terminology used in this article and the context for this project, both with respect to the kinds of visualization tools that were investigated and the scale and context of the participatory situations that were addressed.

Terminology

The focus of the article is on the evaluation of visualization tools in terms of their effectiveness in enhancing participants' understanding of design options and fostering engagement and participation in the design process. More specifically, it is intended to shed light on the usefulness of different types of drawings in achieving these goals.

The three aspects of the drawings' effectiveness - understandability, engagement, and participation – were chosen mainly with the participant in mind. A brief introduction to the three main criteria is provided here. A more in-depth discussion of these concepts and where they came from form the bulk of the article.

- **Understanding** refers to the participants' ability to visualize the proposed setting and gain a sense of the range of design possibilities. A drawing would effectively communicate a design idea if participants were able to get a sense of what it would be like in the setting. Participants would be able to distinguish the various elements of the drawing and comprehend what they represent. They would also have the ability to think about what might happen in the setting or predict potential uses, maintenance, or other issues.

- **Engagement** refers to the drawing's ability to hold the participants' attention. It includes the extent to which the participants find the drawing or its contents interesting and whether it motivates them to think about or explore various design options.

- **Participation** refers to the participants' sense that the drawing supports their ability to take part in design discussions or to provide their input. It entails having the confidence, skills, and motivation to be able do what is asked of them. It also encompasses the sense that their input matters and that they have been heard.

Focus on static simulations

A wide range of tools are available to help people visualize and make decisions about alternatives for future landscapes. Table 5.1 provides an overview of existing visualization tools organized into four types varying in the level of interaction they permit for participants in the design process.

Static simulations, including drawings and photographs, represent a setting from one perspective in space and time. They provide minimal interaction; for instance, participants view completed drawings created by the designer.

Physical models allow the participant to move about the model and view it from different angles. Some physical models have adjustable pieces that permit participants to try different arrangements.

Computer animations and real time simulations are dynamic visualization tools that allow the viewer to experience movement through the landscape. These techniques give the user a sense of being immersed in a setting and sometimes allow the user to navigate and explore the setting from multiple perspectives (Al-Kodmany, 2002).

GIS-based decision support tools refer to computer programs that combine Geographic Information System (GIS) mapping and impact analysis to help communities analyze and compare alternative future landscape scenarios. Users can track and analyze a variety of community indicators in response to different planning and development choices. Some of these programs (e.g., CommunityViz, MetroQuest) include tools to create 3D models and animations of future landscapes.

Context

The visualization tools included in Table 5.1 differ with respect to the scale and content of the projects for which they are used. This review is particularly interested in visualization tools appropriate for depicting small-scale, nature-oriented settings that do not yet exist. Projects of interest include the design of parks, plazas, streetscapes, gardens, and outdoor seating areas. The tools most commonly used by landscape architects to represent these types of settings are static simulations, particularly drawings. Static simulations are highlighted in the table and

Table 5.1
Examples of Visualization Tools

Static Simulations

- Plans, section, elevations
- Wire-frame image
- Photomontage or photo-manipulation (Photoshop)
- Photorealistic digital images (Urban Advantage, Visual Nature Studio, World Construction Set, Vantage Point)
- Freehand artistic renderings (perspective drawings, watercolor, paintings)

Physical Models

- Full-scale mock ups
- Small-scale models
- Adjustable small-scale models

Computer animations / Real-time Simulations

- Virtual reality (Vision Dome) (Sanoff, 2000)
- "Fly through" models (e.g., CommunityViz, MetroQuest)
- Game-based visualization (SimCity) (Sanoff, 2000)
- Berkeley's Urban Simulator

GIS-based Decision Support Tools (maps, tables, figures)

- Geographic Information System
- CommunityViz (http://placeways.com/communityviz/about.php) (Placeways, 2009)
- MetroQuest (http://www.metroquest.com/) (MetroQuest, n.d.)
- What if? (http://www.whatifinc.biz) (What if? Inc., 2009)
- INDEX by Criterion Planners/Engineers, Inc. (Randall, Churchill, & Baetz, 2003)
- Place^{3}s (adaptation of INDEX for evaluating energy impacts) (Randall, et al., 2003)
- Neighbourhood Greening extension of GIS (Randall, et al., 2003)
- Planning Support Systems, i.e., sketching and GIS (Al-Kodmany, 2001; Vonk & Ligtenberg, 2010)

The table combines information from the following main sources: Kwartler & Longo (2008), Al-Kodmany (2002), Lawrence (1993), and Geertmen & Stillwell (2003).

are the subjects of this review. Because static simulations are used in other types of design projects as well, studies in the context of land use planning, urban development, forest management, environmental management, and architectural design are included in this review.

While our emphasis is on static simulations it should be noted that numerous studies in landscape planning and design have used virtual reality (Orland, Budthimedhee, & Uusitalo, 2001; Stock, Bishop, & Green, 2007), game-based engines (Herwig & Paar, 2002), animations (Crawford, 2006), and Geographic Information Systems (Al-Kodmany, 1999, 2001; Kwartler, 2005; Mahdjoubi & Wiltshire, 2001). Virtual walks have been compared to real settings in the context of estimating forest conditions (Fujisaki, et al., 2007) and assessing people's perceptions of an urban park (Bishop & Rohrmann, 2003). Although virtual reality and other interactive tools could be used for small-scale nature settings, this is not commonly practiced in landscape architecture. Therefore, studies focusing on these tools are not included in this review.

Static simulations

Static simulations, such as drawings, depict the proposed landscape from a single perspective in space and time. Plans, sections, and elevations represent the setting in two dimensions. Static simulations that provide a 3-dimensional view of the landscape include wire-frame images, photomontages, perspective drawings, and photorealistic digital images.

Static simulations may be hand-drawn, computer-generated, or a combination of both. Hand-drawn renderings are typically created with pen and ink, watercolor, colored pencils, markers, or a combination. Designers routinely use the computer to generate a basic sketch on top of which they draw design features and contextual elements (Shu, 2000). Designers can manipulate photographs or merge images to depict proposed landscapes within an existing context using Photoshop and other imaging software. Wire-frame images and surface models can be created using AutoCAD (Computer-Aided Design). Wire-frame images display all surfaces of a three-dimensional object in outline form (McGraw-Hill Companies, 2003). Surface models provide more detail than wire-frame drawings by adding color, texture, and shading (Oh, 1994). Plans, sections, and elevations of buildings also can easily be rendered using AutoCAD. They are the most abstract of the drawings discussed in this paper, i.e., they lack the concreteness found in real scenes. They require expertise in translating the image into rich 3-dimensional spaces in one's mind.

The computer has become an increasingly powerful tool for creating realistic design drawings. In the past, depictions of terrain and vegetation have presented a substantial challenge; however, recent efforts in this area have led to major improvements. One method called texture mapping uses parts of satellite or aerial images, photographs, or artificially created patterns to add realistic surface textures to the ground, plants, and trees in drawings (Discoe, 2005). Computer models specifically designed for individually drawing plants and land cover also have been developed (Bergen, McGaughey, & Fridley, 1998; Deussen, Colditz, Coconu, & Hege, 2005; Ervin & Hasbrouck, 2001). More sophisticated 3-D visualization programs, such as Visual Nature Studio, can merge GIS-data, Digital Elevation Model (DEM) data, and computer-aided design (CAD) drawings to create photorealistic images of landscapes with simulated terrain, natural features, vegetation, buildings and roads (Donaldson-Selby, Hill, & Korrubel, 2007).

Although significant improvements in the depiction of nature in 3D visualizations have been made, limitations to the use of these computer models in practice still exist. Deussen et al. (2005) report that the amount of time it takes for the computer to render modeled drawings and the memory needed to manage the significant amount of data in them are problems that need to be addressed. In a study in Germany, Paar (2006) reports that the personnel and investment costs, difficulty using the programs, and time-consuming nature of preparing the drawings have been obstacles in the implementation of 3-D visualizations. Similar sentiments have been heard in conversations with landscape architects in the Midwest U.S. Because small-scale nature projects, in particular, often have a small budget, highly detailed, photorealistic representations may not be feasible. Since the costs of creating drawings seem to increase as the level of abstraction is reduced, it would be useful to know the added value of more realistic drawings in terms of enhancing people's understanding, engagement, and participation in the design process.

Method

Approaches to identifying evaluation criteria

As mentioned earlier, a two-pronged approach was taken to address the effectiveness of visualization tools (and static simulations in particular) as they are used in landscape design projects involving public participation. As we are interested in the effectiveness of these traditional tools in helping the public build mental models of proposed planning and design projects, one approach entailed a conceptual framework that focuses on these psychological issues. The second approach was to search the existing literature for works that have addressed the effectiveness of visualization tools.

The Reasonable Person Model

The Reasonable Person Model was developed to address the need for a theory about the kinds of environments and situations that bring out the best in people (S. Kaplan & Kaplan, 2009). It has been applied in a number of contexts including design, ecological restoration, land use planning, environmental decision-making, housing, and education (R. Kaplan, 1977; R. Kaplan, et al., 2008; R. Kaplan, et al., 1998; Phalen, 2009). RPM offers a useful framework for exploring ways to foster a positive experience for participants in design projects (Chapters 2, 3, 4, 6, and 7).

Kaplan and Kaplan (2009) identify three major informational and motivational needs that when met can lead to reasonable, cooperative behavior: (1) building mental models, (2) meaningful action, and (3) being effective. This section provides an overview of each of these domains.

Mental models are crucial for everyday functioning. The *building mental models* component of RPM refers to people's innate desire to understand and explore. They seek situations that make sense to them. They like to know what's going on and to have a sense of what's to come, yet they also are motivated to expand their mental models. In the context of participatory design, designers use visualization tools to help people build mental models of proposed landscapes. These mental models are critical for making predictions about what might happen in the proposed setting (e.g., potential uses, maintenance issues) or how a place might function under different conditions (e.g., seasons, time of day). A mental model of the landscape also allows people to think through different alternatives and ultimately make decisions about the design. A process that engages people in activities that enhance their understanding and allows for exploration supports this human need for mental model building.

People also seek opportunities to make a difference or participate meaningfully in something that matters to them and others, which Kaplan and Kaplan termed *meaningful action*. An important component of meaningful action is feeling that one has been heard. Being asked for input can turn quickly into frustration when people feel they have not been heard.

The third component, *being effective*, refers to feeling competent and clear-headed or able to manage the information one receives and use one's skills and knowledge in an effective manner. Clear-headedness deals mostly with having the attention needed to concentrate on the task at hand. Attention, however, is a limited resource susceptible to fatigue. Thus information that is overwhelming or confusing can easily undermine people's sense of competence and clear-headedness.

From an RPM perspective, design drawings should enhance participants' understanding, be engaging, and promote meaningful participation. The three components of the model are highly interrelated rather than operating as separate stand-alone concepts. In the context of participation in design, participants' understanding of design drawings plays a major role in their ability to provide useful input. Their engagement and interest also will affect their desire to share feedback. People are more likely to be pleasant and feel useful when they are competent in providing their input and feel their feedback matters.

Kaplan and Kaplan have identified expertise as an important factor affecting understanding in participation efforts. The use of jargon is commonly identified as a major obstacle in effective communication between experts and laypeople (R. Kaplan, et al., 1998; S. Kaplan & Kaplan, 1982; Reymen, Whyte, & Dorst, 2005). However, the problem is greater than a lack of a common language. Expertise, while invaluable in designing spaces, can prevent designers from seeing things the way non-designers see them (R. Kaplan, et al., 1998; S. Kaplan, 1977). These differences not only apply to interpreting design drawings, but also to understanding design concepts, problems, and terminology (S. Kaplan, 1977). To add to this problem, experts' memory of how they once saw things before they became experts has faded (R. Kaplan, et al., 1998), preventing them from being able to put themselves in the layperson's shoes. They cannot remember, for instance, what it was like to view design drawings as a beginner. The storage of information in the expert's brain becomes more compact and efficient, and old ways of seeing are altered as knowledge expands, experience accumulates, and skills improve (Chase & Simon, 1973; de Groot, 1965; S. Kaplan, 1977).

Methodology for searching relevant literature

There is a substantial literature on landscape visualization and the different types of tools available for planning and design projects involving public participation. For example, Bishop and Lange co-edited a book on landscape visualization and have written a number of works that identify and classify visualization tools, present applications of the tools, and discuss issues related to their effectiveness (Bishop & Lange, 2005a, 2005b; Lange, 2002, 2005; Lange & Bishop, 2005). Kwartler and Longo (2008), Geertmen and Stillwell (2003), and Al-Kodmany (2002) present visualization tools used to help communities visualize alternative planning scenarios. Lawrence (1993) presents a typology of architectural design tools and provides an overview of their characteristics. Sanoff (2000) also describes a few visualization techniques in his book about community participation methods in design and planning, including simulation modeling, virtual reality (Vision Dome), and game simulation (SimCity).

By contrast, far less attention has been paid to the focus of this paper: the *evaluation* of visualization tools particularly as they are used in landscape design projects involving public participation. Such an evaluation could take several forms, including a conceptual discussion of important aspects of a drawings' effectiveness, a comparison of drawings and their advantages and disadvantages in communicating design ideas based on professional experience, or an empirical study investigating the performance of drawings on specific evaluation criteria.

To find pertinent material we searched for studies testing three main aspects of various drawings' effectiveness in the participatory design process. The first aspect is the participants' understanding of design drawings and the settings they depict. The second aspect is the participants' interest or engagement in the drawings and the participation process. The third aspect is the participants' sense of their ability to meaningfully participate in design discussions and provide their input.

We also explored factors assumed to affect these outcomes such as the drawing's level of realism, accuracy, and abstraction. Level of realism can be defined as how realistic the drawing looks or how close it matches the real environment. Accuracy refers to the truthfulness of the drawing in representing the correct dimensions, textures, materials, viewpoints, etc. of the setting. Abstraction relates to the style of the drawing or the way in which features of the real environment are represented. An abstract drawing lacks the concreteness found in real scenes. For instance, objects in the real environment may be represented in an abstract drawing as simplified shapes or lines.

Initially, searches were conducted in Google Scholar, Web of Science, and individual journals such as *Landscape and Urban Planning*, *Landscape Design*, *Design Studies*, and *Information Visualization* using one or more of keywords provided in Table 5.2. Many of these searches were unsuccessful, either producing no results or yielding an overwhelming number of articles, most of which were not relevant. Searches were refined by trying different combinations of keywords or limiting the results (in ISI Web of Knowledge) to potentially relevant topics such as environmental studies, architecture, urban studies, planning and development, psychology, and communication. Very few pertinent articles were found using this method.

Table 5.2
Keywords Used in Search

Field / Topic	***Focus of article***	***Tools***
visualization landscape visualization landscape design landscape architecture architecture participatory design public participation pubic communication	evaluation understanding comprehension communication effectiveness comparison of tools lay people	visual graphics visualization tools architectural representations design drawings design graphics simulation Urban Advantage

A further approach was taken in an attempt to increase the relevance of the search results. After identifying several highly pertinent articles (e.g., Mahdjoubi & Wiltshire (2001), Schumann et al. (1996), Bates-Brkljac (2009)), we searched for recent studies that cited these. We also reviewed citations included in these articles to identify past literature. This approach, while not fully systematic, was effective in identifying a web of related articles that provides a reasonably representative picture of the state of knowledge on the effectiveness of the types of visualization tools of interest to us.

Results

Literature-based evaluation criteria

While many researchers identify a need for evaluating the effectiveness of visual simulations in planning and design, few attempts have been made to establish standard criteria and summarize the state of knowledge in this area (Mahdjoubi & Wiltshire, 2001). In one such effort, Mahdjoubi and Wiltshire (2001) reviewed existing theories and empirical studies and developed a theoretical framework to guide research on the evaluation of visual simulations in environmental design, specifically computer-generated simulations. Their synthesis included the early work of Appleyard (1977) and Sheppard (1989), who identified sets of criteria for evaluating the effectiveness of visual simulations.

Our analysis builds on the important contribution of Mahdjoubi and Wiltshire (2001). First we identify the criteria emphasized by Appleyard, Sheppard, and Mahdjoubi and Wiltshire as key issues in evaluating visualization methods. We then compare these to the major criteria based on the Reasonable Person Model. More in depth descriptions of how these researchers, as well as others, define each of their criteria are provided in later sections, along with research findings related to the criteria.

Appleyard's criteria

Appleyard's (1977) work has been highly influential in research on visual simulations in planning and design. It evolved from discussions with colleagues and research at the Environmental Simulation Laboratory at the University of California, Berkeley (Appleyard, 1977). He proposed a research agenda for addressing the lack of knowledge on the effectiveness of visual simulations.

Appleyard identified seven criteria for judging a visual simulation: realism, accuracy, comprehensibility, ability to be evaluated, engagement, cost, and flexibility. Realism and accuracy relate to the simulations' ability to convey how a setting will be experienced. He also believed simulations should be easy for people of all levels of education to understand and should provide the necessary information for participants to assess the design. He defines an engaging simulation as "one that is manipulable in some way by lay persons or is flexible enough for varied alternatives to be presented" (Appleyard, 1977, p. 63). Finally, simulations differ in how much they cost to produce, how accessible they are to the public, and how flexible or adaptable they are to changes made either instantaneously (during a design discussion) or over time (following a participation process.) Some of these criteria are discussed in greater depth in the sections on Aspects of Realism, Understanding, Participation, and Engagement.

Sheppard's criteria

Sheppard recognizes Donald Appleyard, Kenneth Craik, and R. Burton Litton Jr. (all members of his doctoral dissertation committee) as laying the foundation for his work. His guidelines were a result of research also conducted at the Environmental Simulation Laboratory at the University of California, Berkeley, as well as over 13 years of experience of his and colleagues in creating and using visual simulations in practice (Sheppard, 1989). Sheppard (1989) offered a set of guidelines for creating visual simulations in an attempt to address the lack of standards or a comprehensive set of guidelines in the field. He advises that simulations be representative, accurate, clear, interesting, and defensible, which he defines as follows (Sheppard, 1989):

- **Representative** – "…shows important views of the project, and shows the project in typical views and conditions" (p.65).
- **Accurate** – "…shows a view of the project that is not significantly different in appearance from the real view when seen from the same viewpoint" (p.76).
- **Clear** – "…visual content of the image is clearly and unambiguously expressed, is presented without loss of detail, contrast, or sharpness, and is free of distracting or competing elements" (p.96).
- **Interesting** – "…holds the viewers' attention throughout the presentation period and involves them in the issue at hand" (p.98).

- **Defensible** – "…seen to be legitimate; that is, when evidence is presented along with the simulation to show how it was produced and to what extent it is accurate and representative" (p.100).

Mahdjoubi and Wiltshire's criteria

Based on their review of the literature, Mahdjoubi and Wiltshire (2001) proposed three major factors to consider when evaluating visual simulations: decision-maker, visual representation, and design task. They report that existing studies primarily focus on the first two of these. *Decision-maker characteristics* include level of expertise (in design and in the use of visual simulations), occupation, and demographics such as age and gender. *Visual representation* encompasses the level of detail and style of representation (e.g., sketch, photorealistic image).

Design task, the third component, Mahdjoubi and Wiltshire (2001) consider the least emphasized in work in this area. They suggest exploring three dimensions of design tasks, which were inspired by Peeck's (1987) work on the human response to illustrations. The *cognitive* aspect involves the viewers' comprehension of the simulation and ability to perform cognitive tasks such as understanding spatial relationships, dimensions, and orientation. The *affective* function refers to the viewers' judgment of the design and the effects of the simulation on the viewers' attitudes and preferences. The *motivational* aspect relates to the effect of the simulation on fostering or inhibiting participation in the design process. Schumann et al. (1996) measured these three components in a study that assessed non-photorealistic images. Specific measures for each dimension are discussed further in the sections on understanding, engagement, and participation.

Comparison of frameworks

Before comparing the four frameworks in terms of evaluation criteria, it is important to consider the researchers' intended contexts for their evaluation criteria and their definitions of "visual simulation." Regarding the context, both Appleyard and Sheppard focus on the use of visual simulations in communicating proposals for landscapes that do not yet exist. Their guidelines apply to similar types of projects such as proposed freeways, buildings, energy technologies, environmental management techniques, and land use changes. Mahdjoubi and Wiltshire's framework was designed with architectural design decision-making in mind. It discusses computer-generated imagery used to "emulate real life scenes or objects, or to speculate about future events or projects" (Mahdjoubi & Wiltshire, 2001, p. 193). The Reasonable Person Model, while not developed with respect to the specific issues under consideration here, provides a framework that can be used for examining the effectiveness of visualization tools.

Appleyard and Sheppard define visual simulations somewhat differently. Appleyard includes verbal descriptions, photographs, movies, and all types of drawings (plans, sections, perspectives) in his definition of simulation media. He was particularly interested in *experiential* simulations, which attempt to "reproduce a concrete representation of what a place will be like when experienced" (Appleyard, 1977, p. 44). Sheppard (1989) defines a simulation as "visual pictures or images of proposed projects or future conditions, shown in perspective views in the context of actual sites" (Sheppard, 1989, p. 6). The perspective view provides perceptions of depth and places objects in a 3-dimensional relationship with other objects and its surroundings, as they would be seen in a real environment. Mahdjoubi and Wiltshire focus on computer-generated visual simulations.

The analysis of the four frameworks led to the identification of five main categories of criteria for evaluating the effectiveness of visualization tools. The first three are structured around the three dimensions raised by RPM: Understanding, Engagement, and Participation. A fourth major category involves several aspects of realism, a consideration central to the three literature-derived frameworks and to many of the empirical studies on visualization effectiveness. These aspects relate to how closely the drawing matches the real environment in various respects, such as how representative the views are, how accurate the drawing is, or its level of detail or abstraction. The fifth category, Viewer Characteristics, focuses on factors that may affect effectiveness based on background differences of the people viewing the visualization images. These characteristics include the participants' level of expertise, familiarity with the drawings or the settings they depict, and level of education. Table 5.3 lists the criteria by category and identifies which frameworks include each criterion. It allows for a comparison of frameworks, highlighting common criteria and criteria that appear most frequently.

It is quickly evident in viewing Table 5.3 that with respect to the RPM-related domains, all four frameworks address some aspect of Understanding as well as the relevance of prior experience which is likely to impact understanding. RPM is not unique in including criteria relevant to Engagement and Participation but places a greater emphasis on these topics. The next section examines these three domains more closely and discusses the research findings related to them.

Table 5.3
Criteria for Evaluating the Effectiveness of Drawings

	Appleyard's criteria	**Sheppard's criteria**	**Mahdjoubi & Wiltshire's framework**	**Kaplan & Kaplan's RPM framework**
Understanding				
Comprehensible	X		X	X
Clear		X		
Able to perform cognitive tasks (understand spatial relationships, dimensions, orientation)			X	X
Engagement				
Engaging/ interesting	X	X		X
Perceived flexibility / manipulability	X			X
Participation				
Able to evaluate / feel competent in providing input	X			X
Encourage participation / Stimulate discussion			X	X
Aspects of Realism				
Realism	X		X	
Accuracy	X	X	X	
Level of abstraction / style of representation			X	

Table 5.3 (continued) Criteria for Evaluating the Effectiveness of Drawings				
	Appleyard's criteria	**Sheppard's criteria**	**Mahdjoubi & Wiltshire's framework**	**Kaplan & Kaplan's RPM framework**
Level of detail			X	
Representative		X	X	
Viewer characteristics				
Level of experience / expertise (with design and visual media)	X	X	X	X
Familiarity with simulation or settings depicted	X	X	X	X
Professional education			X	
Age			X	
Gender			X	
Other				
Confidence or credibility in visual simulation			X	
Aesthetic judgments and effect on attitude and preferences			X	
Defensibility		X		
Cost of simulation	X			

The table also shows that issues related to realism play a major role in the criteria central to the three frameworks deriving from the literature on visualization but these are not included in RPM. A later section of the paper examines the research on realism and discusses the research findings pertinent to this topic.

Studies related to viewer characteristics, such as level of expertise and familiarity, are typically discussed in the literature in relation to one of the other criteria. Thus, they appear throughout the next two sections rather than in a section of their own.

Understanding, engagement, and participation as evaluation criteria

For each of the three overarching RPM domains we first describe the various ways in which the specific criteria are defined in the literature. Then we provide empirical findings specific to each criterion from studies evaluating static simulations. A summary list of these studies is provided in Appendix 5.A, including the context of the study, sample population, types of static tools tested, and measures on which the tool was evaluated.

Understanding

Achieving a common understanding of design drawings and the proposed designs they depict is of particular importance since they form the basis of design discussions and decision-making. Visual imagery is essential for helping people visualize design alternatives; however, not all visual material is easily understood by the layperson.

From an RPM perspective, understanding refers to the ability to make sense of the drawing and the kind of place it represents. Understanding not only entails being able to envision what it would be like to be in the setting and imagine one's movement through the setting, but also to predict things that might happen there and anticipate issues that might arise (e.g., maintenance issues, seasonal changes) (R. Kaplan, et al., 1998). These tasks are easier when one is familiar with the setting or similar settings (S. Kaplan & Kaplan, 1982). Also, the image depicting the proposed landscape should be intuitive and informative. It should not be confusing, overwhelming, nor distracting.

Appleyard (1977) speaks of *comprehension* in terms of understanding what an experience in the proposed environment would be like. Since a variety of images may be needed to help people understand the relationships between the elements and their connection to reality, Appleyard recommends using a combination of visual media with different levels of abstraction to aid comprehension. Another factor that plays a role in comprehensibility is familiarity with the visual media, as demonstrated by differences between professionals and the public in understanding highly abstract drawings, for example.

Clarity of a simulation, as described by Sheppard (1989), refers mainly to the quality of the reproduction (e.g., not blurry or grainy), but also to the lack of distracting and competing elements. Sheppard explains that people's perception of distracting elements is affected by their familiarity with the visual medium. Elements that a layperson finds distracting or unclear may make perfect sense to a designer. In this way, familiarity with the visual medium has an impact on their interpretation of an image.

Padda et al. (2008) developed a set of criteria for measuring comprehension of visualization tools based on information in the fields of perception, cognition, and visual communications. They define visual comprehension as the ability to "grasp the underlying design intent along with the interactions to explore the visually represented information" (Padda, et al., 2008, p. 83). According to their findings, visual representations are most effective cognitively when they are legible, provide multiple perspectives, and most closely match the information being represented. The material should be organized in a way that it is easy to comprehend, which includes being navigable (referred to as *reachability* in their criteria). The visualization also should include only the essential elements. Some of the criteria proposed to address this goal are *simplicity, clarity, emphasis*, and *distinctiveness*.

Schumann et al. (1996) measured cognitive aspects of non-photorealistic images produced with a sketch-renderer in Computer Aided Design software. They asked survey respondents to rate whether the image was *comprehensible*, *clear*, *recognizable*, and *spatial*. These measures were chosen based on Peeck's (1987) work on the human response to illustrations.

Mazza and Berre (2007) present a series of *cognitive tasks* that could be used to measure participants' understanding of visualization techniques. Although their work deals with Information Visualization in general and research methodologies used in evaluating them, some of the cognitive tasks can be applied to understanding design proposals. Descriptions of some of these tasks as described by Mazza and Berre are provided below. We added examples specific to design drawings based on our interpretation of the tasks.

- Locate – point to or describe an object in the representation that you already knew existed (e.g., an existing building, parking lot)

- Identify – locate an item in the drawing that you did not know before seeing the representation (e.g., new construction)
- Distinguish – distinguish among different objects in the representation (e.g., stairs vs. ramps, trees vs. bushes, trees vs. telephone poles)
- Associate – able to form relationships between objects (e.g., understand the spatial relationships between objects)

Empirical findings on understanding

The difficulty laypeople have in understanding two-dimensional drawings, particularly plan drawings, is well documented (Lawrence, 1983, 1993; Mahdjoubi & Wiltshire, 2001; Pietsch, 2000). Yet they are commonly used by designers to share their ideas. People have trouble picturing a three-dimensional space from a plan view.

Schumann et al. (1996) found that architects considered the wireframe image (i.e., 3-D outline of an object) to be more comprehensible, recognizable, and clear than the shaded wireframe and sketch. The architects chose the sketch significantly more often than the wireframe or shaded wireframe for presenting initial design ideas early in the design process and significantly less often for presenting final designs.

Oh (1994) found that, although an individual's actual familiarity with the site remained constant, the respondent's ability to recognize the site from the images (i.e., perceived familiarity) differed across media types, improving as the level of detail increased. Among the four simulations, a significant difference in familiarity was found between the most detailed computer model (touched-up drawing with photograph as background) and the least detailed, wire-frame drawing. Also, details on vegetation and landscape features were considered to be insufficient in the surface model (S-M) drawing which included colors, textures, and shading. Participants commented that the wire-frame drawing made trees look dry.

Focus group interviews and semi-structured interviews performed at the preliminary stages of a study by Bates-Brkljac (2009) provided useful information about the non-designers' understanding of the architectural representations. First, non-experts perceived the quantity of information in the watercolor, artistic drawings to be overwhelming, and as a result, less credible (Bates-Brkljac, 2007, 2009). Second, the higher level of abstraction in the freehand perspective drawing was challenging for the planning commissioners and non-architect, building professionals. The study reports that freehand perspective drawings "failed to elicit much useful comments from the public because the artistic graphic features of the representations were 'difficult' for the average untrained observer" (Bates-Brkljac, 2007, p. 6). The architects, on the other hand, had no trouble deciphering the designs given their experience with freehand perspective drawings. Based on their findings, Bates-Brkljac (2009) concluded that the perspective drawing appears to be "inadequate for non-architects and limits their comprehension and capabilities as communicative medium to a wider audience" (Bates-Brkljac, 2009, p. 434), suggesting that perspective drawings may be more appropriate for internal dialogue between designers than as a means of communicating with the public.

C omparing freehand sketches and photorealistic images, Pietsch (2000) describes a study by Harrilchak (1993) that found "…photorealistic images [were] ... consistently rated as most effectively communicating useful information of proposed design changes" (Pietsch, 2000, p. 531). People expected more from a photorealistic image than from a hand-drawn sketch where "they know that the end product will be considerably different" (Pietsch, 2000, p. 531). Their expectations changed based on the visual medium used.

Engagement

Researchers recommend that visual simulations be engaging or interesting (Appleyard, 1977; Perkins & Barnhart, 2005; Schumann, et al., 1996; Sheppard, 1989). Engagement refers to the extent to which the drawing holds the viewers' attention. Some researchers believe participants are more likely to find a drawing interesting if it is relevant to their concerns (R. Kaplan, et al., 1998; Sheppard, 1989). Engaging tools have been described as tools that can be easily manipulated, especially by laypeople, in order to explore different alternatives and respond to requested changes (Appleyard, 1977; S. Kaplan & Kaplan, 1982; Schumann, et al., 1996). From an RPM perspective, exploration of this kind is important for building mental models of a proposed landscape (S. Kaplan & Kaplan, 1982). This type of engagement can promote more active participation (Appleyard, 1977; S. Kaplan & Kaplan, 1982).

Sheppard's (1989) take on engagement relates less to exploration and more to how the information is presented. He emphasizes the importance of the presentation format and entertainment value of the simulation. Presentations that are too long or slow paced, use too many or seemingly repetitive simulations, and fail to address participants' concerns can lead to boredom. A presentation may be too interesting if the simulation itself is entertaining or fascinating, thereby causing a distraction from the important issues.

Schumann et al.'s (1996) discussion of the affective and motivational effects of images relate to engagement. Measures of the affective aspects of images include whether people judge the image to be interesting, lively, imaginative and creative. Measures of the motivational aspects include whether the image is stimulating to look at and stimulating to changes.

Empirical findings on engagement

Few studies evaluate how engaging different visualization tools are. One study by Schumann et al. (1996) found that architects rated the sketch significantly more "interesting, lively, imaginative, creative, individual and less artificial" and "stimulating to look at" than both the wireframe and shaded wireframe images (Schumann, et al., 1996, p. 38).

Participation

When designers ask laypeople to provide input on design alternatives, they rely heavily on the use of visualization tools in communicating the alternatives. Assessing the effectiveness of these tools in facilitating participation is critical. Participation can be thought of in terms of both the motivation and confidence of participants in providing their input. Using RPM, the motivational component can be measured by the participants' sense that they feel their participation matters and their feedback has been heard (S. Kaplan & Kaplan, 2009). A related measure of participation was used in a study by Schumann et al. (1996) where respondents were asked whether the image was *stimulating to discussions.*

In terms of confidence, RPM offers the concept of *being effective,* which can be used to measure the participants' sense that they can do what is asked of them. This requires being able to manage the information in the drawing by paying attention to important elements and ignoring irrelevant details. Participants could be asked to rate how competent they feel in providing their input based on their comfort with the image provided. Appleyard (1977) proposes a similar criterion that assesses the participants' ability to evaluate the design proposal. He argues that the visual simulation must provide sufficient information in the drawing to represent the qualities expected to be evaluated (e.g., privacy, safety, noise). Appleyard describes the difficulty in this, however, since little is known about the attributes needed in a drawing to make an assessment of such qualities in an environment.

Empirical findings on participation

In a study by Donaldson-Selby et al. (2007) on urban greening projects, residents strongly agreed that photorealistic images "empowered them to participate more fully in the planning and discussion of urban greening" (p. 12). They also indicated strong agreement that the photorealistic images provided "sufficient information to make decisions with respect to the planting of trees, and use of open space" (Donaldson-Selby, et al., 2007, pp. 11,12).

The study by Schumann et al. (1996), based on architects' impressions, found the sketch was more stimulating to discuss than the wireframe and shaded wireframe images. Respondents also believed the sketch would lead to significantly more active participation than the other images.

Results from a study by Bates-Brkljac (2007) demonstrates the interrelationship between understanding and participation. The study reports that freehand perspective drawings "failed to elicit much useful comments from the public because the artistic graphic features of the representations were 'difficult' for the average untrained observer" (Bates-Brkljac, 2007, p. 6).

Summary

There is little research speaking directly to the effectiveness of different types of drawings in terms of understanding, engagement, and participation. Understandability of drawings has received the most attention of these three areas. There are some indications that sketches and freehand perspective drawings may be more difficult for laypeople to understand than more detailed, realistic-looking drawings. However, findings based on architects' responses suggest that sketches may be more engaging and stimulate more active participation than computer-generated wireframe images. Laypeople's perspective on these issues has not yet been sought.

Aspects of realism and their role in effective visualization

Realism has been a central theme in the studies on visualization tools. Pietsch (2000) states that the "degree of realism can significantly affect the perception of the model - the comprehension of the image, the tentativeness or concreteness of the proposal, and the accuracy or inaccuracy of the representation" (Pietsch, 2000, p. 531). Many researchers are interested in how close to the real setting a simulation needs to be in order to make informed decisions about the setting. In these cases, realism refers to how well the visual simulation compares to the real environment. The majority of empirical studies on visual simulation focus on this aspect of realism. They test the "representational validity" of simulations by comparing people's responses to visual simulations to their responses to the real environment. Appendix 5.A provides brief descriptions of studies on static simulations that evaluate aspects of realism.

Appleyard (1977) is one researcher who believed a visual simulation should try to depict how a proposed environment will be experienced. He makes the distinction between apparent realism and actual realism, i.e., a realistic simulation versus one that is equivalent in perceptual experience. Appleyard found it relatively easy to convince people that a simulation is realistic. He asserts the more important test is that of *actual realism* where the cognitive, affective, and behavioral responses to the simulation are compared to responses to the real environment. Another way to assess actual realism is to analyze the media in terms of how well it replicates the detail, texture, tone, color, field of view, multiple points of view, 3-dimensionality, movement, and sound in the real environment. According to Appleyard, a simulation's *accuracy* depends on correct dimensions, use of multiple viewpoints, and specification of materials, vegetation, etc.

Sheppard (1989) emphasizes the need for a visual simulation to be *representative* of a project by portraying important views, as well as typical views and conditions. This requires the use of more than one visual simulation with appropriate *fields of view* where spatial relationships and site context are visible.

Showing movement and changes over time also contribute to a simulation's representativeness. Sheppard defines an *accurate* simulation as one that includes objects as seen in the real setting with the correct position, scale, shape, color, detail, and texture. These elements correspond closely to Appleyard's measures of realism and accuracy.

Abstraction is an aspect of realism that some researchers believe plays an important role in people's understanding and engagement in design drawings (Bates-Brkljac, 2009; Pietsch, 2000). Pietsch (2000) defines abstraction as the "selection of information included in the creation and presentation of computer visualisation modelling" (p. 521). Ervin (2001) defines the level of abstraction as the "filter by which information…[is] selected, discard[ed], highlighted in representation" (p. 60). He discusses the need for more research on assessing the appropriate levels of abstraction for different purposes and in different contexts.

Sheppard (1989) views abstraction as contributing to inaccuracies in simulations. While he recognizes that a simplified or abstract drawing may help in understanding some aspects of a design such as spatial arrangement, he stresses the failure of abstractions in providing information about other important design elements and details. This can lead to confusion and make it difficult for people to judge the design. Sheppard adds that designers may use abstract or stylistic drawings to manipulate people's perception of a project. For example, Sheppard found that artists' renderings tended to make the project more attractive. He warns that lay people with little experience with architectural drawings might easily be misled.

Kaplan and Kaplan (1982) take a different stance than Appleyard and Sheppard on the importance of realism in simulations and the effects of abstraction. They discuss the effectiveness and merits of using a simplified representation and point out a number of negative consequences associated with the idea that simulations should strive to replicate the environment it depicts. First, the high level of detail that results from efforts to achieve exactness can overload participants with too much information. Second, exact replicas fail to take advantage of people's ability to make predictions, decisions, and judgments by calling to mind "what if" scenarios. In fact, people's cognitive structures are simplified representations of things experienced in the world. Since simplified simulations correspond more closely to these cognitive structures, these simulations can facilitate knowledge transfer and be easier for people to work with (S. Kaplan & Kaplan, 1982).

Pietsch (2000) discusses other ways in which abstraction can serve a particular purpose. Omitting details can help focus people's attention on the relevant issues at hand. It also can communicate uncertainty or the tentative nature of interpretations of a simulation.

According to Kaplan and Kaplan (1982), a simulation is "intended as an aid to thought, not as a full-fledged substitute for reality" (p. 201). It is created with a specific purpose in mind. Therefore, the important test of the effectiveness of a simulation is whether it supports people's ability to evaluate, judge, or respond to the simulation in the same way they would respond to the real environment "with respect to that purpose" (p.201).

Like Kaplan and Kaplan (1982), there are other researchers that resist the idea of trying to make a simulation look as real as possible. As reported in Pietsch (2000), Lehtonen takes the stance that the "Simulation of a future planned environment cannot equal with the real world and it is not even worthwhile attempting so" (Lehtonen, 1985, p. 21). Lawrence (1993) also recommends architectural tools be chosen based on the purpose of the simulation, which will determine how similar it needs to be to reality, recognizing the fact that "a simulation is not a replica of a real-life situation but a representation of it" (Lawrence, 1993, p. 302). Pietsch (2000) concludes that the appropriate balance among realism, accuracy, and abstraction has yet to be found.

Empirical findings on "aspects of realism"

In comparing computer-generated 3-D images, freehand perspective drawings, watercolor paintings, and photomontages, Bates-Brkljac (2009) found photomontages to be the most preferred method of representation in terms of its credibility, realism, and sufficient level of detail. Non-architect participants perceived the freehand perspective drawings as the least accurate and rated them considerably less credible. The majority of these participants found the perspective drawings "chaotic" and "abbreviated." In addition, although a high level of detail was strongly related to greater perceived accuracy, images that looked too perfect or embellished lost credibility. The photomontage was deemed credible due to its lack of embellishment.

Oh (1994) compared respondents' perceptions of a variety of characteristics of a building and its surrounding landscape (e.g., orderly, colorful, barren, formal, noisy) when looking at computer simulations versus a photograph of the real, post-construction site. They found that responses to the wire-frame image were most different than responses to the real environment. The image that elicited the most similar responses to the photograph of the actual setting was the "image processing" (I-P) drawing, which was created by superimposing a surface model of the building onto a photograph of the existing landscape and touching it up with realistic textures, shading, and colors borrowed from the photograph. The simulated landscape in the wire-frame image was rated significantly less attractive than the same landscape presented in the three other images. When a high level of detail and realism are not important, Oh recommends using a surface model image (S-M) or surface model with photograph as the background (COMB) since these images yielded responses moderately similar to the post-construction photograph.

In terms of respondents' confidence in the simulations, Oh (1994) found that images with greater level of detail were associated with greater confidence that the image depicted an actual landscape. People with more experience with computer simulations were more confident in the images with a photograph of the existing landscape as the background than were people with less experience. No differences in confidence were found between the groups for the wire-frame nor surface model images.

Wergles and Muhar (2009) found that, compared to site visits, 3D digital models were better at communicating spatial layout and worse at conveying textures, mobility, slope and height differences, new versus existing things (e.g., size of trees, lawn), certain lighting features and materials, and sounds. Also, the overall impressions of the site were different between the two and were influenced by the architects' focus, or lack of focus, on certain aspects in the drawings. As stated by the authors, the setting was "put exactly in the perspective that the architect desired" (Wergles & Muhar, 2009, p. 180).

Researchers in forest management have been concerned with the validity of computer-generated images for assessing people's preferences of forest management alternatives. Bergen et al. (1995) tested photorealistic images rendered using an early version of Vantage Point, which draws individual trees on a digital terrain model to depict tree stands. They found low correlations between individuals' assessment of scenic beauty in photographs compared to corresponding Vantage Point images. In another study of scenic beauty assessment for forest scenes, Daniel and Meitner (2001) found low correlations between responses to abstract images and full color photographs. They concluded that black and white sketches, grayscale photographs, and stylized paintings were insufficient for rating scenic beauty and concluded that only full color photographs should be used for this purpose.

In summary, a decent amount of research exists that compares people's perceptions of visual representations to those of the corresponding real environment. These efforts have been driven primarily by interest in whether these visual representations serve as adequate surrogates for the real environment when assessing these landscapes. Many of these studies explore the relationship between level of detail and perceived accuracy or credibility of the image. In most instances, drawings with a greater level of detail (e.g., photomontage) were perceived as more accurate or credible, but this was not the case for all computer-generated 3D images. In terms of eliciting similar responses to the real environment, both photorealistic and abstract images leave something to be desired. Assessments of attractiveness or scenic beauty using visual simulations versus their real counterparts ranged from low to moderately similar at best. The existing research provides little additional knowledge on the role that realism plays in enhancing imagery of a place, fostering exploration of design ideas, and encouraging feedback.

Summary and Conclusions

The analyses presented in the previous sections are based on criteria derived from RPM as an overarching conceptual framework and from criteria proposed by researchers who have examined the effectiveness of particular visualization tools. In addition to identifying evaluation criteria, we presented empirical findings specific to each category of criteria in an attempt to answer our main research question, "What do we know about the effectiveness of different types of drawings?"

The answer to this question remains relatively unchanged. In the past researchers reported that few studies had tested the effectiveness of visualization tools in participatory design projects (Bates-Brkljac, 2009; Mahdjoubi & Wiltshire, 2001; Pietsch, 2000; Reymen, et al., 2005; Sheppard, 2001). The same remains true today. This literature review found that little is known about the effectiveness of different design drawings in fostering communication in design projects for future landscapes, particularly from the layperson's perspective. Also, studies on visualization have primarily been in the context of planning and community development. Only one study was found that focused on small-scale, nature-oriented settings (Donaldson-Selby, et al., 2007).

Nine studies were found on the effectiveness of static visual simulations, two of which are literature reviews and the rest are empirical studies (see Appendix 5.A). All but one of the studies evaluate some aspect of realism, which is in line with Mahdjoubi and Wiltshire's (2001) finding that research on visual simulations has primarily focused on the issue of realism. Many of these studies, as discussed in the previous section, test the representational validity of static simulations, particularly their ability to elicit the same responses as the real environment.

No empirical studies were found that directly measure *laypeople's* comprehension of and engagement in different types of design drawings. One study tested first year landscape architects' understanding of a digital 3D model (Wergles & Muhar, 2009). Interviews in a preliminary study gathered some useful information on planners' understanding of design drawings (Bates-Brkljac, 2009), but measures of understanding were not included in the final study's design. In terms of participation, only one study included a measure that asked residents whether the visualization tool enhanced their participation in the planning process (Donaldson-Selby, et al., 2007).

The study design of Schumann et al. (1996) was most promising for the purpose of evaluating drawings on psychological issues, specifically people's comprehension, engagement, and participation. However, only the architects' point of view was obtained. Architects rated their expectations of the viewers' ability to comprehend the drawings, interest in the drawings, and the extent to which the drawing might stimulate the viewers' to actively participate in design discussions.

Unfortunately, non-designers were not asked. Since differences in the perceptions of experts and laypeople are well documented (Bates-Brkljac, 2009; R. Kaplan, et al., 1998; S. Kaplan & Kaplan, 1982; Mahdjoubi & Wiltshire, 2001; Reymen, et al., 2005), asking laypeople directly about their comprehension, engagement, and participation is critical.

It is reasonable to say that visual imagery plays a key role in the participation process. People care deeply about proposed changes in their neighborhoods and seek information that can help them visualize the changes. At the same time, there are reasons to believe that some visual images are more effective than others in providing the information sought by those who might be affected by the changes.

Since a key objective of design drawings is to build participants' understanding of design alternatives, research on their effectiveness needs to include the participants' assessment of how well the drawings provide a sense of what landscape alternatives might look like. Can participants' envision these landscapes from multiple perspectives and in different conditions? Are the drawings clear, intuitive, and absent of distracting elements? Equally important is the drawings' success in engaging or holding the participants' interest and strengthening people's motivation and ability to participate in design discussions. There is a great need for research aimed at assessing drawings on these issues with the ultimate goal of supporting the participants' ability to analyze and make decisions about the landscape.

The realism of the visualizations is important in terms of providing laypeople a sense for how a proposal might look and function once built. The studies focusing on realism, however, have tended to examine realism as an issue in its own right as opposed to studying the role of realism as a factor in achieving the desired outcomes of effective participation. In other words, are more realistic renderings more effective in engaging the public, in helping people feel they can meaningfully participate, and in enhancing their understanding? If producing images that are more accurate and realistic requires greater effort, it is important to gain some understanding of when in the participatory process such accuracy is needed. Might greater detail even be a hindrance under some circumstances? These questions all deserve empirical attention.

Another research consideration is the participants' level of expertise. Because experts view things differently than laypeople, gathering input directly from laypeople is essential for better understanding the effectiveness of drawings in public participation efforts. Investigating the impact of familiarity, both in terms of the types of drawings used and the settings they depict, on a drawing's effectiveness also could be worthwhile.

Finally, the context of the design project and purpose behind the public participation also may be important. While studies in the contexts of architecture, planning, and forest management provide some insight into the usefulness of different visual tools in communicating design ideas, caution should be taken in applying results from these studies to landscape architecture. Tools that are successful in enhancing visualization of buildings, land use changes, and forest vistas may not be good for small-scale nature settings. Thus, studies specific to small-scale nature settings would be valuable.

Participation has become critical in design and planning, even for small-scale projects. Considering the reliance of these efforts on visual imagery in general, and more specifically on various forms of drawing, it is discouraging that so little work has addressed the effectiveness of visual communication. If the visual imagery is confusing, it is likely to hinder citizens' ability to imagine the planned changes and provide meaningful input, leading to a frustrating participatory process for both designers and participants. Enhancing understanding, engagement, and participation can make a real difference in both the decisions made about future landscapes and experiences of those involved in the process. Research aimed at exploring ways of achieving these goals would be a great contribution to the design field.

Appendix 5.A
Studies on the effectiveness of visual simulations (alphabetical)

Author	Context	Respondents (sample population)	Tools	Aspects of realism	Engagement	Understanding	Participation	Specific Evaluation Criteria
Bates-Brkljac 2006, 2007, 2009	Urban developments, architectural design, U.K.	• Architects • Professionals in the building field (e.g., engineers, planners, surveyors) • Members of planning council	• Computer-generated 3-D image • Photomontage • Freehand perspective drawing • Watercolor painted perspective	X		X	X	• Credibility • Realism • Sufficient level of detail • *Understanding (preliminary study, focus interview)* • *Participation (preliminary study, focus interview)*
Bergen et al. (1995)	Forest management (large-scale)	• Students and faculty from forestry and other areas (n=29)	• Photographs of real scenes vs. computer-generated images (Vantage Point images, prototype version of program)	X				• Realism (representational validity) • Scenic beauty (preference)

Appendix 5.A (continued)
Studies on the effectiveness of visual simulations (alphabetical)

Author	Context	Respondents (sample population)	Tools	Aspects of realism	Engage.	Underst.	Particip.	Specific Evaluation Criteria
Daniel and Meitner (2001)	Forest management, (scale = mid-range vistas)	• Undergraduate psychology students	Photograph vs. Photomanipulation: • Grayscale photograph • Stylized painting • Black and white sketch	X				• Validity of representation *(Realism)* • Perceived scenic beauty
Donaldson -Selby (2001)	Urban greening projects (e.g., vegetable gardens, communal crops, grass, and street trees) in residential development, South Africa	• Professional experts • Residents	• Photorealistic images (Visual Nature Studio)	X			X	• Accuracy, credibility • Usefulness for decision-making • Empowered to participate

Appendix 5.A (continued)
Studies on the effectiveness of visual simulations (alphabetical)

Author	Context	Respondents (sample population)	Tools	Aspects of realism	Engage.	Underst.	Particip.	Specific Evaluation Criteria
Mahdjoubi and Wiltshire (2001) *(Lit review)*	Environment-al design	• n/a *(Lit review)*	• Computer visual simulations • Traditional drawings	X	X	X	X	Lit review: • Interest and engagement (including participation) • Comprehension • Representativeness • Realism and accuracy • Visual realism and level of detail
Oh (1994)	Building and site design	• Undergraduate students taking "Intro to City Planning" class or "Advanced Graphics for Landscape Architecture" class	Computer simulations:[1] • wire-frame image (W-F) • surface model image (S-M) • Combined surface model with photograph (COMB) • Image processing (IP)	X				• Realism (compare adjectives of real setting to adjectives rated in drawings) • Visual attractiveness • Confidence that simulation shows a real setting • Site familiarity

[1] Descriptions: wire-frame image (W-F) = simple line drawing; surface model image (S-M) = drawing with color, shading, and textures; combined surface model (COMB) = surface model with scanned photograph for background; and image processing (IP) = surface model with photograph touched up with textures, shading, colors borrowed from photograph.

Appendix 5.A (continued) Studies on the effectiveness of visual simulations (alphabetical)								
Author	**Context**	**Respondents (sample population)**	**Tools**	**Aspects of realism**	**Engage.**	**Underst.**	**Particip.**	**Specific Evaluation Criteria**
Pietsch 2000 (lit review)	Planning in urban environments in Australia (includes small and large scale)	• n/a (lit review)	• 3D computer visualization images • Interactive 3D computer models where user can choose the view • Animation • Brief discussion of urban simulator, virtual reality, GIS	X				Lit review: • Realism • Abstraction • Accuracy
Schumann 1996	Building design	• Architects and architecture students (and their judgment of viewers' impressions of image)	Non-photorealistic AutoCAD drawings: • wireframe • shaded wireframe • sketch		X	X	X	• Cognitive effects (e.g., comprehendible, recognizable, clear, spatial) • Affective effects (artificial, interesting, lively, imaginative, creative, and individual) • Motivational effects (e.g., stimulating to look at, stimulating to discussions, stimulating to changes)

Appendix 5.A (continued)
Studies on the effectiveness of visual simulations (alphabetical)

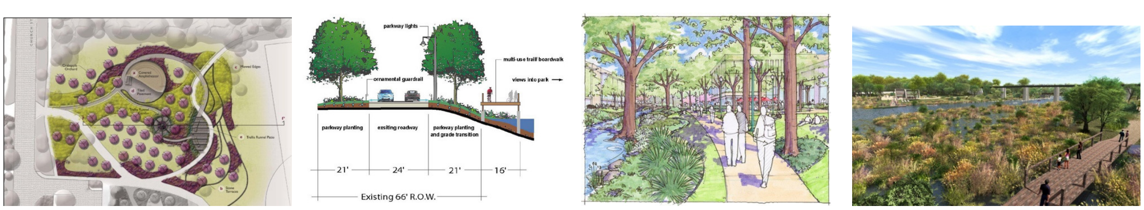
Author	**Context**	**Respondents (sample population)**	**Tools**	**Aspects of realism**	**Engage.**	**Underst.**	**Particip.**	**Specific Evaluation Criteria**
Wergles & Muhar (2009)	Remodel of large urban square in Vienna, Austria	• First year landscape architecture students	• Site visits (post-construction) vs. computer visualizations (at proposal stage) • Digital 3D model with geometry, texture, and lighting (created with 3D Studio Max software)	X		X		• Representational validity • Perception • Attention • Retention • Comprehension • Deduction

CHAPTER 6

LAYPEOPLE'S EVALUATION OF THE EFFECTIVENESS OF TRADITIONAL LANDSCAPE DESIGN DRAWINGS

In design projects involving large-scale public participation, citizens or potential users may be asked to provide input on design proposals presented at a public meeting or shared in local newspapers, online, or displayed in a public place. Participants may see only a few drawings and may not have the opportunity to discuss the design directly with the designer. Thus, they must rely on their own ability to understand and interpret the drawings. With an increasing number of local governments mandating public participation in design and planning decisions, more laypeople are being asked to provide feedback on design projects represented by stand-alone landscape architecture drawings. The effectiveness of this approach to public participation, including the visual materials used, has received little to no attention in the literature.

Plans, sections, perspective drawings, and photorealistic drawings (including photo-manipulations and computer-generated images) are the most common types of drawings used by landscape architects to communicate design ideas for future landscapes (Figure 6.1). These drawings have dominated the field as a result of designers' training and design standards in the field. Designers may feel they have a good sense of the effectiveness of these drawings in communicating design ideas; however, they rarely have the opportunity to test their assumptions. Most designers



Plan Section Perspective Drawing Photorealistic Drawing

Figure 6.1 Examples of the four types of drawings included in the study probably have never asked their participants directly about how helpful the design drawings were in visualizing and evaluating the design. Also, while plenty of literature exists on how to create design drawings, few empirical studies evaluate the effectiveness of design drawings from the participants' perspective. Thus, little is known about the usefulness of different drawings in helping laypeople understand design alternatives.

Designers' decisions about which drawings to create and include in public participation efforts are strongly based on the expected effectiveness of the drawing in achieving a particular purpose, as well as the amount of time and effort it takes to create the drawings. Research evaluating different types of design drawings can provide valuable information about where designers should concentrate their efforts. Also, because design drawings play a major role in how the proposed landscape is perceived, knowing more about the effectiveness of these drawings from the layperson's perspective can greatly impact decisions that are made about these landscapes. It also can contribute to making the public participation process more productive and meaningful for all involved.

This study provides a systematic investigation of the effectiveness of four drawing types – plans, sections, perspective drawings, and photorealistic drawings - when presented as stand-alone visual representations of nature settings. In an online survey, participants rated individual drawings (Appendix 6.A) in terms of how understandable, engaging, and abstract they found the drawing to be. They also rated how confident they would be, based on their level of comfort with the drawing, in discussing the design with the landscape architect if given the opportunity. These measures were chosen based on a theory of human behavior called the Reasonable Person Model (RPM) (S. Kaplan & Kaplan, 2009), which emphasizes the role that information and the environment play in the way people act (see Chapter 1). The relationships among these measures also are evaluated in this study, allowing the predictions of the model to be tested empirically.

A previous study gathered laypeople's input on the effectiveness of a design session as an approach for getting their feedback on the design of nature trails (see Chapter 2.) Findings revealed that some design presentations were more understandable than others, and the visual materials used in these presentations made a difference. However, because each presentation included a combination of drawings, it was difficult to discern which drawings were more effective than others. The aim of the current study is to provide more insight into the role that specific types of drawings might play in the understandability of design presentations. The current study eliminates factors associated with the participatory context that might have affected participants' understanding, engagement and sense of participation in the previous design discussions, such as the designers' personalities, communication skills, and presentation style, as well as the physical and social setting in which the participation took place.

Background

As discussed in Chapter 5, a literature review found few studies that evaluate the effectiveness of design drawings in participatory design projects. The main focus in the literature has been on realism, i.e., how real the drawing looks or how accurate or close it is to reality. There is little research speaking directly to the effectiveness of different types of drawings in terms of understanding, engagement, and participation. No empirical studies were found that directly measure *laypeople's* comprehension of and engagement in different types of design drawings. Only one study measured laypeople's perspective on the effect the drawings had on their level of participation (Donaldson-Selby, et al., 2007). This study also was the only one in the context of small-scale nature settings. The rest of the studies were carried out in architecture, planning, or forest management projects.

The literature review provided some insight into the understandability of drawings. First, the difficulty laypeople have in understanding two-dimensional drawings, particularly plan drawings, is well documented (Lawrence, 1983, 1993; Mahdjoubi & Wiltshire, 2001; Pietsch, 2000). There are some indications that sketches and freehand perspective drawings also may be more difficult for laypeople to understand than photorealistic drawings. In a study by Harrilchak as reported in Pietsch (2000), photorealistic images were considered more effective in communicating design ideas than hand-drawn sketches. Bates-Brkljac (2009) found freehand perspective drawings of urban development designs to be difficult for planners to understand due to the level of abstraction.

In terms of participation, one study suggests sketches may be more engaging and stimulate more active participation than computer-generated wireframe images. In an evaluation of non-photorealistic AutoCAD images,[6] architects rated the sketch significantly more "interesting, lively, imaginative, creative, individual and less artificial" and "stimulating to look at" than both the wireframe and shaded wireframe images (Schumann, et al., 1996, p. 38). Architects also believed such sketches led to more active participation. Laypeople's perspective on these issues was not sought in this study.

Laypeople's perspective was investigated, however, in a study by Donaldson-Selby et al. (2007). Residents indicated photorealistic images "empowered them to participate more fully in the planning and discussion of urban greening" and provided "sufficient information to make decisions" about the nature settings.

Since a key objective of design drawings is to build participants' understanding of design alternatives, research on their effectiveness needs to include the participants' assessment of how easy it is to make sense of the drawings and the kind of place it represents. Equally important is the drawings' success in engaging or holding the participants' interest and strengthening people's motivation and ability to participate in design discussions. The literature review identified a great need for research aimed at assessing the effectiveness of drawings on these issues. Because experts view things differently than laypeople (R. Kaplan, et al., 1998; S. Kaplan, 1977), gathering input directly from laypeople is essential for better understanding the effectiveness of drawings in public participation efforts.

The context: Participation in design

Laypeople's participation in design can take many forms, and the type of interaction that takes place between designers and participants can have a significant effect on the participants' level of understanding. Small group discussions between the designer and client are most common in the practice of landscape design. These interactions can be one-on-one or can include a small team of administrators and representatives from different user groups. In these participatory situations, designers can describe the designs depicted in the drawings and focus their clients' attention on important elements in the drawings. The conversational

[6] AutoCAD (Computer Aided Design) refers to a computer software program used in the design field to produce design and construction drawings.

nature of the discussion can provide ample opportunities for clients to ask questions and seek clarification on things they find confusing. Also, designers can use several types of drawings in these design discussions to provide multiple perspectives of the setting and depict various design alternatives. Using a combination of drawing types is believed to enhance people's understanding of the proposed setting (Appleyard, 1977).

In other cases, participation in design can include a large number of participants where the public or potential users are invited to provide feedback on a proposed landscape, such as in the design of a local public park. This participation often comes later in the design process after a final proposal has been developed by the city's design team. In these cases, the final proposed design may be depicted in a few design drawings in a public presentation, newspaper, or online, and the public is asked to provide comments. Participants may not have a chance to interact with the designer.

This study applies more to this latter case where opportunities to discuss the design are limited and where information about the design is presented primarily with stand-alone drawings. The study evaluates laypeople's perspective on the effectiveness of different types of design drawings in terms of understanding, engagement, and confidence in discussing the drawing. Although the drawings represented actual design projects, the focus of this study was not to gather feedback on these projects. In fact, most of these projects were already complete by the time of the study. The main goal was to conduct a controlled, systematic study to determine a baseline level of laypeople's understanding of and engagement in different types of drawings independent of a specific design project. Thus, detailed information about the projects was not provided.

Method

Study participants completed an online survey (see Appendix 6.B) where they were asked to rate a series of drawings of nature settings on various aspects of the drawings' effectiveness. Four types of drawings were included: plans, sections, perspective drawings, and photorealistic images (Figure 6.1). The purpose of the study was described as an effort to collect people's feedback on different types of drawings commonly used by designers. Appendix 6.A presents the drawings used in the study organized by drawing type.

Drawing sampling

Criteria for selection

The 23 drawings used in the study were created by professional landscape architects, except for two by first year landscape architecture students. The drawings were chosen from a collection of images graciously provided by three landscape architecture firms in the Midwest U.S. and first-year students in a landscape architecture program. Designers were asked if they would be willing to share some of their existing work for a study intended to better understand the advantages and disadvantages of different types of drawings in communicating design ideas to non-designers and in gathering their input on the designs.

The main criterion for selecting drawings was the drawing type. Efforts were made to represent these equally. The final drawings are categorized as plans, sections, perspective drawings, and photorealistic drawings. The categories are discussed in the next section: Main independent variables.

The search for drawings was limited to the kinds of imagery traditionally included in public participation efforts related to the design of small-scale nature settings. The drawings were originally created for actual landscape design projects before this study's conception. In the study, however, they were treated as stand-alone drawings, and no descriptions of the projects were provided.

The selected drawings represented multiple landscape design projects ranging from trail and ecological enhancements in existing natural areas to the design of new parks, trails, outdoor plazas, streetscapes, and outdoor seating areas. To ensure that the drawings would be representative of those used in small-scale nature projects, drawings depicting nature settings of a relatively small-scale were selected. Approximately half of the drawings showed settings in the range of less than 1 acre to 2 acres. A little less than half of the drawings showed nature areas estimated to be between 10 and 30 acres. The largest settings were 312 and 363 acres depicted in two plan drawings.

The drawings were chosen to provide a range of styles and media both across and within type. Some of the drawings were hand-rendered, some were computer-generated, and some were a combination of both. Media varied across drawings and included watercolor, pen and ink, colored pencil, and pastels. Computer programs used to create some of the drawings included Photoshop, Illustrator, and AutoCAD (Computer-Aided Design).

Efforts were made to include a mix of drawings with and without text in the drawing labeling features in the design. Of the eight drawings with these labels, two of them were hand-written in traditional architecture style (e.g., Plan I in Figure 6.2), while the remaining six were typed.

Another consideration was the inclusion of people and the method of representing people in the drawings. Fourteen drawings had people in them. Of these, four showed people in silhouette form while two used photographs of people superimposed into the scene. People in the remaining eight drawings were hand-drawn or computer-generated.

Presentation format

All drawings were represented in full color. Images were formatted to 96 dots per inch to match the resolution of most computer monitors. The drawings were resized to fit a standard computer screen without the need for scrolling. This resulted in a file size of 500 by 325 pixels on average. Original proportions of the drawings were maintained during image resizing.

Drawings were displayed one at a time with the rating scales positioned directly below the drawing. They were arranged in a random order, other than making sure the different types of drawings were interspersed throughout the survey. The order was the same for each participant. While altering the order would have been preferable, the feature for randomizing across drawings (with multiple ratings per drawing) was not discovered at the time.

Main independent variable: Type of design drawing

The main independent variable in the study is the type of design drawing. Four main types of drawings are included: plans, sections, perspective drawings, and photorealistic drawings. Each of these types is next described in detail.

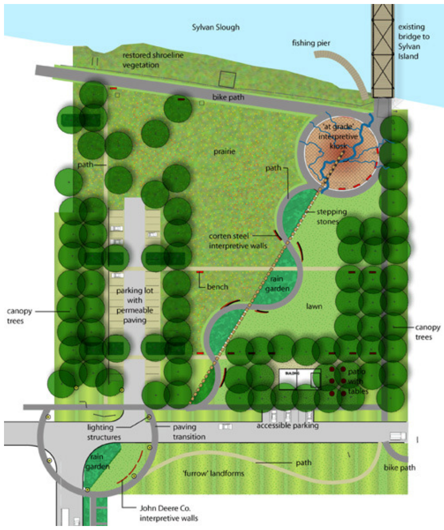
Plan drawings

Plan drawings depict the landscape from an aerial view and are usually presented in 2-dimensions. They show spatial relationships among various features of the landscape much like a map. The six plan drawings used in the study (Figure 6.2) were the most varied of the four types in terms of scale, style, and media. Two settings (top row) were approximately two acres, two settings (middle row) were around 15 to 30 acres, and two (bottom row) were greater than 300 acres. Five of the six plans provided a traditional aerial view, while one provided a slightly angled view from above. Two of the six were computer-generated and used crisp lines and simple geometric shapes for representing trees and other nature elements. Colored pencil was used for the majority of the other plans. None of the plans included people. Four of the six drawings had labels in the drawing.

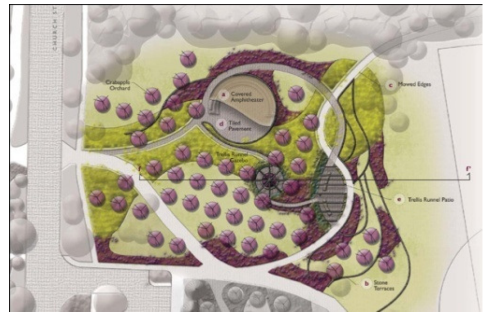
Section drawings

Section drawings provide a 2-dimensional view of the land, as if a vertical plane was cut through the landscape. A bold, thick line represents the ground and depicts the slope of the land. All four section drawings in the study (Figure 6.3) were computer-generated and were similar in scale. Three of the four drawings are similar in style. The most distinguishing feature of Section Y is the background. In the center of the drawing the background is a sky-blue rectangle, while the rest of the background in the drawing is white.

The most striking difference across the four section drawings is the representation of the trees, which are the main focus of the drawings. The trees in Section M are a bold green with distinct edges. In Section T, the trees are a light pink color and are opaque. The tree tops in Section A appear to have been colored a light green with an airbrush paint tool. In Section Y, some trees are shown with leaves using an opaque green while other trees show bare branches.

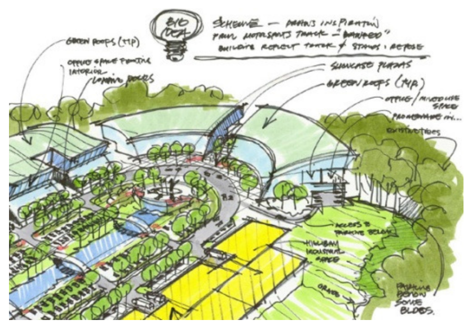


Plan S



Plan M

Plan A



Plan K

Plan I

Plan R

Figure 6.2 Plan drawings used in the study[7]

[7] The names of the drawings were derived from the original names provided by the designers.

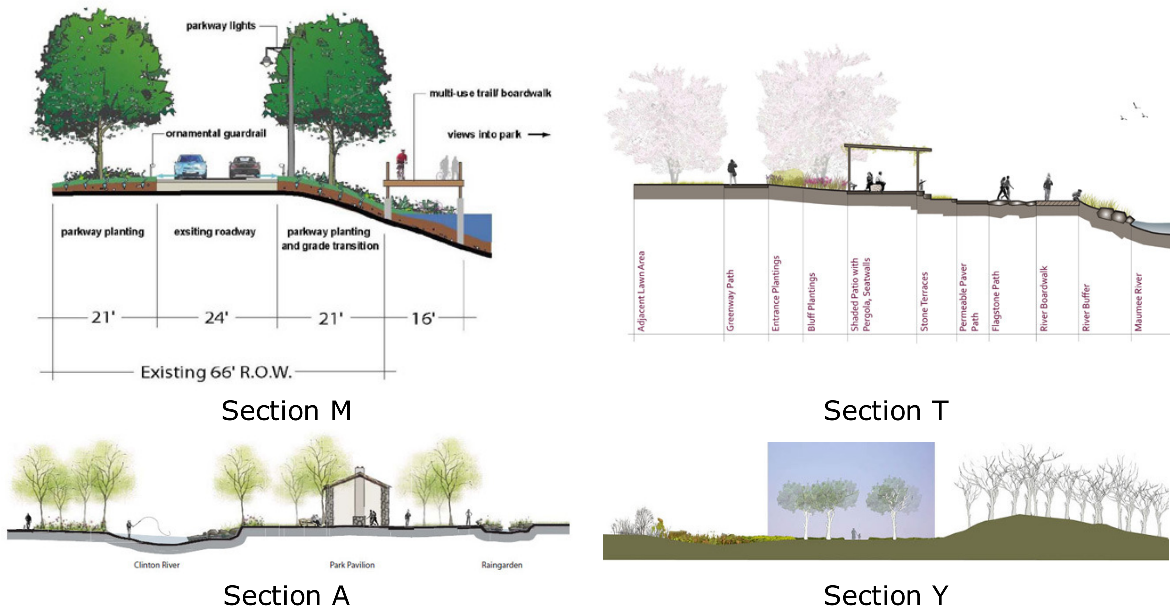


Figure 6.3 Section drawings used in the study

Perspective drawings (prsp)

Perspective drawings provide a 3-dimensional view of the setting as it would be perceived by the eye. Three of the perspective drawings (Figure 6.4) showed the setting at eye-level, while one drawing, a plaza with fountains, was shown from a bird's eye view (Perspective F). The fountain drawing was slightly different in content as well, since the setting was dominated by gray pavement or hard surfaces rather than greenery or vegetation.

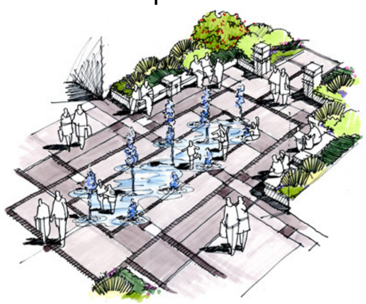
One of the perspective drawings (Perspective T) differed in that the colors were more vivid (higher saturation) and included a greater spectrum of colors. It had a more photo-realistic feel than the other perspective drawings, but was hand-drawn. People were included in all of the drawings, three of which represented them in outline form with some clothing detail.

Photorealistic drawings (pht)

In landscape modeling, photo-realism refers to the "effort to create synthetic images such as computer renderings, indistinguishable from photographs of real objects or scenes" ("photo-realism," 2010). In this study, the photorealistic images were all computer-generated and include photomontages, photo-manipulated images, and images created solely using 3D visualization software (Figure 6.5).

Perspective P

Perspective J



Perspective F

Perspective T

Figure 6.4 Perspective drawings used in the study

Photorealistic B

Photorealistic C

Photorealistic R

Photorealistic W

Photorealistic L

Photorealistic F

Figure 6.5 Photorealistic drawings used in the study

They are the least abstract or most realistic-looking drawings of the four drawing types. They are very similar to one another in terms of level of detail, scale, and depiction of greenery. People are included in all of the photorealistic drawings. Two of the photorealistic drawings use superimposed photographs of people, one shows silhouettes only, and the rest of the drawings show people created using computer software.

Excluded drawings

Only 20 of the 23 originally selected drawings were included in the descriptions of the four types, with six plans, six photorealistic drawings, and four each for sections and perspective drawings. Two of the excluded drawings (Plan C and Perspective M) were the initial drawings in the survey. Since participants were unfamiliar with the kinds of drawings as well as the rating scales, it was decided to consider these as practice drawings and exclude them from further analysis. The third excluded drawing (Perspective C) combined photo-manipulation with a watercolor, perspective drawing. Though originally categorized as a "perspective drawing," the inconsistent results across dependent variables for the factor analyses suggested that this drawing should not be considered as representative of any one category.

Other independent variables

Level of experience

Participants were asked two questions that rated their level of experience; one with landscape architecture or architectural drawings and another with computer-generated drawings. Both questions used a five point scale from "none" to "a great deal." "Experts" were defined as people who rated themselves as 4 ("quite a bit") or 5 ("a great deal") on either of the two questions.

Drawing's abstraction

Participants rated how abstract they perceived each drawing to be on a five point scale. An abstract drawing was defined as one "lacking the concreteness found in real scenes." A low score indicated that the participant perceived the drawing to be similar to that which would be seen in reality.

Dependent variables

Participants were asked to rate each scene in terms of four properties, in each case using a 5-point scale (from 1, "not at all" to 5, "very much"). The definitions of the items to be rated were provided at the beginning of the survey and could be accessed via a link on each page of the survey. Definitions were stated as follows:

- **Understandable** - it is easy to make sense of what I am seeing and what kind of place it is. A low score would mean it is difficult to figure out what the scene is about.
- **Engaging** - the drawing is interesting to look at; holds my attention
- **Frustrating** - the drawing makes me feel aggravated or confused
- **Confidence – "Based on this drawing, I would feel confident discussing the design with the landscape architect."** Consider an opportunity to provide input to the landscape architect on the design depicted in the drawing. Based on your comfort with the drawing, how confident would you be in discussing this design?

Procedure

Adults only were invited to take the survey. The initial screen of the survey informed them of the purpose of the study, which was to collect their feedback on typical drawings used by landscape architects to show designs of nature settings. Participants were told their responses were anonymous, and that their participation in the project was voluntary. Contact information was provided in case they had questions about their participation in the study.

The initial screen also included instructions, which asked participants to rate the effectiveness of each drawing for the items listed. Definitions of the items were provided. Participants were told they had the option of providing additional comments about the effectiveness of each drawing in the space provided on each page. The survey permitted participants to go back to previous drawings and ratings if they wished and allowed them to modify their ratings. The instructions and item definitions were accessible at any point in the survey via a link on each page.

The survey was available online for three weeks. Participants were asked to take the survey only once. The survey took on average 15 minutes to complete.

Participants

Participants in the study were approached through several venues, all leading to a website for accessing the survey. Responses were collected using Qualtrics online survey software, permitting total anonymity. A link to the survey was sent via email to priests, directors, and staff of a Catholic church, who then forwarded it to parishioners. In addition, the link was posted on Facebook and emailed to family and friends with the request that they forward it to anyone who might be interested. These distribution methods make it impossible to assess the return rate. A total of 511 people completed the survey. Of these, 497 responses were deemed usable after deleting responses with data missing for more than 10 items. This sample included 91 experts and 404 laypeople based on their responses to two questions measuring their level of experience with landscape or architectural drawings and computer-generated drawings. (Two respondents did not provide data for the expertise ratings.) The results presented in this chapter are based on laypeople only (n=404). These participants reported some to no experience with landscape or architectural drawings or computer-generated drawings.

As shown in Table 6.1, approximately two thirds (68%) of the survey respondents were female. Half (52%) of the respondents were between the ages of 23 and 39, and an additional 27 percent were between the ages of 40 and 59. Fifteen percent of the respondents were 60 years old or older and 6 percent were between the ages of 18 and 22.

Most participants (93%) were located in the United States and represented 35 states. The three most represented states were Michigan, Texas, and Massachusetts at 25%, 20%, and 11% of the total respondents respectively. Those located outside of the U.S. included the United Kingdom, Jamaica, Canada, Belgium, France, and New Zealand.

Results

The major focus of the study is the comparison of drawing types in terms of the main dependent variables – understandability, engagement, and confidence. However, the first two sections address a prior question of whether the pre-defined drawing types show internal consistency with respect to each of the dependent measures. In the first set of analyses, the pre-defined categories are tested for their fit or coherence. The second analysis explores whether the participants' perceptions

Table 6.1
Respondent Demographics for Online Survey (Laypeople Only)

Gender	**Respondents (% of total)**
Male	128 (32%)
Female	274 (68%)
Age	
18-22	23 (6%)
23-39	209 (52%)
40-59	109 (27%)
60+	62 (15%)
Location (International)	
United Kingdom	9
Jamaica	6
Canada	5
Belgium	1
France	1
New Zealand	1
Total (Int'l)	**23 (6%)**
Location (U.S.)	
New England	
Massachusetts	45 (11%)
Rhode Island	16 (4%)
Connecticut	1
Maine	1
New Hampshire	1
Vermont	1
Mid Atlantic	
New York	8 (2%)
Pennsylvania	5 (1%)
D.C.	4 (1%)
Maryland	3 (1%)
New Jersey	2

Location (U.S.) (continued)	**Respondents (% of total)**
Midwest	
Michigan	103 (25%)
Illinois	19 (5%)
Minnesota	12 (3%)
Ohio	11 (3%)
Indiana	3 (1%)
Wisconsin	3 (1%)
Missouri	2
South	
Florida	11 (3%)
Georgia	5 (1%)
Virginia	4 (1%)
Louisiana	3 (1%)
Arkansas	1
Mississippi	1
North Carolina	1
South Carolina	1
Tennessee	1
Southwest	
Texas	79 (20%)
Arizona	4 (1%)
New Mexico	2
Oklahoma	1
West	
California	14 (4%)
Colorado	1
Utah	1
Washington	1
State not specified	3
Total (U.S.)	**374 (93%)**
Total #respondents	**404**

Note: Totals may not add to 404 due to lack of response from some participants.

of the drawings correspond to the pre-defined categories. A final section addresses the relationships among understandability, engagement, and confidence as well as the role that abstraction plays with respect to each of these measures.

Testing the fit of the pre-defined types of drawings

A confirmatory factor analysis (CFA) was performed to test how well the drawings within the pre-defined types fit together. CFA allows the researcher to define the factors and the items within each factor and then test the fit of the model to the data. AMOS 18.0 (James L. Arbuckle, 2009), a structural equation modeling software, was used to run the test.

The analysis yields a number of indicators for measuring model fit. However, some of these indicators are less applicable with larger sample sizes as was the case here. Therefore, in this study, only Root Mean Square Error of Approximation (RMSEA) was used to determine model fit. According to Browne and Cudeck (1993), an RMSEA value less than 0.05 indicates a good model fit, values between .05 and .08 a fair fit, and values over 0.10 a poor fit (J.L. Arbuckle, 2009; Bollen & Long, 1993; Browne & Cudeck, 1993).

The RMSEA values from the CFA for the abstraction measure and each dependent variable are reported in Table 6.2. The test indicates a fair fit of the pre-defined types of drawings across all variables.

Table 6.2
Confirmatory Factor Analysis Model Fit
(n=404)

Main Variable	**RMSEA**
Abstraction	0.074
Understandability	0.057
Engagement	0.057
Frustration	0.058
Confidence	0.065

One can identify potential improvements of the model using a feature in AMOS 18 called "modification indices." This feature tests multiple modifications of the model and suggests changes that are likely to pay off in the form of smaller chi-square values (J.L. Arbuckle, 2009). The analysis requires that the dataset be entirely complete, i.e., no missing data. Thus, to run this analysis, a new dataset was created based on the 287 participants for whom there was complete data for each variable across all drawings. The overall model fit showed no major differences using this smaller, but complete, dataset. As a result of this analysis, the pre-defined groups were maintained for subsequent analyses.

In addition to the CFA, Cronbach's alpha was calculated to further investigate the pre-defined groups of drawings for each variable. A coefficient of 0.70 or higher is often used as an indication of sufficient internal consistency (de Vaus, 2002; Nunnally, 1978). As Table 6.3 shows, only *frustration* did not meet this standard, with one alpha coefficient (perspective drawings) below .70. The other variables – *understandability*, *engagement*, *confidence,* and *abstraction* - show a moderate to high internal consistency for the pre-defined types of drawings.

Table 6.3
Cronbach's Alphas for Pre-defined Groups

Type	**# dwgs**	**Abstract-ion**	**Under-standing**	**Engage-ment**	**Frustr-ation**	**Confid-ence**
Plan	6	0.80	0.77	0.82	0.76	0.80
Section	4	0.71	0.72	0.72	0.71	0.74
Perspective	4	0.77	0.74	0.73	0.64	0.75
Photorealistic	6	0.77	0.84	0.83	0.72	0.86

Due to the complexity of conducting multiple levels of analyses on so many variables, it was decided to focus efforts on four of the five main variables. *Frustration* was less critical to the study relative to the other variables, thus, it was excluded from further analysis.

Laypeople's perceptions of drawing types vs. pre-defined types

The previous analyses are based on pre-defined categorization in terms of drawing type. The coherence of these types in terms of the participants' perception of the drawings, however, may or may not correspond to this typology. An exploratory factor analysis was thus performed for each main variable to identify the underlying structure of the drawings from the laypeople's perspective. This statistical method groups the drawings based on patterns found in the variability of the ratings. While using the ratings as the basis for the analysis, the focus is not on how well each drawing reflects the quality being rated, but rather on the patterns or relationships among the reactions to the drawings. In other words, it reveals laypeople's perceptions of how the drawings group together. A great value of this method is the ability to extract groups of drawings from the data without explicitly asking participants to group the drawings. As a result, the groupings can reveal interesting patterns of which participants' may be unaware or unable to articulate.

The exploratory factor analysis was performed using the Principal Components method with Varimax Rotation. Since this analysis was conducted for exploratory purposes, drawings with loading of 0.45 or higher were retained. The analysis was performed separately for the dependent variables of *understandability*, *engagement*, and *confidence*. Factors were extracted in two ways in order to determine if there was a common pattern across the dependent variables. The first method of extraction was based on eigenvalues greater than one, while the second was defined by a fixed number of 5 factors based on a scree test.

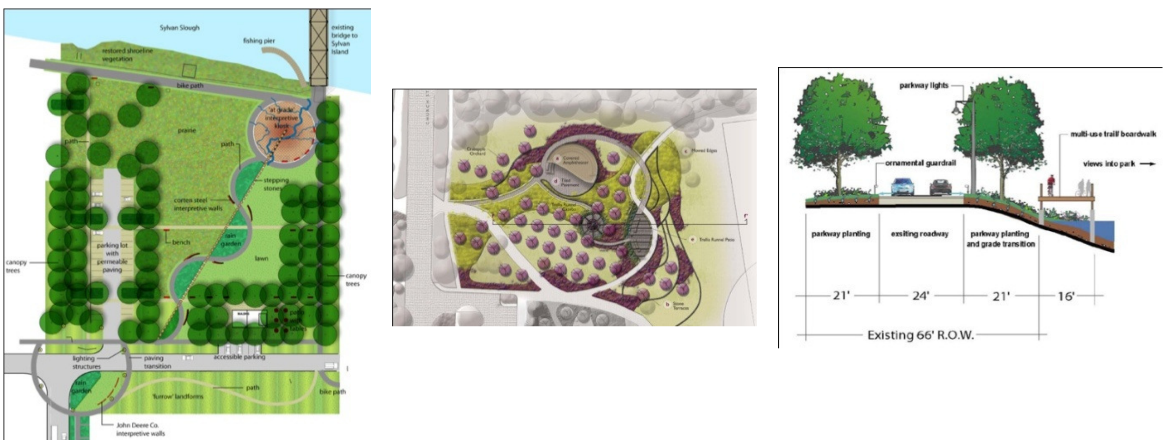
Table 6.4 shows the factor structure based on the forced extraction of 5 factors as it was most consistent across *understandability*, *engagement*, and *confidence.* The table also includes sample sizes and mean ratings for each drawing, as well as the alpha coefficient for each factor. The factor structure was the same

TABLE 6.4
Exploratory Factor Analysis Groupings with
Alpha Coefficients, Sample Sizes, and Mean Ratings

	Understandability		**Engagement**		**Confidence**	
Photorealistic	**Alpha =**	**0.84**		**0.83**		**0.87**
	N	Mean	N	Mean	n	Mean
Photorealistic W	404	4.27	404	3.99	399	3.87
Photorealistic R	403	4.17	402	3.73	400	3.70
Photorealistic B	403	3.75	404	3.23	400	3.34
Photorealistic C	403	3.71	403	3.09	398	3.20
Photorealistic F	404	4.26	403	3.67	400	3.82
Photorealistic L	404	3.80	404	2.95	400	3.29
Perspective T	--	--	--	--	400	3.71
Perspective	**Alpha =**	**0.74**		**0.73**		**0.72**
Perspective J	403	3.81	401	3.61	398	3.54
Perspective P	403	3.49	402	2.94	398	3.11
Perspective F	404	3.27	404	2.90	398	3.04
Perspective T	404	4.00	404	3.93	--	--
Sections (limited)	**Alpha =**	**0.65**		**0.67**		**0.69**
Section T	404	3.18	403	2.32	401	2.81
Section A	404	3.78	404	2.88	400	3.24
Section Y	403	2.16	403	1.83	402	1.96
Plans (limited)	**Alpha =**	**0.74**		**0.78**		**0.77**
Plan A	403	2.82	404	2.35	398	2.59
Plan I	404	2.94	404	2.58	396	2.74
Plan R	403	1.88	401	1.91	394	1.95
Plan K	404	2.62	404	2.51	400	2.58
Unique pln & sct	**Alpha =**	**0.68**		**0.72**		**0.69**
Plan S	404	4.14	402	3.36	399	3.70
Plan M	403	3.01	404	2.57	395	2.70
Section M	404	3.81	404	2.72	401	3.28

across the different dependent variables and drawing types with only one exception. In the case of confidence, one drawing, Perspective T, grouped with the photorealistic drawings rather than with the other perspective drawings of which it was a member.

The factor structure based on the exploratory factor analysis is striking for its close match to the pre-defined groups. Four of the factors are homogeneous with respect to the four types of drawings: photorealistic drawings, plans, perspective drawings, and sections. The three drawings comprising the fifth factor, however, include two drawing types (Figure 6.6). Two of these drawings (Plan M and Section M) also loaded onto their expected group (plan and section, respectively) for each dependent variable, although with lower loadings. The remaining plan drawing (Plan S) was consistently separate from the plan group. The consistency of this fifth factor across the three analyses is also noteworthy.



Plan S Plan M Section M

Figure 6.6 Drawings in the fifth factor group

The three drawings in the fifth factor group were all computer-generated, 2-dimensional drawings. They share a number of characteristics that set them apart from the rest of the plans and sections. First, these drawings have neat, crisp lines and edges, and bold colors. The setting can easily be parsed into distinct areas, and yet the overall spatial relationships among the areas are clear.

In the plans, trees are drawn individually and are represented using circles of one size and color throughout the drawing. The trees in the section drawing (Section

M) are a bold green with distinct edges, unlike the trees in the other section drawings which are opaque or air-brushed.

The scale of these three drawings – each 2 acres or less -- is also similar. The two plans in this group represent settings of the smallest scale for the plan drawings. The scale of the section drawing (Section M) is similar to the other section drawings; however, it provides a slightly closer and more detailed view of the ground.

All three drawings have typed labels identifying features of the drawing. The two plans are two of four plans that had labels; however, the labels in the other two drawings were handwritten in traditional architecture style. The section drawing was one of three section drawings with typed labels. It also included measurements, unlike the other sections.

The fifth factor group presents an interesting finding regarding the perceptions of participants. However, for subsequent analysis, the three drawings in this group are categorized in their respective pre-defined "section" or "plan" group based on the findings of the confirmatory factor analysis (Table 6.2) and alpha coefficients (Table 6.3). The results of the exploratory factor analysis shed light on the perceived differences among individual drawings within drawing types, particularly plans and sections. This will be discussed in greater depth in a later section.

Comparing the effectiveness of drawing types

A major focus of the study is to assess the effectiveness of each drawing type as a means of conveying information to laypeople. Thus, participants' ratings for each of the three dependent variables – understandability, engagement, and confidence – were examined to see whether the drawing types were equivalent with respect to these qualities. In addition, the analyses assessed whether there is variation within drawing type with respect to these concerns. In other words, are there some discernible characteristics that may make some drawings more effective than others even though they represent the same categorization?

Statistically, these analyses need to take into account that each participant rated all drawing types. A linear mixed model procedure (SPSS Inc., 2009) was used to account for the repeated measure design. The repeated covariance type used in the analysis was compound symmetry. Bonferroni adjustments were made for multiple comparisons of the estimated means. The same statistical procedure permits examination of the drawings within each type.

Mean Ratings

Table 6.5 presents the mean ratings by drawing type for each of the three main dependent variables. The pattern across the three effectiveness measures is most similar for two of the three variables. All four drawing types are distinctly different with respect to understandability and confidence. For these variables, photorealistic drawings were rated the highest, followed by perspective drawings, sections, and then plans. Engagement showed a slightly different pattern where photorealistic and perspective drawings were not rated significantly different from each other. The same was true for sections and plans, which were significantly less engaging than the other two types. Appendix 6.A provides the mean ratings for understandability, engagement, and confidence for each individual drawing, organized by type.

Table 6.5
Laypeople's Mean Ratings by Drawing Type (n=404)

	Understandability		**Engagement**		**Confidence**	
Drawing	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Plans	2.90	0.71	2.55 [1]	0.84	2.71 [a]	0.76
Sections	3.23	0.81	2.44 [1]	0.83	2.83 [a]	0.82
Perspective	3.64	0.73	3.35 [2]	0.80	3.35	0.78
Photorealistic	4.00	0.75	3.44 [2]	0.82	3.54	0.81

Mean differences between types are significant at p<.001 for all pairs within a variable except:
--the pair marked with an alphabetic superscript, which is significant at p<.05 (p=.039);
--pairs sharing the same numeric superscript, which are NOT significant at p<.05 where (1) p=.093; (2) p=.217.

The mean ratings for drawing type are informative in showing their effectiveness relative to each other. However, a more detailed examination of the specific drawings within each type can provide a better understanding of particular attributes that may contribute to the effectiveness of the drawings. Figure 6.7 presents the means for each scene for each of the dependent variables (in order of most to least understandable). We turn now to the results of these detailed comparisons of the means of drawings within each drawing type, for each of the three effectiveness measures.

How understandable are the drawings?

Participants found the understandability of the four types of drawings to be significantly different in all pairwise comparisons of drawing types ($p<.001$) (Table 6.5.) The order of drawing types from most to least understandable is photorealistic drawings, perspective drawings, sections, and plans. However, as can be seen in Figure 6.7, the mean understandability for individual scenes shows substantial variability within each drawing type. While the three top-rated scenes are all photorealistic drawings, the four next highest in terms of understandability, include each of the other drawing types. However, all but one of the six lowest ratings are plan drawings.

Plans

The mean understandability ratings of plans ranged widely from 1.88 to 4.14, a difference of 2.26 points, by far the greatest range across the drawing types (Table 6.6, Figure 6.8). Three of the six drawings were relatively similar in their ratings, while one was notably lower and another was rated as fourth highest of all the drawings. Plan R, the lowest-rated drawing among all study scenes, depicted the largest area in all of the drawings – a 363 acre park.

Although relatively similar in understandability, the plan drawings receiving similar ratings varied considerably with respect to scale. Despite the differences in scale, the amount of information and size of the features represented in the drawing were relatively similar in being highly detailed with relatively small features. The lowest rated plan also was highly detailed, but had tiny features and appeared busier than the others. However, all these drawings were rated no better than mid-scale in terms of understandability.


#1
Pht W
u=4.27
e=3.99
c=3.87

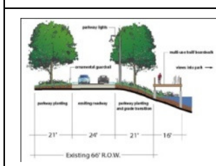

#2
Pht F
u=4.26
e=3.67
c=3.82


#3
Pht R
u=4.17
e=3.73
c=3.70


#4
Plan S
u=4.14
e=3.36
c=3.70


#5
Prsp T
u=4.00
e=3.93
c=3.71


#6
Prsp J
u=3.81
e=3.61
c=3.54


#7
Section M
u=3.81
e=2.72
c=3.28


#8
Pht L
u=3.80
e=2.95
c=3.29

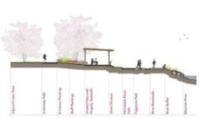

#9
Section A
u=3.78
e=2.88
c=3.24

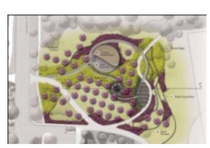

#10
Pht B
u=3.75
e=3.23
c=3.34

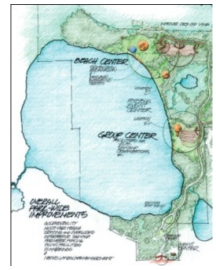

#11
Pht C
u=3.71
e=3.09
c=3.20


#12
Prsp P
u=3.49
e=2.94
c=3.11


#13
Prsp F
u=3.27
e=2.90
c=3.04


#14
Section T
u=3.18
e=2.32
c=2.81


#15
Plan M
u=3.01
e=2.57
c=2.70


#16
Plan I
u=2.94
e=2.58
c=2.74


#17
Plan A
u=2.82
e=2.35
c=2.59


#18
Plan K
u=2.62
e=2.51
c=2.58


#19
Section Y
u=2.16
e=1.83
c=1.96


#20
Plan R
u=1.88
e=1.91
c=1.95

Figure 6.7 Mean ratings for individual drawings in order of most to least understandable (Prsp = perspective; Pht = photorealistic; u=understandability; e=engagement; and c=confidence.)

Table 6.6
Understandability of PLANS

Drawing	Mean	Std. Dev
Plan R	1.88	0.98
Plan K	2.62 [a]	1.07
Plan A	2.82 [a,b,1]	1.01
Plan I	2.94 [1,2]	1.05
Plan M	3.01 [b,2]	1.15
Plan S	4.14	0.98

Note: All pairs of means are significantly different at p<.001 except:
--Pairs sharing the same alphabetic superscripts which are significant at p<.05 where p=0.01.
--Pairs sharing the same numeric superscript which are NOT significantly different at p<.05 where (1) p=0.67 and (2) p=1.00.

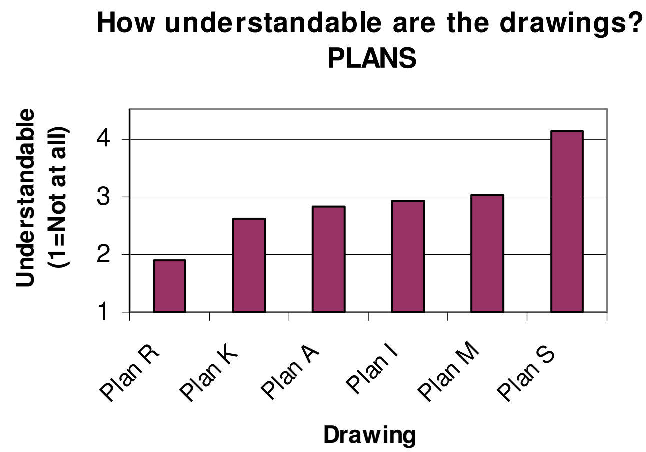


Figure 6.8 Comparison of plan drawings for understandability

As previously discussed, Plan S and Plan M were grouped together in the exploratory factor analysis. Both were computer-generated, represented small 2-acre settings, included typed labels, and used circles of a consistent size and color for the trees. However, despite these similarities, Plan S was rated a full scale point more understandable than Plan M. Therefore, a closer examination of the differences between these drawings is warranted. First, the colors of the trees were green in Plan S and a purplish pink in Plan M. Another difference was the linearity of the design in Plan S versus the curvilinear design in Plan M. Plan S was dominated by straight vertical and horizontal lines, and the trees were neatly organized in rows and columns. This linearity may have contributed to its perceived neatness or coherence compared to the other plans.

Comments from participants provide some insight into the characteristics of the plan drawings that impacted their understandability. First, scale and amount of information in the drawing seems to matter. Participants noted that the two plans representing large areas (both Plan R and Plan I, each depicting over 300 acres) and the plan depicting 25 acres (Plan A) were zoomed out too far to interpret the details or know what they were looking at. Plan S, which represented a 2-acre area, was consistently described as being very clear. The two plans rated lowest in terms of understandability, Plan R and Plan K, were described as being too messy or busy.

Illegible writing in Plan K was a major problem for half of the people who commented on the drawing. Comments from some participants regarding Plan M indicated that the colors were confusing, unnatural, or distracting.

A designer reviewing the results found the understandability of the highest rated plan (Plan S) interesting. He noted aspects of the drawings that he thought participants would have trouble understanding, such as the forms used for the kiosk area and rain gardens and the meaning of the labels, "at grade" interpretive kiosk and "corten steel interpretive walls." He states, "…[the participants] seem to have overlooked questions I would have in thinking that the plan is understandable and engaging…" (Grese, R., personal communication.)

Sections

Participants found section drawings to be more understandable than plans, although the four section drawings received divergent ratings, with a range of 1.65. Two of the four sections (Section A, Section M) received similar ratings of 3.8. Significantly lower, at midscale, was Section T. The fourth section drawing (Section Y) was rated second lowest in terms of understandability of all the drawings (Table 6.7 and Figure 6.9).

Table 6.7 Understandability of SECTIONS

Drawing	Mean	Std. Dev
Section Y	2.16	1.08
Section T	3.18	1.23
Section A	3.78[1]	0.97
Section M	3.81[1]	1.10

Note: All pairs of means are significantly different at p<.001, except the pair marked with a numeric superscript, which is NOT significant at p<.05 where p=1.00.

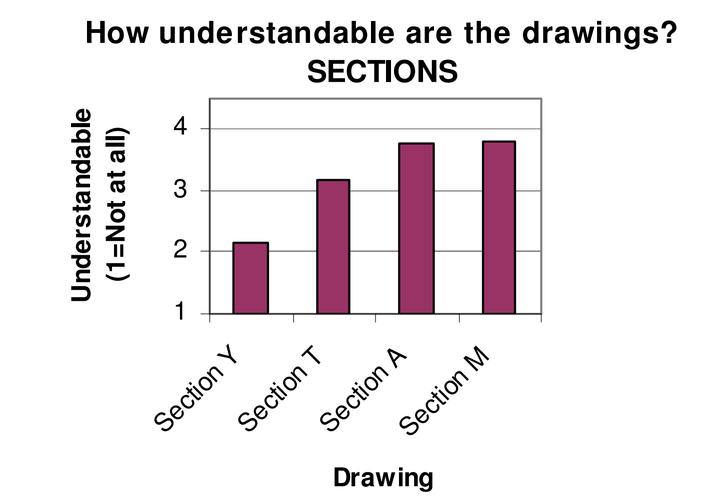


Figure 6.9 Comparison of section drawings for understandability

Compared to the other sections, the leaves of the trees in the two most understandable section drawings were consistently green and clearly visible throughout the drawing. This provides additional evidence that using colors true to nature may enhance understandability, as seen with plans.

According to participants' comments, the 2-dimensional perspective and lack of context in the section drawings made it difficult to envision the space. However, the labels in the section drawings that were rated most understandable seemed helpful. Section T also included labels, but the vertical alignment of the text was difficult for some to read. Section M was described as being simple, straightforward, and very clear.

One section in particular, Section Y, was set apart from the rest. The mean rating was a full scale point lower than the next section, making it only "a little" understandable. Comments indicated that participants had difficulty interpreting the blue background that was shown in only the middle portion of the drawing. It should be noted that this drawing was the only one of the twenty drawings created by a first year landscape architecture student.

Perspective drawings

Perspective drawings were the second most understandable of the four drawing types. The mean ratings for each of the perspective drawings fell between 3.3 ("somewhat" understandable) and 4.0 ("quite a bit"). The mean differences between drawings were statistically significant in all cases (Table 6.8, Figure 6.10).

Table 6.8 Understandability of PERSPECTIVE Drawings

Drawing	Mean	Std. Dev
Prsp F	3.27	1.088
Prsp P	3.49	.960
Prsp J	3.81	.891
Prsp T	4.00	.971

Note: All pairs of means are significantly different at p<.01 where p=.004 or p<.001.

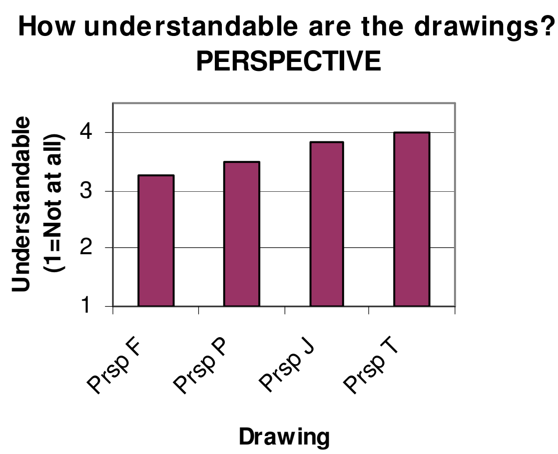


Figure 6.10 Comparison of perspective drawings for understandability

Each of the four perspective drawings included people. In three of them, the people were hand-drawn in outline form. Comments by some participants indicate the outlines of people provided just enough information to not be distracting; other participants, by contrast, found them to be "strange" or "ghostly." The number of people in the scene also seemed to matter. For example, some participants commented that there were too many people in Perspective P.

The lowest rated perspective drawing, Perspective F, provided a bird's eye view of a plaza with a water fountain feature. While bird's eye drawings are often favored by designers and encouraged by teachers for showing the overall relationships within a design (Grese, R., personal communication), the result indicates participants had trouble interpreting this drawing. However, comments from participants suggest that the lower rating was due to difficulties understanding the water and fountains. Almost all of the comments expressed confusion about the water feature in the drawing. Water features are typically difficult to depict in drawings. Thus, the content of the drawing may have played a greater role in this drawing's understandability than the viewpoint.

Photorealistic drawings

Photorealistic drawings were rated the most understandable of the four types of drawings. These six drawings were ranked in the top 11 drawings on understandability.

Within type, the photorealistic drawings had the smallest range among the ratings of individual scenes -- with means between 3.71 and 4.26, a difference of 0.55 (Table 6.9, Figure 6.11). The six drawings divided into two sets of three, significantly different in perceived understandability between the two sets but not within them.

One of the main differences between the more understandable and less understandable sets of photorealistic drawings is the treatment of people in the scene. In the top three drawings, people are computer-generated and in full color. The bottom three scenes have white silhouettes or black and white photographs of people superimposed into a full color scene.

Table 6.9
Understandability of PHOTOREALISTIC Drawings

Drawing	Mean	Std. Dev
Pht C	$3.71^{1,2}$	1.086
Pht B	$3.75^{1,3}$	1.066
Pht L	$3.80^{2,3}$	1.141
Pht R	$4.17^{4,6}$	.985
Pht F	$4.26^{4,5}$	.890
Pht W	$4.27^{5,6}$	.864

Note: All pairs of means are significantly different at $p<.001$, except pairs sharing the same numeric superscripts, which are NOT significant at $p<.05$ where (1-5) $p=1.00$ and (6) $p=0.79$.

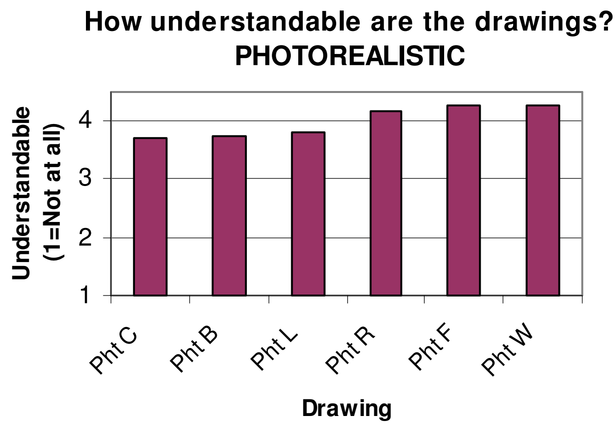


Figure 6.11 Comparison of photorealistic drawings for understandability

As with the perspective drawings, participants' comments indicate differences in opinion regarding the representation of people in the photorealistic drawings. Some participants found the silhouettes and black and white photographs to be "distracting," "ghostly," or "strange." Other participants found them helpful in getting a sense of the scale of the setting. A couple of participants commented that the white silhouettes allowed them to imagine themselves in the setting.

Other comments focused on the lack of integration between the computer-generated and photographic portions in some of the images. For example, the angular paths in Photorealistic F and the stark white path in Photorealistic B were described as not fitting well into the rest of the scene. Also, the combination of black and white photographs and color scenes (e.g., Photorealistic B, Photorealistic C) did not work well for some participants.

Summary of understandability

The drawings varied substantially with respect to their understandability. While understandability of the photorealistic scenes was significantly higher than the others, and the plan drawings received the lowest mean, it is not the case that understandability is simply a function of drawing type. Within drawing types, variability ranged from about one-half scale point to over two points on a five-point scale.

The difficulty laypeople have in understanding two-dimensional drawings, particularly plan drawings, is well documented (Lawrence, 1983, 1993; Pietsch, 2000). This study provides additional support that plans and sections generally are more difficult for laypeople to understand than photorealistic images and perspective drawings. Envisioning a setting from a 2-dimensional view is difficult for most people. Photorealistic drawings and perspective drawings, which provide a more comparable view to that which would be perceived in reality, fared quite well on understandability.

A striking finding from this study, however, is that not all plans are hard to understand. There is strong indication that the scale and amount of information in the drawing matter. Participants found plans representing mid to large scale settings to be less understandable. They found it difficult to make sense of such drawings because the features appear very small. Understandability was enhanced when the drawing provided a closer view, which made the features more easily identifiable. This was true for section drawings as well. The most understandable section in the study provided a slightly larger, closer view with more visible ground details than the other sections.

Coherence is another important characteristic that contributed to understandability. The most understandable plan was neat, coherent, and simple in its representation of nature. The design was very linear with distinct edges, rows, and columns. Different areas of the park were easily distinguishable, and the spatial relationships among the elements were clear. Trees were represented with simple circles of the same color and size. The most understandable section also was described as simple and straightforward.

Legibility was a key factor in the drawings' understandability. Based on comments, the labels seem to help participants' understanding of the drawings. However, the legibility of the labels was critical. Frustration was expressed due to illegible handwriting. In this study, participants seemed to prefer typed labels aligned horizontally rather than vertically.

Finally, consistency with common perceptions appears to enhance understandability. One feature that set the best plan above the other 2-acre plan was the color of the trees. They were green, as opposed to purplish-pink. Also, the use of green in the two highest rated sections compared to the opaque pink trees used in a less understandable section is noteworthy as well. Finally, the blue sky background in only the middle portion of the lowest-rated section seemed to confuse participants.

How engaging are the drawings?

Mean ratings for engagement ranged widely from 1.8 to 4.0. Participants found photorealistic images and perspective drawings significantly more engaging than plans and sections (Table 6.5). Overall, photorealistic images and perspective drawings were considered equally engaging, as were plans and sections. The nine drawings receiving the lowest engagement ratings consisted of five of the six plans and all four sections. Appendix 6.C lists the individual drawings, color-coded by drawing type, in order of descending means for each dependent variable.

Plans

Plan drawings received ratings for engagement between 1.9 and 3.4, a difference of 1.5 points. Although this range is not as great as for understandability, the range for plans was the greatest across drawing types. As was true for understandability, Plan R received by far the lowest rating and Plan S was by far highest. While the order among the others did not parallel the order for understandability, here again the mean ratings were relatively similar, and all below mid-scale (Table 6.10, Figure 6.12).

Participants' distinctions among the plan drawings were not consistent for engagement and understandability. Though equally understandable, Plan I was considered more engaging than Plan A. The more vibrant colors and lake feature in Plan I might have contributed to its engagement. In another example, Plan K was less understandable than the other mid-range drawings, but was as engaging as these drawings. In this case, participants may have been engaged in Plan K because it required more effort to figure out what was going on in the drawing.

Table 6.10 Engagement of PLANS		
Drawing	**Mean**	**Std. Dev**
Plan R	1.91	1.017
Plan A	2.35 [1]	1.116
Plan K	2.51 [1,2,3]	1.267
Plan M	2.57 [2,4]	1.152
Plan I	2.58 [3,4]	1.156
Plan S	3.36	1.212

Note: All pairs of means are significantly different at $p<.005$ except pairs sharing the same numeric superscript, which are NOT significantly different at $p<.05$ where (1) $p=0.12$ and (2-4) $p=1.00$.

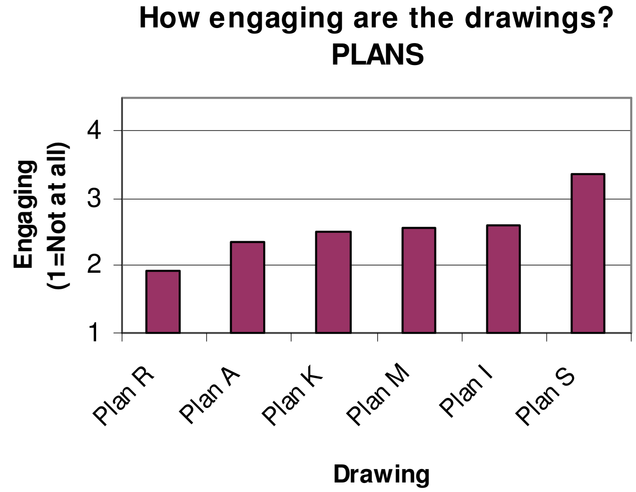


Figure 6.12 Comparison of plan drawings for engagement

Sections

All four section drawings were rated below mid-scale, with a range between 1.8 to 2.9 (Table 6.11, Figure 6.13). The two top-rated drawings were considered

Table 6.11 Engagement of SECTIONS		
Drawing	**Mean**	**Std. Dev**
Section Y	1.83	.973
Section T	2.32	1.192
Section M	2.72 [1]	1.172
Section A	2.88 [1]	1.168

Note: All pairs of means are significantly different at $p<.001$, except the pair marked with a numeric superscript, which is NOT significant at $p<.05$ where $p=0.07$.

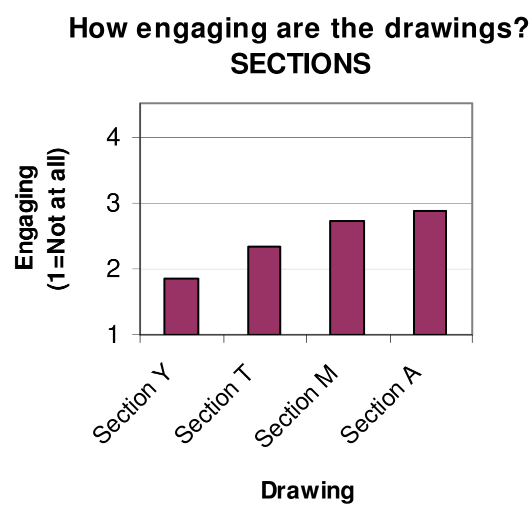


Figure 6.13 Comparison of section drawings for engagement

equally engaging, as they were for understandability. Section Y was the least engaging drawing of all twenty drawings.

Perspective drawings

Perspective drawings were considered to be "somewhat" to "quite a bit" engaging with ratings falling between 2.9 and 3.9 (Table 6.12, Figure 6.14). All but one pair (Perspective F and Perspective P) were statistically different.

Table 6.12 Engagement of PERSPECTIVE Drawings

Drawing	Mean	Std. Dev
Prsp F	2.90 [1]	1.124
Prsp P	2.94 [1]	1.086
Prsp J	3.61	1.027
Prsp T	3.93	1.047

Note: All pairs of means are significantly different at $p<.001$ except the pair marked with a numeric superscript, which is NOT significant at $p<.05$ where $p=1.00$.

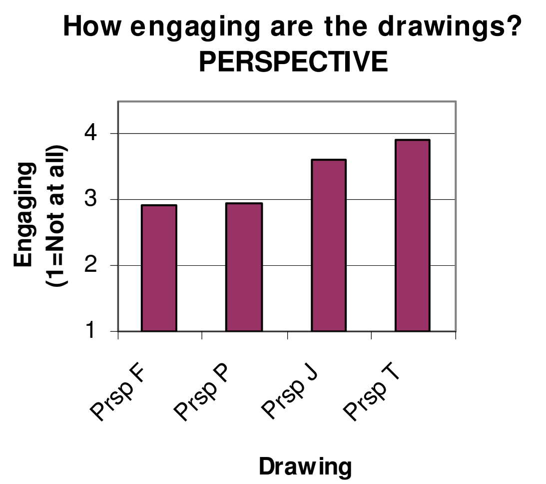


Figure 6.14 Comparison of perspective drawings for engagement

Perspective T, the most engaging perspective drawing, was the second highest rated drawing overall for engagement. Many comments regarding Perspective T stated that the "bright colors were engaging," or the colors were "nice" or "beautiful." Only three participants said the colors were "too much," "unnatural," or "distracting from the design."

Perspective J depicted a path along a river with abundant nature and people in outline form with some clothing detail. It too was more colorful and had more greenery than the lower rated perspective drawings, which were dominated by paved surfaces.

Photorealistic drawings

Mean ratings of photorealistic drawings for engagement ranged from 3.0 to 4.0, a wider range than that for understandability. All photorealistic drawings were significantly different from one another except for three pairs (Table 6.13, Figure 6.15). Some pairs that were equally *understandable* were significantly different for *engagement*. For instance, Photorealistic W was more engaging than Photorealistic F and Photorealistic R. Similarly, Photorealistic L was as understandable as Photorealistic B, but was significantly less engaging.

Table 6.13
Engagement of PHOTOREALISTIC Drawings

Drawing	Mean	Std. Dev
Pht L	2.95 [1]	1.233
Pht C	3.09 [1,2]	1.182
Pht B	3.23 [2]	1.164
Pht F	3.67 [3]	1.089
Pht R	3.73 [3]	1.105
Pht W	3.99	.941

Note: All pairs of means are significantly different at p<.001, except pairs sharing the same numeric superscript, which are NOT significant at p<.05 where (1) p=0.21; (2) p=0.27, and (3) p=1.00.

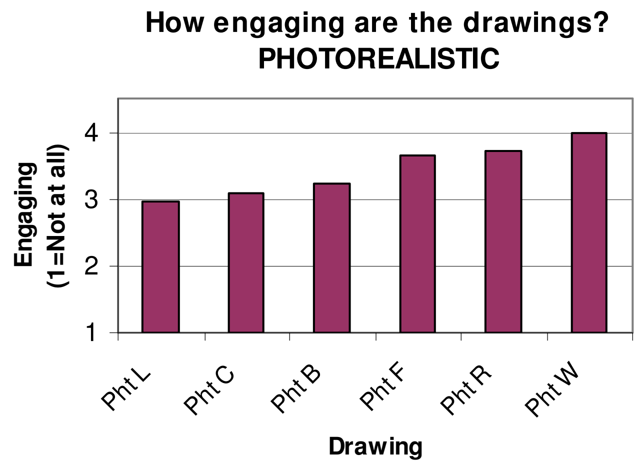


Figure 6.15 Comparison of photorealistic drawings for engagement

The representation of people in the photorealistic drawings might have played a role in participants' ratings for engagement. Recall that the top three drawings all had computer-generated, full color figures of people. As previously discussed, some participants found the black and white superimposed photographs of people (Photorealistic B, Photorealistic C) and the white silhouettes (Photorealistic L) distracting. A couple of participants noted that the close up view of the people and the birds in Photorealistic B were engaging.

The complexity of the drawings also might have impacted people's engagement. Photorealistic W, the most engaging of all drawings, depicts a wetland landscape with a variety of textures and colors. This drawing appears to have greater diversity in plants and materials than the other photorealistic drawings.

Summary of engagement

Overall, photorealistic drawings and perspective drawings were more engaging than plans and sections. The results suggest that drawing type, complexity, and color play a role in how engaging a drawing is. Drawings at the top of the list had a greater range of colors and higher color saturation than the other drawings. They also depicted more plant diversity in the landscape. Within photorealistic images, there is some indication that representing people as full color, computer-generated figures is more engaging than superimposing black and white photographs or white silhouettes.

While the range in mean scores for individual drawings for engagement (1.8 to 4.0) was similar to the range for understandability (1.9 to 4.3), the pattern of results for engagement was somewhat different. First, more similarities were found when comparing drawings types. Photorealistic drawings were as engaging as perspective drawings, and plans were as engaging as sections. Second, the variability within a drawing type was more similar across types for engagement - one scale point for photorealistic drawings, perspective drawings, and sections and 1.5 points for plans on a five-point scale.

Comparing individual drawings within type, some pairs that were statistically equivalent for understandability were significantly different for engagement, and vice versa. These results suggest that the relationship between engagement and understandability is not as straightforward as one might expect.

How confident would you feel discussing the design with the landscape architect?

The order of drawing types in which participants were most to least confident is photorealistic drawings, perspective drawings, sections, and plans -- the same order as *understandability* (Table 6.5). All differences in mean ratings were significant with plans and sections at $p<.05$ and the rest at $p<.001$. The means for individual drawings range between 2.0 and 3.9, a slightly smaller range than understandability and engagement (Appendix 6.C).

Plans

Plan ratings for *confidence* ranged from 2.0 to 3.7, a difference of 1.7 points (Table 6.14, Figure 6.16). This difference is less than that for understandability and slightly more than that for engagement. Once again, Plan R and Plan S received the lowest and highest ratings, respectively. Participants felt equally confident in discussing the designs depicted in the mid-range plans, despite the fact that some of these drawings were less understandable than the others. This finding provides support that *confidence* and *understandability* are measuring slightly different aspects of effectiveness. Participants were less sensitive to individual plans when rating their confidence than when rating understandability or engagement.

Table 6.14
Confidence in PLANS

Drawing	Mean	Std. Dev
Plan R	1.95	1.089
Plan K	2.58 [1,2,3]	1.123
Plan A	2.59 [1,4,5]	1.072
Plan M	2.70 [2,4,6]	1.061
Plan I	2.74 [3,5,6]	1.058
Plan S	3.70	1.079

Note: All pairs of means are significantly different at $p<.001$ except pairs sharing the same numeric superscript, which are NOT significantly different at $p<.05$, where (1) $p=1.00$; (2) $p=0.70$; (3) $p=0.12$; (4) $p=1.00$; (5) $p=0.24$; (6) $p=1.00$.

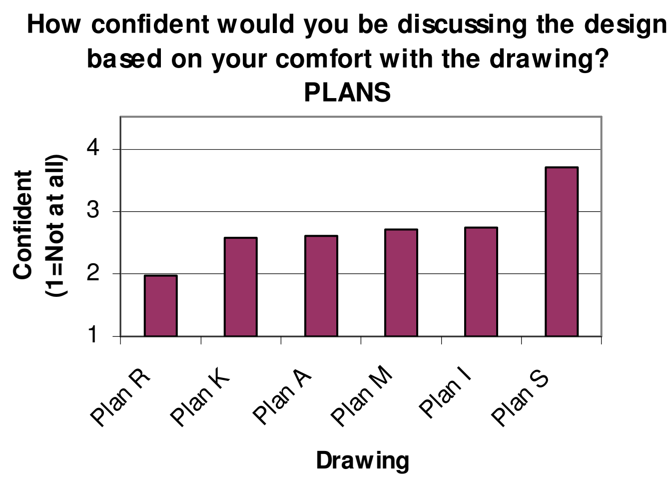


Figure 6.16 Comparison of plan drawings for confidence

Sections

Participants were less confident in discussing section drawings than photorealistic and perspective drawings, and slightly more confident than plan drawings. The pattern of results for *confidence* closely matched the pattern of results for *understandability*. The difference between the highest and lowest rated section drawings for confidence was 1.6 – the same as understandability (Table 6.15, Figure 6.17). Two of the sections were considered statistically equivalent for confidence, as they were for understandability and engagement. Section T was significantly lower at 2.8. Section Y was rated the second lowest of all drawings as it was for understandability.

Table 6.15
Confidence in SECTIONS

Drawing	Mean	Std. Dev
Section Y	1.96	1.003
Section T	2.81	1.182
Section A	3.24 [1]	1.054
Section M	3.28 [1]	1.111

Note: All pairs of means are significantly different at p<.001, except the pair marked with a numeric superscript, which is NOT significant at p<.05 where p=1.00.

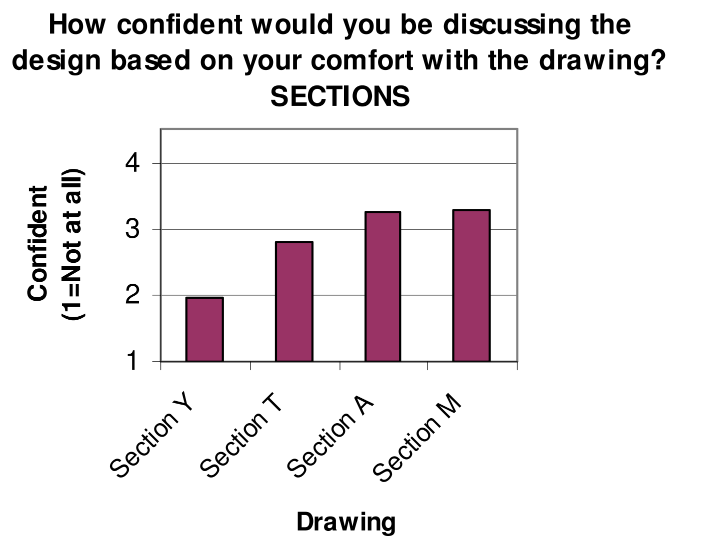


Figure 6.17 Comparison of section drawings for confidence

Perspective drawings

The mean perspective ratings for confidence fell between 3.0 and 3.7 (Table 6.16, Figure 6.18). While the range is comparable to the ratings for understandability, the mean difference between the two perspective drawings receiving the lowest confidence rating is not significantly different. These same two drawings were also considered equally engaging.

Photorealistic drawings

Of the four drawing types, participants were most confident in discussing photorealistic drawings. The difference between the highest and lowest means for photorealistic drawings was 0.7 points for confidence, a slightly greater difference than that for understandability but smaller than that for engagement (Table 6.17, Figure 6.19). Results for pairwise comparisons were the same as understandability except for one pair of drawings – Photorealistic W and Photorealistic R. These drawings were considered equally understandable, but participants were more confident in discussing Photorealistic W than Photorealistic R. In contrast to plans, participants were more sensitive to individual drawings for confidence than for

Table 6.16
Confidence in PERSPECTIVE Drawings

Drawing	Mean	Std. Dev
Prsp F	3.04 [1]	1.069
Prsp P	3.11 [1]	1.001
Prsp J	3.54 [a]	1.000
Prsp T	3.71 [a]	1.005

Note: All pairs of means are significantly different at p<.001, except:
--the pair marked with an alphabetic superscript which is significant at p<.05 (p=.01); and
--the pair marked with a numeric superscript, which is NOT significant at p<.05 where p=1.00.

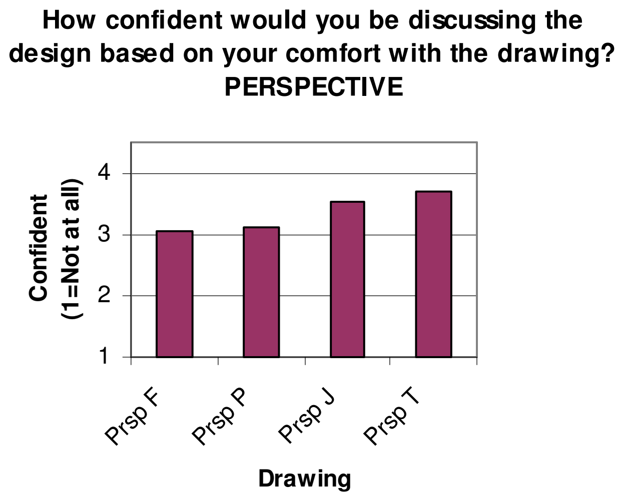


Figure 6.18 Comparison of perspective drawings for confidence

Table 6.17
Confidence in PHOTOREALISTIC Drawings

Drawing	Mean	Std. Dev
Pht C	3.20 [1,2]	1.062
Pht L	3.29 [1,3]	1.185
Pht B	3.34 [2,3]	1.059
Pht R	3.70 [a,4]	1.032
Pht F	3.82 [4,5]	.987
Pht W	3.87 [a,5]	.967

Note: All pairs of means are significantly different at p<.001, except:
--the pair marked with an alphabetic superscript, which is significant at p<.01; and
--pairs sharing the same numeric superscript, which are NOT significant at p<.05 where (2) 0.16; (4) 0.28; and (all others) p=1.00.

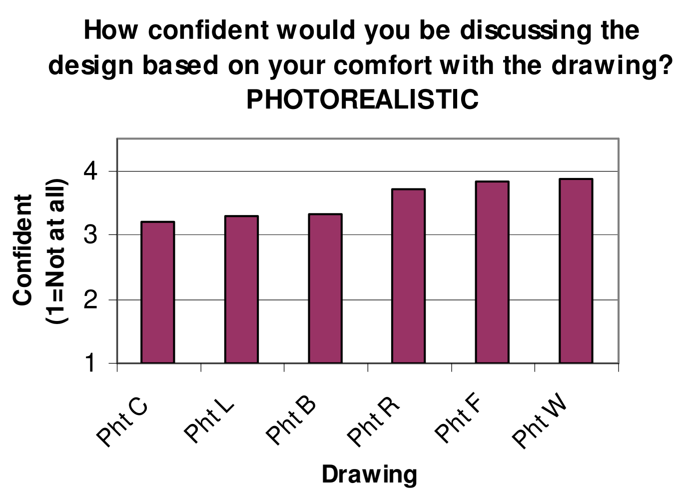


Figure 6.19 Comparison of photorealistic drawings for confidence

understandability. Recall that Photorealistic W was considered more engaging than Photorealistic R.

Summary of confidence

Participants were most confident in discussing photorealistic drawings followed by perspective drawings, sections, and then plans. Mean scores again varied substantially across drawings, although the range was slightly smaller for *confidence* than for *understandability* and *engagement*. In general, mean scores for *confidence* were somewhat lower than for *understandability*.

Comparing pairs of drawings, the pattern of results for *confidence* on the whole was similar to *understandability* with some notable differences. The most striking finding was that participants' *confidence* in plan drawings was less sensitive to individual drawings than their *understandability* was. Four of the six plans were considered equal in terms of *confidence*, despite differences in understandability. In contrast, participants were slightly more sensitive to individual photorealistic drawings for confidence than for understandability. These drawings were rated differently from one another for engagement as well.

Relationships among the effectiveness variables

The discussion of each of the effectiveness measures already alluded to some similarities among the findings. A more detailed analysis of the relationships among these three main measures of effectiveness is one of the major goals of the study. *Understandability* and *confidence* are expected to be positively correlated since being able to make sense of the drawing would most likely enhance confidence in discussing the design. The relationship between *understandability* and *engagement*, however, is not that clear. A highly understandable drawing could draw people into the scene, or it could be quite boring. A drawing that is difficult to understand could be considered engaging as people try to figure out what is going on in the drawing. Further, it is possible that these relationships vary across drawing types. In order to test these relationships, bivariate correlation coefficients (Table 6.18) were computed and analyzed. The rank order of drawings (Appendix 6.C) also was examined to identify patterns in the relationships between dependent variables for specific drawings.

Overall, the correlation coefficients indicate strong relationships among all three dependent variables for each drawing type. As shown in Table 6.18, correlation coefficients across variables and drawing types range from 0.64 to 0.80.

Table 6.18
Relationships Among the Effectiveness Variables
Correlation Coefficients

	Understandability x Confidence	Engagement x Understandability	Confidence x Engagement
Plans	0.80	0.76	0.76
Sections	0.78	0.64	0.70
Perspectives	0.78	0.73	0.74
Photorealistic	0.76	0.67	0.71
All correlations are significant at p<.01.			

Relationship between understandability and confidence

The correlation coefficients in Table 6.18 support the expectation that participants' confidence in discussing drawings was closely linked to their ability to understand the drawings.

While the overall pattern of results was similar for understandability and confidence, notable differences exist within drawing types. For example, participants made fewer distinctions within plan drawings when rating their confidence than when rating understandability. For these drawings the rank order of drawings was the same for the two measures, while for each of the other three drawing types there were drawings that differed by two positions in rank order (Appendix 6.C). Only one drawing, Photorealistic B, differed in rank order by more than two positions, with seventh place ranking in confidence and tenth place in understandability. In terms of means, however, for all but the least understandable drawing, the understandability rating was higher than the confidence rating.

Relationship between understandability and engagement

As reflected in the correlations (Table 6.18), the relationship between understandability and engagement depends on drawing type.

While sections had the most consistent patterns across variables in the comparative analysis, they have the weakest correlation (0.64) between understandability and engagement. A look at the rank orders in Appendix 6.C provides insight into this finding. Relative to other drawings, the ranks of three of four section drawings are considerably lower or worse for engagement than for understandability. Two sections (Section M and Section A) beat two photorealistic drawings (Photorealistic B and Photorealistic C) and two perspective drawings (Perspective P and Perspective F) in the ranks for understandability, but fell in the ranks below these drawings for engagement.

Photorealistic drawings had the next lowest correlation (0.67) between understandability and engagement ratings. Here two of the six drawings differed by three positions in relative rank order, with the ranking for engagement better than for understandability.

Based on the ranks, three-dimensionality seems to be the most important factor for engagement. These results also suggest that simplicity and consistency in color usage (full color vs. combined with black and white) can enhance understandability.

It is also worth noting that although the relative rank ordering was different by two or more places for over half the drawings, the actual mean was consistently lower for engagement than understandability for each of these drawings. In other words, although some drawings had better ranks for engagement than understandability, the mean scores were always lower for engagement than understandability.

Relationship between engagement and confidence

Engagement was more correlated with *confidence* than with *understandability.* The correlations, ranging from .70 to .76, indicate that participants who are engaged in a drawing may be more inclined to discuss the design with the architect.

In comparing rank orders (Appendix 6.C), one of the photorealistic drawings (Photorealistic B) that was discrepant in its rank order for understandability when compared to the other two ratings, was at the same ranking for engagement and confidence. By contrast, Photorealistic C ranked more favorably in terms of engagement (8^{th}) than for confidence (11^{th}), and the opposite pattern was true for two of the section drawings (Section M and Section T), which ranked two to four positions lower or less favorably in engagement than in confidence.

As previously discussed, participants were less sensitive to individual plan drawings when rating confidence than when rating engagement. They also found more photorealistic drawings to be alike when rating confidence than when rating engagement. Thus, while the relationship between engagement and confidence is strong, it is clear that the two variables are measuring different aspects of effectiveness.

Summary of relationships between effectiveness variables

Overall, the relationships among the effectiveness variables are strong. *Understandability* and *confidence* were most closely related with the highest correlation coefficients across drawing types. As expected, participants were more confident in discussing drawings that they understood well. *Engagement* and *confidence* had the second strongest relationship across drawing types. Participants were more inclined to discuss the drawings when they found the drawings engaging. The relationship between *engagement* and *understandability* was weaker relative to the others, but was still fairly strong. It was more highly dependent on drawing type.

While the relationships are strong, results of the analyses indicate the three measures are capturing different aspects of the drawings' effectiveness. One striking finding is that participants generally rated each drawing higher on understandability than both confidence and engagement, regardless of drawing type. This was true even when the drawing was ranked lower (or worse) on understandability. This suggests that other factors are at play in people's engagement and confidence in discussing the drawings with landscape architects. While making drawings understandable is important, designers need to explore other ways to help people feel engaged and comfortable participating in design discussions.

The use of all three measures to evaluate effectiveness of drawings was insightful in a number of ways. These insights are described for each drawing type.

Plans

Plans had the highest correlations between effectiveness variables compared to all other drawing types. One plan, Plan S, performed very well for all three measures. This strengthens the argument that not all plans are inferior to other drawing types. A well designed plan can be understandable, engaging, and instill confidence in participants.

Our knowledge about plans benefited from including confidence in addition to understandability in analyzing its effectiveness. Participants' confidence discussing plans was not as sensitive to individual drawings as their understandability was. Also, the comparative analyses of plans provided examples where understandability and engagement did not go hand in hand.

Sections

Of all drawing types, sections had the weakest correlations between two of the three pairs of effectiveness variables. The comparison of ranks among the effectiveness variables provides insight into which drawings contributed to these weaker relationships. Two sections, which were simple representations that used colors consistent with common perceptions, ranked well for understandability, but dropped in the ranks for engagement. These results point to the important role that 3-dimensionality plays in engagement. It also speaks to the usefulness of simple representations in enhancing understandability. The analyses also provide a couple examples where understandability and confidence diverge.

Perspective drawings

The relationships between effectiveness variables were strong for perspective drawings, yet the study still benefited from analyses of all three measures. The comparative analyses within drawing type revealed that, like plans, participants made fewer distinctions among perspective drawings when rating confidence than when rating understandability. Also, valuable information was gleaned regarding the representation of people, its effects on understandability and engagement, and other factors that contribute to engagement.

Photorealistic drawings

Photorealistic drawings performed very well on all three measures of effectiveness. However, analyses of the relationships among the effectiveness variables revealed cases where other drawing types were superior to photorealistic drawings. Some photorealistic drawings, particularly photomontages, ranked quite well for engagement, but dropped below other drawing types for understandability. This contributed to a weaker correlation between these variables.

Other interesting findings emerged from the comparative analyses within type. In contrast to plans and perspective drawings, participants were *more* sensitive to individual drawings when rating their confidence discussing the drawings than when rating their understandability of the drawing. Distinctions among drawings also were made for engagement when the same drawings were considered equally understandable. This finding shed light on factors contributing to engagement, particularly the variety of colors and textures in drawings.

Role of abstraction in the effectiveness of drawings

A recurring theme in the literature on the effectiveness of drawings is the relationship between a drawing's abstraction and its understandability (see Chapter 5). Researchers disagree about what the appropriate level of abstraction is for seeking input from the public on design alternatives. S. Kaplan and Kaplan (1982) emphasize the cognitive benefits of a more abstract, simplified representation and its usefulness in helping participants to judge design alternatives. In many situations, a high level of detail is not needed to assess features of a design; a simplified representation can be as effective, and also is less taxing on the participant's cognitive load. Pietsch (2000) reports other researchers who believe simplification can be an asset by focusing laypeople's attention on the important features of the design. Sheppard (1989), on the other hand, believes abstraction contributes to inaccuracies in a drawing. He stresses the failure of abstract drawings in providing important features and details of the environment, which can affect people's judgment of the design. He also warns that laypeople can be easily misled by abstract drawings. Ervin (2001) identified a need for more research on assessing the appropriate levels of abstraction. This study investigates the role that abstraction plays on people's perceptions of understandability, engagement, and confidence in discussing the design for four types of drawings depicting small-scale nature settings.

Participants rated each drawing in terms of how abstract it was. Abstraction was defined as "lacking the concreteness found in real scenes." Results reveal that participants perceived the four types of drawings to be different from one another in their level of abstraction (Table 6.19). Participants perceived plan drawings to be the most abstract of the four drawing types with a mean of 2.9 out of 5.0. They rated photorealistic drawings least abstract, followed by perspective drawings, then sections.

Table 6.19
Role of Abstraction

	Descriptive Statistics		**Correlation Coefficients**		
(n=404)	**Mean score**	**Std Dev**	**Underst. X Abstraction**	**Eng. X Abstraction**	**Conf. x Abstraction**
Plans	2.89	0.87	-0.49	-0.43	-0.42
Sections	2.58	0.88	-0.43	-0.31	-0.38
Perspectives	2.41	0.84	-0.37	-0.32	-0.32
Photorealistic	1.70	0.65	-0.37	-0.24	-0.32

All pairs of mean scores are significantly different at $p<.001$.
All correlations are significant at $p<.01$.

Level of abstraction is believed to play an important role in people's understanding and engagement in design drawings (Bates-Brkljac, 2009; Pietsch, 2000). However, the results from this study indicate that these relationships may not be as strong as one might expect. While understandability, engagement, and confidence all were lower for drawings perceived as more abstract (i.e., all correlations are negative), the correlation coefficients (Table 6.19) are all relatively low. Only for the most abstract drawings, i.e., plans, are all three correlations above .40.

Table 6.20 offers a comparison of understandability and abstraction for each of the drawings. If more abstract drawings were consistently less understandable, the two listings in the Table should closely parallel each other. (Each list is in rank order, with abstraction means listed from lowest to highest.) The table includes a number of examples where understandability and abstraction do not coincide with one another. For instance, Plan S was ranked fourth overall for understandability and

Table 6.20
Ranks of Individual Drawings

RANK	UNDERSTANDABILITY (most to least) Drawing	N	Mean	SD	ABSTRACTION (least to most) Drawing	N	Mean	SD
1	Pht W	404	4.27	.864	Pht W	403	1.40	.790
2	Pht F	404	4.26	.890	Pht R	404	1.45	.866
3	Pht R	403	4.17	.985	Pht F	404	1.59	.854
4	Plan S	404	4.14	.981	Prsp T	404	1.84	1.022
5	Prsp T	404	4.00	.971	Pht B	404	1.90	1.047
6	Prsp J	403	3.81	.891	Pht L	403	1.94	1.088
7	Section M	404	3.81	1.095	Pht C	402	1.94	1.019
8	Pht L	404	3.80	1.141	Section A	404	2.09	1.038
9	Section A	404	3.78	.966	Section M	401	2.12	1.191
10	Pht B	403	3.75	1.066	Prsp J	400	2.28	1.069
11	Pht C	403	3.71	1.086	Plan S	403	2.30	1.201
12	Prsp P	403	3.49	.960	Prsp P	401	2.64	1.118
13	Prsp F	404	3.27	1.088	Section T	404	2.72	1.234
14	Section T	404	3.18	1.229	Plan A	404	2.72	1.172
15	Plan M	403	3.01	1.149	Plan I	401	2.86	1.208
16	Plan I	404	2.94	1.045	Prsp F	404	2.90	1.193
17	Plan A	403	2.82	1.010	Plan K	403	2.96	1.235
18	Plan K	404	2.62	1.070	Plan M	403	3.12	1.247
19	Section Y	403	2.16	1.079	Section Y	403	3.40	1.322
20	Plan R	403	1.88	.975	Plan R	401	3.41	1.320

eleventh for abstraction. Despite the fact that this drawing was more abstract than half of the other drawings, it fared very well on understandability. Recall that this plan drawing was a simple representation of a 2-acre nature setting with circles of consistent size and color to represent trees. The trees were organized neatly in rows and columns, and the paths and nature areas had clear edges. This finding provides evidence that simplicity in representation can enhance understandability.

Two other examples where abstraction and understandability greatly diverged involved photorealistic drawings, Photorealistic B and Photorealistic C. They were ranked tenth and eleventh on understandability, but fifth and seventh on abstraction, respectively. They were considered as understandable as other more abstract perspective drawings (Perspective J) and section drawings (Section A, Section M). Recall that Photorealistic B and Photorealistic C were photomontages that combined black and white photographs of people with computer-generated, full color nature scenes. These findings provide additional evidence that low abstraction is not consistently associated with higher understandability.

One question that remains is the appropriate level of abstraction when representing people. The drawings in the study present a variety of methods for depicting people. Results from earlier analyses reveal that opinions differ regarding the effectiveness of these different methods. Some participants found the outlines of people in Perspective J to provide just enough information to not be distracting, while others found them to be "strange" or "ghostly." For some the combination of black and white photographs of people and full color nature scene in Photorealistic B and Photorealistic C did not work well. Others found the people in Photorealistic B to be engaging. Based on the ranks discussed in the previous paragraph, there is some indication that the more abstract representation of people in Perspective J served its purpose quite well for understandability.

Summary of the role of abstraction

Findings from this study reveal that the relationship between abstraction and effectiveness is not a simple one. The three least abstract drawings were rated highest on understandability and engagement, while the three least understandable drawings were most abstract. However, the correlation coefficients for the relationships between abstraction and each variable were quite low, indicating a weak relationship. Also, when considering individual drawings within type, less abstraction (or a more detailed drawing) was not consistently associated with higher effectiveness. In fact, simplicity in representation enhanced understandability in several cases.

Conclusion

Many people recognize the benefit of involving citizens in the design of nature areas intended for public use. Pubic participation can lead to designs that better meet the users' needs and increase the likelihood that the park will be visited and protected. Involving citizens also can strengthen public support for the project and ensure their cooperation. Also, it can allow citizens to gain a sense of ownership of the park, which can promote participation in its maintenance and care. Finally, participation demonstrates respect since people greatly appreciate being asked for their input in design projects that affect them (S. Kaplan & Kaplan, 1978, 1982).

As more cities mandate citizen involvement in public design projects, citizens likely will be asked more often to comment on proposed designs depicted in landscape architecture drawings. In many cases, these drawings will be presented in newspapers, online reports, or public displays where little interaction between citizens and the designers will be possible. Knowing how well laypeople understand different types of design drawings, how engaging the drawings are, and how confident laypeople are in providing comments can help designers choose drawings that enhance citizen participation and result in valuable comments. This information also can be valuable in deciding where to focus their efforts when creating design drawings.

This study provides useful insight into the effectiveness of four types of drawings: plans, sections, perspective drawings, and photorealistic drawings. Findings indicate that photorealistic drawings are highly effective as a means of communicating design ideas to laypeople, as other studies have found. Perspective drawings also fare quite well in this study. Plans and sections, in general, are less effective than photorealistic and perspective drawings. These results are consistent with other studies found in the literature.

One of the most striking findings, however, is the variability in effectiveness *within* drawing types. The most notable difference among drawings is with respect to the understandability of the plan drawings. The difference between the most understandable and least understandable plan drawing is a dramatic 2.3 points on a five point scale. Section drawings also differ greatly with a range of 1.7 points. This study reveals that not all plans and sections are difficult for laypeople to understand. One plan in particular was rated the fourth most understandable of all twenty drawings. Also, some of the section drawings were rated higher on understandability than some of the perspective drawings and photorealistic drawings.

The study findings reveal a number of key factors that explain these differences in the perceived effectiveness of drawings. For understandability and confidence, important factors include the amount of information, simplicity in representation, coherence and legibility, and consistency with common perceptions. For engagement, 3-dimensionality seems to be the most important characteristic of the drawings, since nine out of ten of the plans and sections represent the bottom nine drawings in the ranks for engagement. Complexity also plays a major role in how engaging the drawings are rated. The following section identifies the major themes that emerge from the study and summarizes the findings related to each theme.

Amount of information

Results indicate that using many and/or very small features to represent different characteristics or details of a setting can reduce understandability. Too much detail can be overwhelming to the layperson, making it difficult to grasp what the details represent.

While it is true that the most understandable plan depicts a site less than two acres, and the least understandable drawing is a plan representing the largest acreage at 363 acres, scale alone does not seem to be a determining factor for understandability. The other plan drawings, which represent settings at three different scales, perform equally well on understandability. Therefore, understandability of plans seems to relate more to the amount of information or detail shown or to the size of the features in the drawing rather than to the scale of the actual site being depicted. For instance, a close view of a small area could be as effective as using simplified, large features to depict elements of a much larger setting.

Simplicity in representation

Numerous findings from this study lead to the conclusion that simplicity can enhance understandability and confidence. First, while most plans are low in understandability, the plan drawing receiving the highest rating on understandability differs in a number of respects. It uses simple circles of a consistent size and color to represent the trees, organized neatly into rows and columns. The section drawing that fares quite well on understandability was described as being "simple" and "straightforward." Although limited to 2-dimensions, it has easily identifiable features and seems to provide an adequate level of detail.

Results from the analysis investigating the role of abstraction in a drawing's effectiveness also point to the importance of simplicity. While more abstract drawings are generally more difficult to understand than less abstract drawings, a closer examination of individual drawings reveals cases where more abstract drawings perform better than less abstract drawings. Simplicity and coherence are major factors in explaining the success of these drawings. Thus, the relationship between level of abstraction and effectiveness may be weaker than expected.

Finally, abstractness with respect to representing people in a drawing also deserves discussion. Both the ratings and comments provided by participants suggest some differences in opinions regarding the effectiveness of the different methods used to represent people. There is some indication that using abstract representations of people can be as effective as using photographs. With respect to understandability, some drawings with outlines of people perform as well as black and white photographs of people superimposed into a color scene. Drawings with people presented in full color, however, seem most effective for understandability. Some people find the white silhouettes helpful since they can imagine themselves there. Others find the silhouettes "ghostly" or "strange."

Coherence and legibility

A design drawing is coherent when one can distinguish areas or features of the setting and understand the spatial relationships among them. The elements in a coherent drawing seem to fit together well. Legibility refers to the ability to read any writing or labels in the drawing and identify the features in the setting. In terms of a legible environment, it also can be defined as having clear paths, landmarks, and other features that enhance one's ability to find their way through the setting.

The results of this study indicate that both coherence and legibility are important factors in enhancing understandability. In general, the most understandable drawings have clear paths and easily identifiable features. Areas within the pictured setting can easily be distinguished from one another through the use of distinct edges or colors. The most striking difference in coherence is between the most and least understandable plan drawing.

Some of the plan drawings had stylized handwriting that some viewers found to be illegible. Otherwise, participants' comments indicate that the text labeling features of the design seems to help understand the drawings. In this study, participants seem to prefer typed labels aligned horizontally rather than vertically.

Using colors consistent with common perceptions

Plan drawings and sections that use colors consistent with common perceptions fare better than those that do not. Drawings depicting green trees are more understandable than those with pink trees. Using a sky blue background for only a portion of a section drawing causes confusion as well. According to comments, some participants also have trouble with the combination of black and white photographs and color scenes. The results indicate that color accuracy in representing nature features and overall consistency in the use of color within a drawing can enhance people's understanding of drawings.

Complexity

While the previous issues were particularly pertinent with respect to understandability, complexity appears to be an important factor for engagement. Complexity refers to variations in the colors, textures, and patterns in a drawing, which could represent the diversity of plants, landscapes, and natural features. In this study, drawings with a full spectrum of vibrant colors are more engaging than drawings dominated by light colors such as pastels or grays.

However, results from this study also suggest that maintaining a balance between coherence and complexity is an important factor in how understandable and engaging a drawing is. Providing complexity by using a variety of patterns and colors to represent different textures, vegetation, and materials can enhance engagement. At the same time, too much information can overwhelm participants. Thus, coherently organizing the drawing into distinct regions or elements, as a means of handling increased complexity, is key to creating an understandable and engaging drawing.

Relationships among variables

A second goal of the study was to test the relationships among the different measures of effectiveness. Overall, the relationships among understandability, engagement, and confidence are fairly high. Understandability and confidence are most closely related. Participants are more confident in discussing drawings that they can easily understand. The relationship between engagement and confidence also is strong. This result suggests that participants who are more engaged in the drawing may be more inclined to discuss the drawing with the designer. The relationship between engagement and understandability, while strong, is not as straightforward and depends on drawing type. Discrepancies between understandability and engagement are found that indicate understandable drawings can be boring, and less understandable drawings may be engaging when they require more effort to figure them out.

Some of the high correlation among the effectiveness variables may be due to the fact that the same people rated all three qualities. Another study where participants rate only one quality would be useful to see if similar results are found.

The study brought to light the benefits of using all three measures for determining the effectiveness of drawings. Discrepancies among variables for individual drawings are insightful regarding the advantages and disadvantages of the drawings. The results highlight the importance of considering multiple ways of enhancing participants' understandability, engagement, and confidence in discussing design drawings.

The study also investigates the role that abstraction plays in a drawing's effectiveness. Results indicate a weak negative relationship between abstraction and each of the dependent variables – understandability, engagement, and confidence. There are a number of instances where a simplified yet more abstract drawing fares better than a less abstract photorealistic drawing.

Implications in design

The results provide valuable information to designers regarding balancing effort in creating drawings and the drawings' effectiveness in communicating design ideas. Results indicate that some of the simpler, less time consuming drawings can be effective in helping people visualize the design if certain conditions are met. On the other hand, quick sketches seem to be better suited for internal communications among designers than for public presentations.

In the past, photorealistic drawings were incredibly time consuming and thus, rarely used. With the development of a number of computer software programs, these drawings are easier to create than they used to be, but still demand good graphic skills. Given participants favorable response to these drawings, training in creating photorealistic drawings seems worthwhile. However, a word of caution about these drawings is necessary. Because photorealistic drawings tend to be highly convincing, designers must be careful about how they depict the proposed setting so as to not mislead or deceive their participants (Bates-Brkljac, 2009; Pietsch, 2000; Sheppard, 1989; Wergles & Muhar, 2009).

Up until now, there has been no research on the effectiveness of design drawings from the layperson's perspective. This study contributes to closing this gap in an effort to improve the public participation process in design for both designers and participants. Some basic assumptions are tested, and interesting results emerged. A critical next step is to share the results with more designers. Their reactions could reveal cases where the study's findings either validate or challenge commonly held positions or claims in the field regarding the effectiveness of design drawings.

The study provides valuable insight into ways that understandability, engagement, and participation can be enhanced. People prefer situations in which they can understand what is going on, are engaged, and feel competent in doing the tasks that are asked of them. Research that contributes to learning ways of making the participation process more people-friendly can have substantial impact on decisions that are made about the landscape and the cooperation of the people around us along the way.

Appendix 6.A
Mean ratings organized by drawing type
(u=understandability; e= engagement, c=confidence in discussing the design)

Photorealistic drawings (Pht):

Pht W

u=4.27
e=3.99
c=3.87

Pht R

u=4.17
e=3.73
c=3.70

Pht B

u=3.75
e=3.23
c=3.34

Pht C

u=3.71
e=3.09
c=3.20

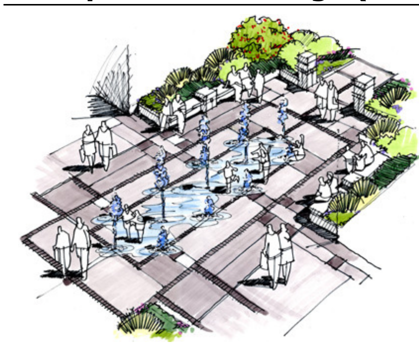
Pht F

u=4.26
e=3.67
c=3.82

Pht L

u=3.80
e=2.95
c=3.29

Perspective Drawings (Prsp):



Prsp F

u=3.27
e=2.90
c=3.04

Prsp J

u=3.81
e=3.61
c=3.54

Prsp P

u=3.49
e=2.94
c=3.11

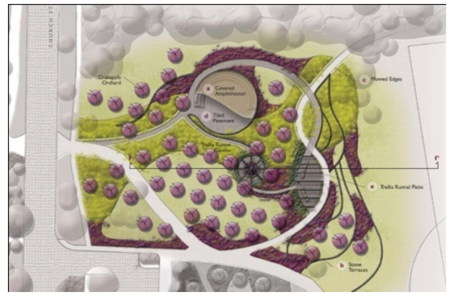
Prsp T

u=4.00
e=3.93
c=3.71

Plans:

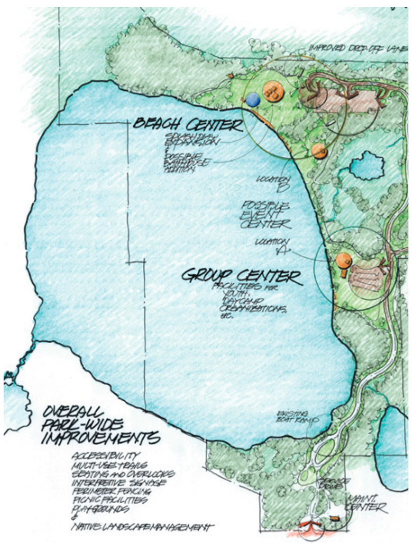
Plan A

u=2.82
e=2.35
c=2.59



Plan M

u=3.01
e=2.57
c=2.70

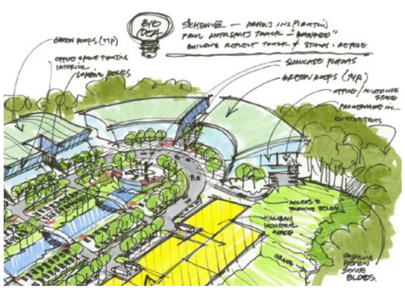


Plan I

u=2.94
e=2.58
c=2.74

Plan R

u=1.88
e=1.91
c=1.95



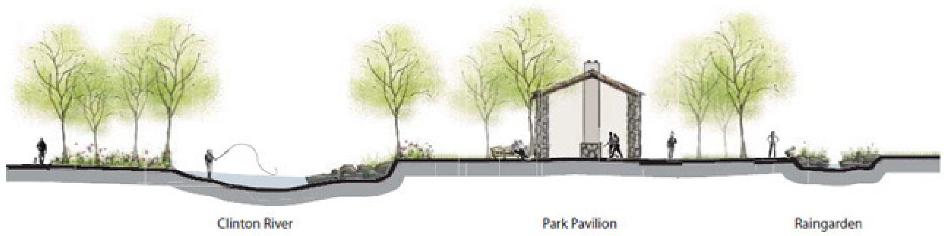
Plan K

u=2.62
e=2.51
c=2.58

Plan S

u=4.14
e=3.36
c=3.70

Section drawings:

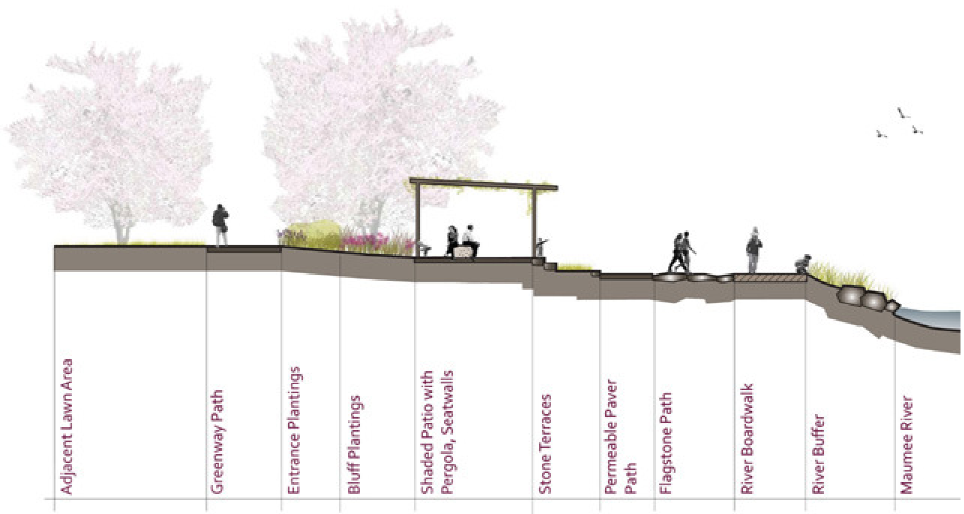


Section A

u=3.78
e=2.88
c=3.24

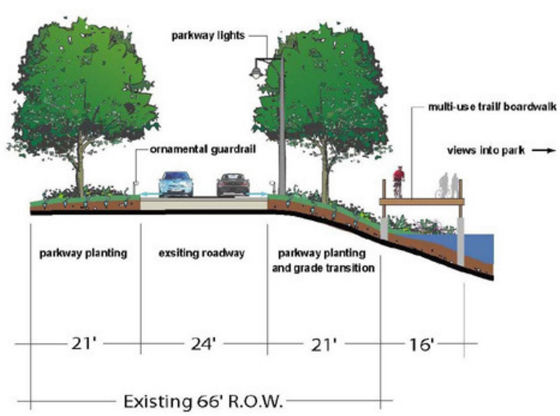
Section Y

u=2.16
e=1.83
c=1.96



Section T

u=3.18
e=2.32
c=2.81



Section M

u=3.81
e=2.72
c=3.28

Appendix 6.B

Example Pages from Survey

Study Purpose

Study Description: Landscape architects use a variety of drawings to communicate design ideas and gather people's input on design options for nature settings. Little is known about the effectiveness of these drawings from the layperson's perspective. The purpose of this study is to collect your feedback on different types of drawings commonly used by designers.

Participation: The survey consists of 23 drawings showing designs of several nature settings. You will be asked to rate each drawing on 5 aspects of its effectiveness. You also will have the opportunity to add your own comments about the effectiveness of the drawing if you so desire.

Adults (age 18+) are invited to take the survey. The survey should take approximately **15 minutes** to complete. Your responses are **anonymous**. We do not ask for your name or any identifying information. Your participation in this project is voluntary. Please take the survey only once.

If you have any questions about your participation or the study, please contact Kimberly B. Phalen, Principal Investigator, PhD Candidate, School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI, 401-481-6303, email: bosworth@umich.edu

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Instructions and Definitions

Instructions:
The drawings displayed on the following pages are typical drawings used by landscape architects to show designs of nature settings. Please rate the effectiveness of each drawing for the items listed. Definitions of the items are provided below. Feel free to provide additional comments regarding the effectiveness of the drawing in the space provided.

Definitions:

Understandable - it is easy to make sense of what I am seeing and what kind of place it is. A low score would mean it is difficult to figure out what the scene is about.

Engaging - the drawing is interesting to look at; holds my attention

Frustrating - the drawing makes me feel aggravated or confused

Abstract - the drawing lacks the concreteness found in real scenes

Based on this drawing, I would feel confident discussing the design with the landscape architect. Consider an opportunity to provide input to the landscape architect on the design depicted in the drawing. Based on your comfort with the drawing, how confident would you be in discussing this design?

Image provided by Johnson Hill Land Ethics Studio, www.jhle-studio.com, Ann Arbor, MI.

The drawing shown is...

Click here for definitions

	Not at all	A little	Somewhat	Quite a bit	Very much
understandable	○	○	○	○	○
engaging	○	○	○	○	○
frustrating	○	○	○	○	○
abstract	○	○	○	○	○

Based on this drawing, I would feel confident discussing the design with the landscape architect.

Not at all	A little	Somewhat	Quite a bit	Very much
○	○	○	○	○

Additional Comments (optional):

Background

Please indicate your age:

Less than 18	18-22	23-29	30-39	40-49	50-59	60-69	70+
○	○	○	○	○	○	○	○

What is your gender?

- ○ Male
- ○ Female

In which state (if in the U.S.) or country (if outside the U.S.) do you live?

How much experience do you have with the following:

	None	Very little	Some	Quite a bit	A great deal
Landscape or architectural drawings	○	○	○	○	○
Computer-generated drawings	○	○	○	○	○

Appendix 6.C

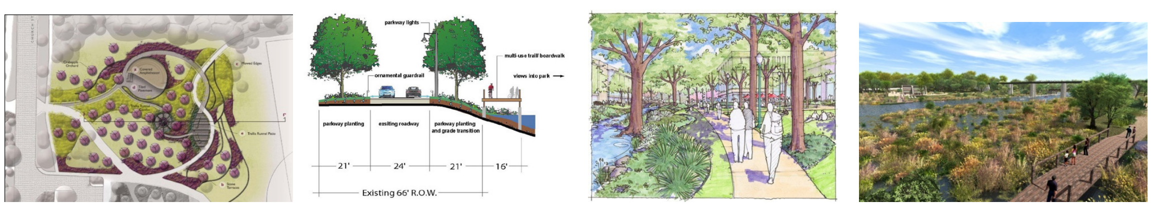
Individual drawings in descending order of mean ratings for each variable
Drawing type is color-coded to assist in identifying patterns. (Abbreviations: Prsp = perspective drawing; Pht = photorealistic drawing; Sct = Section)

	Understandability (u)			Engagement (e)			Confidence (c)		
RANK		Drawing	Mean		Drawing	Mean		Drawing	Mean
1		Pht W_u	4.27		Pht W_e	3.99		Pht W_c	3.87
2		Pht F_u	4.26		Prsp T_e	3.93		Pht F_c	3.82
3		Pht R_u	4.17		Pht R_e	3.73		Prsp T_c	3.71
4		Plan S_u	4.14		Pht F_e	3.67		Plan S_c	3.70
5		Prsp T_u	4.00		Prsp J_e	3.61		Pht R_c	3.70
6		Prsp J_u	3.81		Plan S_e	3.36		Prsp J_c	3.54
7		Sct M_u	3.81		Pht B_e	3.23		Pht B_c	3.34
8		Pht L_u	3.80		Pht C_e	3.09		Pht L_c	3.29
9		Sct A_u	3.78		Pht L_e	2.95		Sct M_c	3.28
10		Pht B_u	3.75		Prsp P_e	2.94		Sct A_c	3.24
11		Pht C_u	3.71		Prsp F_e	2.90		Pht C_c	3.20
12		Prsp P_u	3.49		Sct A_e	2.88		Prsp P_c	3.11
13		Prsp F_u	3.27		Sct M_e	2.72		Prsp F_c	3.04
14		Sct T_u	3.18		Plan I_e	2.58		Sct T_c	2.81
15		Plan M_u	3.01		Plan M_e	2.57		Plan I_c	2.74
16		Plan I_u	2.94		Plan K_e	2.51		Plan M_c	2.70
17		Plan A_u	2.82		Plan A_e	2.35		Plan A_c	2.59
18		Plan K_u	2.62		Sct T_e	2.32		Plan K_c	2.58
19		Sct Y_u	2.16		Plan R_e	1.91		Sct Y_c	1.96
20		Plan R_u	1.88		Sct Y_e	1.83		Plan R_c	1.95

CHAPTER 7

ROLE OF EXPERTISE IN PERCEPTIONS OF DESIGN DRAWINGS

Design drawings are the primary means by which designers share their design ideas with the public. In many instances, laypeople, however, have difficulty understanding the drawings that are presented (Bates-Brkljac, 2009; Lawrence, 1983, 1993; Mahdjoubi & Wiltshire, 2001; Pietsch, 2000). A critical question, therefore, is whether designers perceive the effectiveness of design drawings differently than laypeople. Research on expertise would suggest that this may be the case (Chase & Simon, 1973; de Groot, 1965; S. Kaplan, 1977). Much of this work, however, has addressed areas of expertise that do not speak to the issues involved in design drawings. This study investigates the role that expertise plays in the evaluation of four types of design drawings (see Figure 7.1) with respect to their understandability, sense of engagement, and the viewers' confidence in being able to discuss the design. It compares the perceptions of participants with experience in landscape or architectural design drawings to those with little to no experience. It focuses on drawings used in the design of small-scale nature settings.



Plan　Section　Perspective Drawing　Photorealistic Drawing

Figure 7.1 Examples of the four types of drawings included in the study

Landscape architects develop their expertise through many years of training and experience. As knowledge expands and experiences accumulate, the way information is organized in their brain changes accordingly (S. Kaplan, 1977). Their mental models, or knowledge structures, become more compact and accessible. As a result, experts are proficient in defining the design problem, identifying constraints, and envisioning alternative solutions. One would expect that they can transform abstract, 2-dimensional drawings into rich, 3-dimensional spaces and manipulate them in their mind in order to test various design options.

However, the expertise that affords designers these strengths also can inhibit effective communication between designers and laypeople. Expertise can prevent designers from seeing things the way laypeople see them (Bates-Brkljac, 2009; R. Kaplan, et al., 1998; S. Kaplan, 1977; Mahdjoubi & Wiltshire, 2001; Reymen, et al., 2005). This can lead to a number of unintended consequences of expertise in participatory design efforts.

The unintended consequences of expertise

As with other contexts for public participation, one can readily call to mind situations that fail in fostering information exchange and end in frustration for both designers and participants. There are times when only the most irate participants share their concerns, often in a manner that does not support further information sharing and discussion. In design situations, participants may not provide feedback on a proposed design or participate in design discussions. When asked what they would like the proposed setting to look like, participants sometimes have little to say in response or make unrealistic demands.

What causes these failures in designers' efforts to seek feedback from participants? Designers may attribute them to factors out of their control such as the participants' lack of education, beliefs, or personality. However, they are often problems of expertise. In the following paragraphs, common situations that arise in participatory design efforts are identified from the designer's perspective. Alternative explanations are then discussed from a cognitive and environmental psychology perspective. The explanations are rooted in a theory called the Reasonable Person Model (S. Kaplan & Kaplan, 2003, 2009) which highlights the important roles that mental model-building (including understanding and exploration), being effective (e.g., being engaged, having a sense of competence), and meaningful action play in people's behavior, willingness to participate, and quality of life (see Chapter 1.) Being listened to and feeling heard are important components of meaningful action (S. Kaplan & Kaplan, 2009). Participants are more likely to participate when they feel they can make a difference and have been heard.

Designers also benefit from knowing their expertise is needed and that their choices and actions can make a difference. The discussion sheds light on some of the factors within the designer's control that can affect laypeople's participation and sense that they have been heard.

Participants have nothing to say

Designers may interpret people's failure to provide feedback as a sign that participants are not interested in the proposed design. However, participants' silence can reflect their lack of understanding of the material presented. The use of jargon is commonly identified as a major obstacle in effective communication (R. Kaplan, et al., 1998; S. Kaplan & Kaplan, 1982; Reymen, et al., 2005). Design terminology can be distracting for laypeople and can deplete the mental resources needed to do what is asked of them – to compare design alternatives. Participants' frustration can lead the designer being left without valuable feedback on the design. Even more detrimental, participants may avoid this state of confusion by checking out of the process altogether, thereby denying them an opportunity for meaningful action. Alternatively, they might develop distrust for the designer or attribute the designer's word choice to arrogance or disrespect. This can significantly strain the working relationship.

Laypeople's understanding of design drawings also can affect their ability to provide feedback. The difficulty laypeople have interpreting 2-dimensional drawings is well documented (Chapter 6) (Lawrence, 1983, 1993; Mahdjoubi & Wiltshire, 2001; Pietsch, 2000). They often cannot imagine the depicted setting with the richness and depth that designers expect of them. Laypeople may not develop a full understanding of the design options if they cannot interpret the drawings. As a result, they may not be able to provide feedback or may lack the confidence to carry on discussions with the expert. Alternatively, laypeople could ask for things that are not feasible. Also, misinterpretations of design drawings can lead to surprises and disappointment once the real setting is complete.

Expertise hinders the ability to put oneself in the layperson's shoes. Experts' memory of how they once saw things before they became experts has faded. Old ways of seeing are altered as experience and knowledge accumulate (R. Kaplan, et al., 1998; S. Kaplan, 1977). Experts' vocabulary and skills have become second nature to them. Thus, it can be difficult for them to identify the terminology or type of drawings that laypeople may have trouble understanding. Opportunities for designers to practice presentations with laypeople can provide insights about ways to offset some of the challenges associated with expertise. Research on the effectiveness of design drawings from the participant's perspective also can be valuable to designers in choosing appropriate visual graphics to use when seeking input from laypeople (Chapter 6).

Participants just don't get it

It can be frustrating for designers when they have to explain a design proposal numerous times, and participants still do not understand it and make unrealistic demands. Also, participants might jump ahead in the design process and want to discuss details that seem irrelevant to judging the overall design in the early planning stages. One might be quick to attribute participants' failure in understanding to their lack of experience with the design process or interpreting drawings. However, there may be other explanations. Participants' knowledge of the local situation and experiences can lead to different perceptions of the design problem or proposed setting than the designer's perceptions (R. Kaplan, et al., 1998; S. Kaplan & Kaplan, 1982; Phalen, 2009; Van Herzele, 2004). Further, research has shown that laypeople's overall approach to design problems and their reasoning is different than experts. For example, in a study by Van Herzele (2004), laypeople judged the design of a park from the perspective of experiencing it within the context of their community. Designers, on the other hand, worked from the "inside out," thinking about the park as the central focus and then addressing the challenge of linking it to the surrounding context (Van Herzele, 2004, p. 208). This led designers to envision potential uses based on how their design could be used, whereas laypeople identified potential uses based on their experiences and their community's needs.

In the same study by Van Herzele (2004), laypeople also thought ahead to potential management issues or undesirable uses of the setting early in the planning stage. When judging the design, they did not distinguish among the various stages of the design process - planning, design, and management – but rather explored options and issues that emerged from their vision of the park and the design process as a whole. Designers, on the other hand, focused more on the immediate task at hand, which was to develop an overall plan or big picture for the park.

Designers can benefit from gaining an understanding of the knowledge and experiences underlying participants' perceptions. Like designers, participants' perceptions are grounded in years of experience and are slow to change (S. Kaplan & Kaplan, 1978). Participants are experts of a different kind; they have expertise in their community and in their role as advocates for their community. Acknowledging laypeople's expertise, seeking their perspective, and respecting their views are critical in promoting participation. Two-way information sharing promotes mutual respect and communicates the value designers place on the participants' knowledge and skills. As a result, participants can gain a greater sense of meaningful action and feel that their efforts *can* make a difference and are needed.

Recognizing how experts' perceptions differ from laypeople's perceptions is a powerful way to mitigate some of the problems that can arise from expertise. To identify some of the differences between experts and laypeople, a study was conducted using four kinds of design drawings, assumed to differ in the amount of expertise required for their understandability (Figure 7.1, see Appendix 7.A for examples). Participants included both laypeople and those indicating they had some experience with landscape or architectural drawings or computer-generated drawings. The study compares experts' and laypeople's ratings of how understandable, engaging, and abstract the different types of drawings are. It also evaluates experts' and laypeople's confidence in discussing the design with a landscape architect.

Method

Study participants completed an online survey where they were asked to rate a series of drawings of nature settings on various aspects of the drawings' effectiveness. Four types of drawings were included: plans, sections, perspective drawings, and photorealistic images (Figure 7.1). They are described in detail below under the heading "Main Independent Variable." The purpose of the study was described as an effort to collect people's feedback on different types of drawings commonly used by designers to depict small-scale nature settings. A side by side comparison of the different types of drawings is provided in Appendix 7.A, which includes the drawings used in the study organized by type.

Drawing sampling

Criteria for selection

The 23 drawings used in the study were created by professional landscape architects, except for two by first year landscape architecture students. The drawings were chosen from a collection of images graciously provided by three landscape architecture firms in the Midwest U.S. and first-year students in a landscape architecture program. Designers were asked if they would be willing to share some of their existing work for a study intended to better understand the advantages and disadvantages of different types of drawings in communicating design ideas to laypeople and in gathering their input on the designs.

The main criterion for selecting drawings was the drawing type. Efforts were made to represent these equally. The final drawings are categorized as plans, sections, perspective drawings, and photorealistic drawings. The categories are discussed in the next section: Main independent variables.

The search for drawings was limited to the kinds of imagery traditionally included in public participation efforts related to the design of small-scale nature settings. The drawings were originally created for actual landscape design projects before this study's conception. In the study, however, they were treated as stand-alone drawings, and no descriptions of the projects were provided.

The selected drawings represented multiple landscape design projects ranging from trail and ecological enhancements in existing natural areas to the design of new parks, trails, outdoor plazas, streetscapes, and outdoor seating areas. To ensure that the drawings would be representative of those used in small-scale nature projects, drawings depicting nature settings of a relatively small-scale were selected. Approximately half of the drawings showed settings in the range of less than 1 acre to 2 acres. A little less than half of the drawings showed nature areas estimated to be between 10 and 30 acres. The largest settings were 312 and 363 acres depicted in two plan drawings.

The drawings were chosen to provide a range of styles and media both across and within type. Some of the drawings were hand-rendered, some were computer-generated, and some were a combination of both. Media varied across drawings and included watercolor, pen and ink, colored pencil, and pastels. Computer programs used to create some of the drawings included Photoshop, Illustrator, and AutoCAD (Computer-Aided Design).

Efforts were made to include a mix of drawings with and without text in the drawing labeling features in the design. Of the eight drawings with these labels, two of them were hand-written in traditional architecture style (e.g., Plan I in Figure 7.2), while the remaining six were typed.

Another consideration was the inclusion of people and the method of representing people in the drawings. Fourteen drawings had people in them. Of these, four showed people in silhouette form while two used photographs of people superimposed into the scene. People in the remaining eight drawings were hand-drawn or computer-generated.

Presentation format

All drawings were represented in full color. Images were formatted to 96 dots per inch to match the resolution of most computer monitors. The drawings were resized to fit a standard computer screen without the need for scrolling. This resulted in a file size of 500 by 325 pixels on average. Original proportions of the drawings were maintained during image resizing.

Drawings were displayed one at a time with the rating scales positioned directly below the drawing. They were arranged in a random order, other than making sure the different types of drawings were interspersed throughout the survey. The order was the same for each participant. While altering the order would have been preferable, the feature for randomizing across drawings (with multiple ratings per drawing) was not discovered at the time.

Main independent variable: Type of design drawing

The main independent variable in the study is the type of design drawing. Four main types of drawings are included: plans, sections, perspective drawings, and photorealistic drawings. Each of these types is next described in detail.

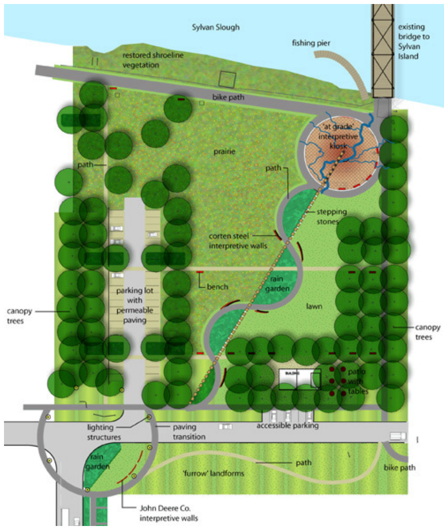
Plan drawings

Plan drawings depict the landscape from an aerial view and are usually presented in 2-dimensions. They show spatial relationships among various features of the landscape much like a map. The six plan drawings used in the study (Figure 7.2) were the most varied of the four types in terms of scale, style, and media. Two settings (top row) were approximately two acres, two settings (middle row) were around 15 to 30 acres, and two (bottom row) were greater than 300 acres. Five of the six plans provided a traditional aerial view, while one provided a slightly angled view from above. Two of the six were computer-generated and used crisp lines and simple geometric shapes for representing trees and other nature elements. Colored pencil was used for the majority of the other plans. None of the plans included people. Four of the six drawings had labels in the drawing.

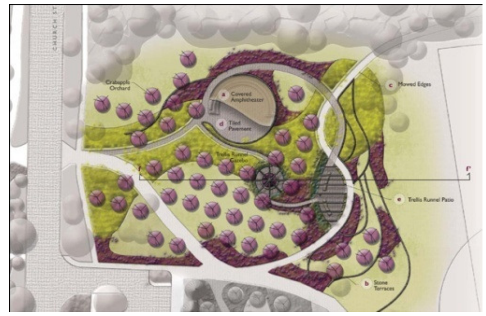
Section drawings

Section drawings provide a 2-dimensional view of the land, as if a vertical plane was cut through the landscape. A bold, thick line represents the ground and depicts the slope of the land. All four section drawings in the study (Figure 7.3) were computer-generated and were similar in scale. Three of the four drawings are similar in style. The most distinguishing feature of Section Y is the background. In the center of the drawing the background is a sky-blue rectangle, while the rest of the background in the drawing is white.

The most striking difference across the four section drawings is the representation of the trees, which are the main focus of the drawings. The trees in Section M are a bold green with distinct edges. In Section T, the trees are a light pink color and are opaque. The tree tops in Section A appear to have been colored a light green with an airbrush paint tool. In Section Y, some trees are shown with leaves using an opaque green while other trees show bare branches.

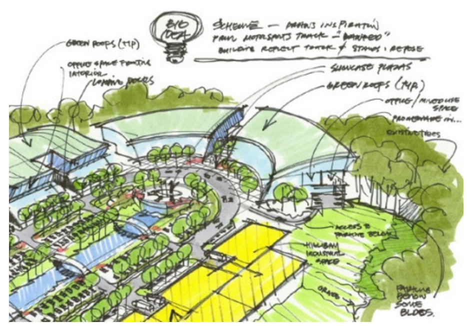


Plan S



Plan M

Plan A



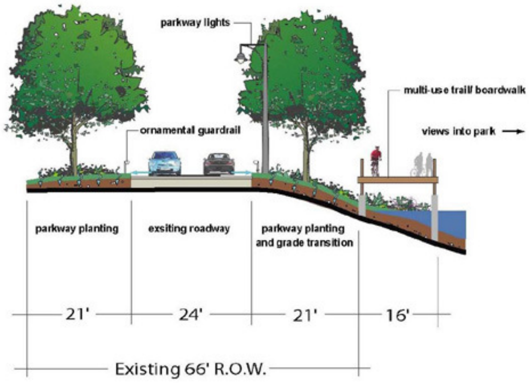
Plan K

Plan I

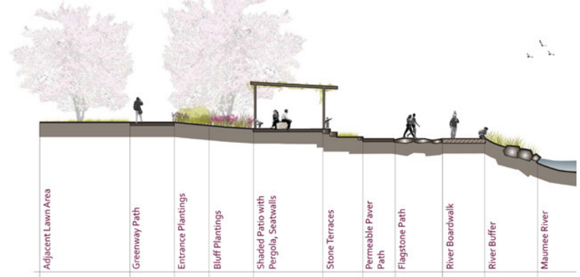
Plan R

Figure 7.2 Plan drawings used in the study[8]

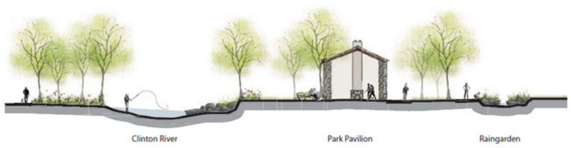
[8] The names of the drawings were derived from the original names provided by the designers.



Section M



Section T



Section A

Section Y

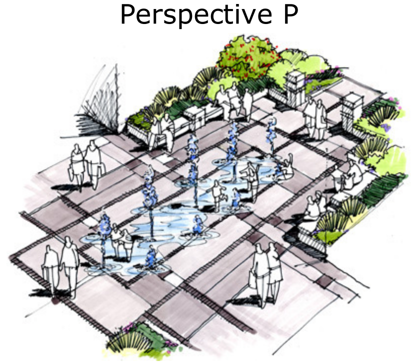
Figure 7.3 Section drawings used in the study

Perspective drawings (prsp)

Perspective drawings provide a 3-dimensional view of the setting as it would be perceived by the eye. All four perspective drawings (Figure 7.4) showed the setting at eye-level, except for one of a plaza with fountains shown from a bird's eye

Perspective P

Perspective J



Perspective F

Perspective T

Figure 7.4 Perspective drawings used in the study view. The fountain drawing was slightly different in content as well, since the setting was dominated by gray pavement or hard surfaces rather than greenery or vegetation.

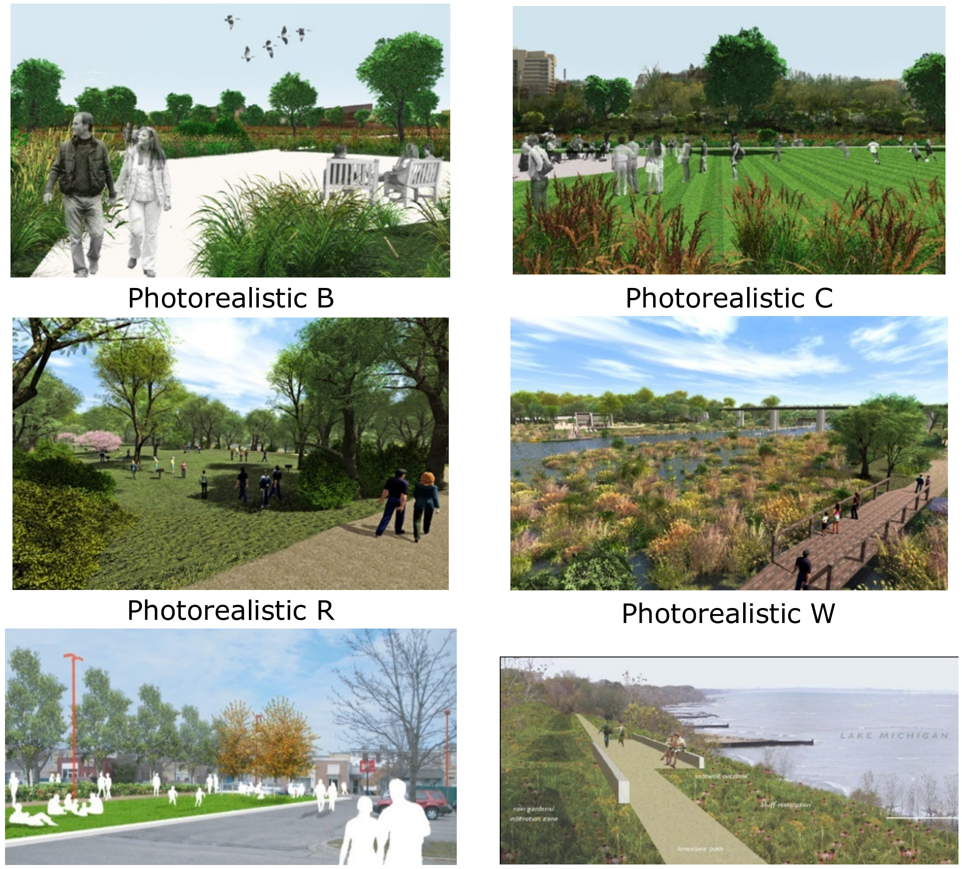
Three of the four perspective drawings were very similar in style and scale. The style of the fourth drawing (Perspective T) differed in that the colors were more vivid (higher saturation) and included a greater spectrum of colors. It had a more photo-realistic feel than the other perspective drawings, but was hand-drawn. People were included in all of the drawings, three of which represented them in outline form with some clothing detail.

Photorealistic drawings (pht)

In landscape modeling, photo-realism refers to the "effort to create synthetic images such as computer renderings, indistinguishable from photographs of real objects or scenes" ("photo-realism," 2010). In this study, the photorealistic images were all computer-generated and include photomontages, photo-manipulated images, and images created solely using 3D visualization software (Figure 7.5). They are the least abstract or most realistic-looking drawings of the four drawing types. They are very similar to one another in terms of level of detail, scale, and depiction of greenery. People are included in all of the photorealistic drawings. Two of the photorealistic drawings use superimposed photographs of people, one shows silhouettes only, and the rest of the drawings show people created using computer software.

Excluded drawings

Only 20 of the 23 originally selected drawings were included in the descriptions of the four types, with six plans, six photorealistic drawings, and four each for sections and perspective drawings. Two of the excluded drawings (Plan C and Perspective M) were the initial drawings in the survey. Since participants were unfamiliar with the kinds of drawings as well as the rating scales, it was decided to consider these as practice drawings and exclude them from further analysis. The third excluded drawing (Perspective C) combined photo-manipulation with a watercolor, perspective drawing. Though originally categorized as a "perspective drawing," the inconsistent results across dependent variables for the factor analyses



Photorealistic B
Photorealistic C
Photorealistic R
Photorealistic W
Photorealistic L
Photorealistic F

Figure 7.5 Photorealistic drawings used in the study

suggested that this drawing should not be considered as representative of any one category.

Other independent variables

Level of experience

Participants were asked two questions that rated their level of experience; one with landscape architecture or architectural drawings and another with computer-generated drawings. Both questions used a five point scale from "none" to "a great deal." "Experts" were defined as people who rated themselves as 4 ("quite a bit") or 5 ("a great deal") on either of the two questions.

Drawing's abstraction

Participants rated how abstract they perceived each drawing to be on a five point scale. An abstract drawing was defined as one "lacking the concreteness found in real scenes." A low score indicated that the participant perceived the drawing to be similar to that which would be seen in reality.

Dependent variables

Participants were asked to rate each scene in terms of four properties, in each case using a 5-point scale (from 1, "not at all" to 5, "very much"). The definitions of the items to be rated were provided at the beginning of the survey and could be accessed via a link on each page of the survey. Definitions were stated as follows:

- **Understandable** - it is easy to make sense of what I am seeing and what kind of place it is. A low score would mean it is difficult to figure out what the scene is about.
- **Engaging** - the drawing is interesting to look at; holds my attention
- **Frustrating** - the drawing makes me feel aggravated or confused
- **Confidence – "Based on this drawing, I would feel confident discussing the design with the landscape architect."** Consider an opportunity to provide input to the landscape architect on the design depicted in the drawing. Based on your comfort with the drawing, how confident would you be in discussing this design?

Procedure

Adults only were invited to take the survey. The initial screen of the survey informed them of the purpose of the study, which was to collect their feedback on typical drawings used by landscape architects to show designs of nature settings. Participants were told their responses were anonymous, and that their participation in the project was voluntary. Contact information was provided in case they had questions about their participation in the study.

The initial screen also included instructions, which asked participants to rate the effectiveness of each drawing for the items listed. Definitions of the items were provided. Participants were told they had the option of providing additional comments about the effectiveness of each drawing in the space provided on each page. The survey permitted participants to go back to previous drawings and ratings if they wished and allowed them to modify their ratings. The instructions and item definitions were accessible at any point in the survey via a link on each page.

The survey was available online for three weeks. Participants were asked to take the survey only once. The survey took on average 15 minutes to complete.

Participants

Participants in the study were approached through several venues, all leading to a website for accessing the survey. Responses were collected using Qualtrics online survey software, permitting total anonymity. A link to the survey was sent via email to priests, directors, and staff of a Catholic church, who then forwarded it to parishioners. In addition, the link was posted on Facebook and emailed to family and friends with the request that they forward it to anyone who might be interested. These distribution methods make it impossible to assess the return rate. A total of 511 people completed the survey. Of these, 497 responses were deemed usable after deleting responses with data missing for more than 10 items. This sample included 91 experts and 404 laypeople based on their responses to two questions measuring their level of experience with landscape or architectural drawings and computer-generated drawings. (Two respondents did not provide data for the expertise ratings.)

As shown in Table 7.1, approximately a quarter (23%) of the survey respondents had expertise in landscape architecture drawings or computer-generated drawings. The two groups differed in a number of respects. The expert group was more equally divided in terms of gender, with a majority being male,

Table 7.1
Respondent Demographics for Online Survey

	Respondents (% of total)	
	Experts	**Laypeople**
Gender		
Male	51 (56%)	128 (32%)
Female	40 (44%)	274 (68%)
Age		
18-22	5 (6%)	23 (6%)
23-39	41 (45%)	209 (52%)
40-59	32 (35%)	109 (27%)
60+	13 (14%)	62 (15%)
Total	**91**	**404**

Note: The total adds to 495 rather than 497 because two respondents did not provide responses to the questions on experience.

while just under a third of the layperson group consisted of males. The age distributions of the two groups were relatively similar, although the layperson group was, on the whole, somewhat younger.

Results

Testing the fit of the pre-defined types of drawings

A confirmatory factor analysis (CFA) was performed to test how well the drawings within the pre-defined types fit together. CFA allows the researcher to define the factors and the items within each factor and then test the fit of the model to the data. AMOS 18.0 (James L. Arbuckle, 2009), a structural equation modeling software, was used to run the test.

The analysis yields a number of indicators for measuring model fit. However, some of these indicators are less applicable with larger sample sizes as was the case here. Therefore, in this study, only Root Mean Square Error of Approximation (RMSEA) was used to determine model fit. According to Browne and Cudeck (1993), an RMSEA value less than 0.05 indicates a good model fit, values between .05 and .08 a fair fit, and values over 0.10 a poor fit (J.L. Arbuckle, 2009; Bollen & Long, 1993; Browne & Cudeck, 1993).

Table 7.2
Confirmatory Factor Analysis Model Fit
(n=497)

Main Variable	RMSEA
Abstraction	0.072
Understandability	0.058
Engagement	0.057
Frustration	0.059
Confidence	0.064

The RMSEA values from the CFA for the abstraction measure and each dependent variable are reported in Table 7.2. The test indicates a moderate fit of the pre-defined types of drawings across all variables.

In addition to the CFA, Cronbach's alpha was calculated to further investigate the pre-defined groups of drawings for each variable. A coefficient of 0.70 or higher is often used as an indication of sufficient internal consistency (de Vaus, 2002; Nunnally, 1978). As Table 7.3 shows, only *frustration* did not meet this standard, with one alpha coefficient (perspective drawings) below .70. The other variables – *understandability*, *engagement*, *confidence,* and *abstraction* - show a moderate to high internal consistency for the pre-defined types of drawings.

Table 7.3
Cronbach's Alphas for Pre-defined Groups (n=497)

Type	# dwgs	Abstract-ion	Under-standing	Engage-ment	Frustr-ation	Confid-ence
Plan	6	0.79	0.78	0.81	0.77	0.83
Section	4	0.71	0.72	0.74	0.71	0.77
Perspective	4	0.76	0.74	0.74	0.65	0.76
Photorealistic	6	0.78	0.84	0.83	0.73	0.86

Due to the complexity of conducting multiple levels of analyses on so many variables, it was decided to focus efforts on four of the five main variables. *Frustration* was less critical to the study relative to the other variables, thus, it was excluded from further analysis.

Comparing experts' and laypeople's perceptions of drawing effectiveness

The main focus of the study was to compare experts' and laypeople's ratings of the effectiveness of different drawing types. Separate comparisons were conducted for understandability, engagement, confidence, and abstraction to assess differences between experts and laypeople for each of the drawing types. In addition, ratings by experts and laypeople were examined independently to determine how the drawing types compared to one another with respect to the outcome variables of understandability, engagement, and confidence, and perceptions of abstractness. An analysis also was conducted on the individual drawings within each drawing type to determine whether there were characteristics that make some drawings more effective than others even though they are included in the same category.

Statistically, these analyses need to take into account that each participant rated all drawing types. A linear mixed model procedure (SPSS Inc., 2009) was used to account for the repeated measure design. The repeated covariance type used in the analysis was compound symmetry. Bonferroni adjustments were made for multiple comparisons of the estimated means. The same statistical procedure permits examination of the drawings within each type.

Understandability

Comparing experts and laypeople for each drawing type

One might expect experts to indicate that they have a greater understanding of the design drawings since they have more experience working with these drawings. Results of this study indicated this was true for plans and sections, but not for the other drawing types.

The expert group found plans and sections to be more understandable than the layperson group found them to be (Table 7.4, Figure 7.6). These results are consistent with other studies that found laypeople have difficulty understanding 2-dimensional drawings (Lawrence, 1983, 1993; Mahdjoubi & Wiltshire, 2001; Pietsch, 2000). Envisioning a three-dimensional space from a 2-dimensional drawing can be challenging for people without design experience.

Perspective drawings and photorealistic drawings, however, did not follow this pattern. The two groups rated perspective drawings similarly on understandability. For photorealistic drawings, by contrast, understandability ratings by the layperson group were higher than by the expert group. Comments provided by some experts indicated confusion over what was being proposed and what was existing in the photorealistic drawings.

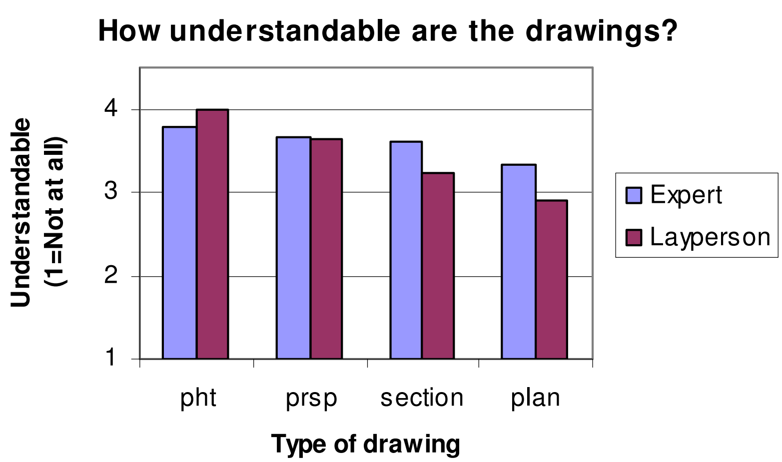


Figure 7.6 Experts' and laypeople's understandability by drawing type
(where pht = photorealistic; and prsp = perspective drawing)

Table 7.4 Mean Ratings of Understandability by Drawing Type				
Drawing type	**Group**	**N**	**Mean**	**Std. Dev.**
Photorealistic	Expert	91	3.79[a]	0.79
	Layperson	404	4.00[a]	0.75
Perspective	Expert	91	3.67	0.77
	Layperson	404	3.64	0.73
Section	Expert	91	3.60[b]	0.76
	Layperson	404	3.23[b]	0.81
Plan	Expert	91	3.34[b,c]	0.72
	Layperson	404	2.90[b]	0.71

[a]Indicates significant difference between experts and laypeople at p<.02.
[b] Indicates significant difference between experts and laypeople at p<.001.
[c] Experts' rating of plan drawings is significantly different than their rating for all other drawing types at p<.02.
Note: For laypeople, mean differences between drawing types are significant at p<.001 for all pairs.

The results suggest that experts and laypeople evaluate design drawings based on different goals or purposes for the drawings. Designers are trained to use drawings as a means of designing a setting and communicating how it will be built or implemented. Laypeople, on the other hand, use design drawings to envision the setting and imagine their experiences there. Therefore, laypeople found the detailed, realistic-looking images easy to understand as they tried to envision the setting, while experts found aspects of the drawings confusing from an implementation or design-build perspective. This interpretation is in line with Van Herzele's (2004) findings which found that laypeople frame and approach design problems differently than experts. This framing likely affects how they approach design drawings as well. The inferences they draw from the images and the assessment of the drawings' effectiveness appear to be driven by their goals and purposes for the design drawings.

The expert's perspective also may lead them to scrutinize photorealistic images more closely than laypeople do. Experts recognize that, although photorealistic images look real, they are only a representation and can omit information or enhance the setting. They will not be an exact match to what is to come. Knowing the limitations of these drawings, experts may be wary of photorealistic drawings. Laypeople, on the other hand, may be easily convinced by the realism of the drawing and not consider how the setting might be different once built.

There is some evidence from other studies, however, that even laypeople can be wary of photorealistic drawings. Bates Brkljac (2009) found that computer-generated images that seemed too perfect or embellished lost credibility. Photomontage drawings were deemed credible due to their lack of embellishment.

Comparing across drawing types for each level of expertise

The means shown in Table 7.4 (and Figure 7.6) also show differences between the two groups in terms of the relative ratings of the drawing types. For the experts, the range across the drawing types was only a half scale point (means between 3.3 and 3.8) and only plans were significantly different than the other types. Laypeople, on the other hand, perceived all drawing types to be significantly different from each other for understandability, and the range across the four drawing types was greater than a scale point (means between 2.9 and 4.0).

Comparing individual drawings within type for each level of expertise

Both participant groups rated individual examples within each drawing type differently, indicating that some instances are more understandable than others. For plan drawings in particular, experts were slightly less affected by individual drawings. They perceived more pairs of individual plans to be similar than laypeople did. However, experts' ratings of plans still varied substantially, ranging from 2.5 to 4.4, a difference of 1.9 compared to 2.3 for laypeople (Table 7.5). These findings indicate that experts, like laypeople, recognize that all plan drawings are not equal. Both experts and laypeople rated Plan S well above the rest and Plan R well below the rest for understandability.

One notable difference in the pattern of results for the two participant samples was found when comparing individual section drawings. Experts perceived Section A and Section T to be equally understandable, whereas laypeople did not. These drawings were of the same style and scale. The main difference was the color of the trees, which were pink in Section T and green in Section A. This finding suggests that experts' understandability likely was less affected by the unnatural colors of the trees than was laypeople's understandability.

Table 7.5
Mean Ratings of Understandability
PLANS

Drawing type	Group	N	Mean	Std. Dev.
Plan R	Expert	91	2.54	1.18
	Layperson	403	1.88	0.98
Plan A	Expert	91	3.00 [3,4]	1.13
	Layperson	403	2.82 [1]	1.01
Plan K	Expert	91	3.12 [4,6]	1.16
	Layperson	404	2.62	1.07
Plan M	Expert	91	3.35 [3,5,6]	1.06
	Layperson	403	3.01 [2]	1.15
Plan I	Expert	91	3.58 [5]	1.00
	Layperson	404	2.94 [1,2]	1.05
Plan S	Expert	91	4.42	0.84
	Layperson	404	4.14	0.98

Note:
--Mean differences between experts and laypeople are significant for all plan drawings (p<.03) except Plan A (p=0.1).
--For laypeople, mean differences for all pairs of plans are significant at p<.02 except those sharing the same numeric superscript of 1 or 2.
--For experts, mean differences for all pairs of plans are significant at p<.01 except pairs sharing the same numeric superscript of 3, 4, 5, or 6.

Engagement

Comparing experts and laypeople for each drawing type

Expert ratings were similar to those of laypeople for perspective drawings and photorealistic drawings, but experts rated plans and sections as more engaging than did laypeople (Table 7.6, Figure 7.7). This may be closely related to the fact that experts have an easier time interpreting plans and sections than do laypeople. As a result, these drawing types may hold the experts' attention longer as they find more to look at.

Comparing across drawing types for each level of expertise

In comparing drawing types, experts had the same pattern of responses as laypeople. Experts found photorealistic images as engaging as perspective drawings (p=1.00), and both of these drawing types were significantly more engaging than plans and sections (p<.001), the latter two types being another pair that was statistically equivalent (p=1.00) (Table 7.6, Figure 7.7).

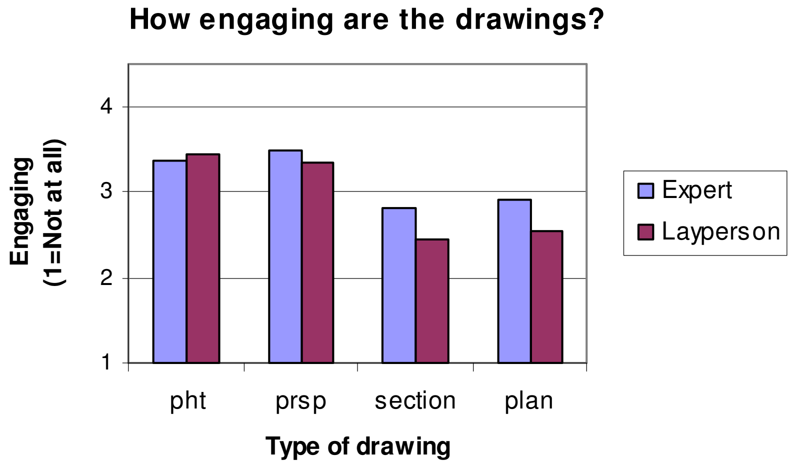


Figure 7.7 Experts' and laypeople's engagement by drawing type (where pht = photorealistic; and prsp = perspective drawing)

Table 7.6
Mean Ratings of Engagement by Drawing Type

Drawing type	Group	N	Mean	Std. Dev.
Photorealistic	Expert	91	3.36 [1]	0.82
	Layperson	404	3.44 [3]	0.82
Perspective	Expert	91	3.49 [1]	0.83
	Layperson	404	3.35 [3]	0.80
Section	Expert	91	2.82*[2]	0.93
	Layperson	404	2.44*[4]	0.83
Plan	Expert	91	2.90*[2]	0.82
	Layperson	404	2.55*[4]	0.84

*Indicates significant difference between experts and laypeople at $p<.001$.
Note: All pairs are significantly different at $p <.001$ except those sharing the same numeric superscript.

Comparing individual drawings within type for each level of expertise

As with understandability, experts' ratings were less variable within drawing type for plans, sections, and photorealistic drawings. Experts perceived more pairs of drawings within a type to be alike than laypeople did. For example, laypeople found Plan S significantly more engaging than the other plan drawings, whereas experts rated Plan S as engaging as three other plan drawings. Also, Plan R, which laypeople found significantly less engaging than all other drawings, was as engaging as Plan A for experts.

Confidence

Comparing experts and laypeople for each drawing type

One might expect experienced participants to indicate greater confidence in discussing the drawings with a landscape architect than do laypeople. As was true for the other dependent variables, results indicated that the effect of expertise on confidence depends on drawing type. Experts were more confident than laypeople in discussing plans and sections. However, the two groups were not significantly different in rating their confidence in discussing photorealistic and perspective drawings (Table 7.7, Figure 7.8).

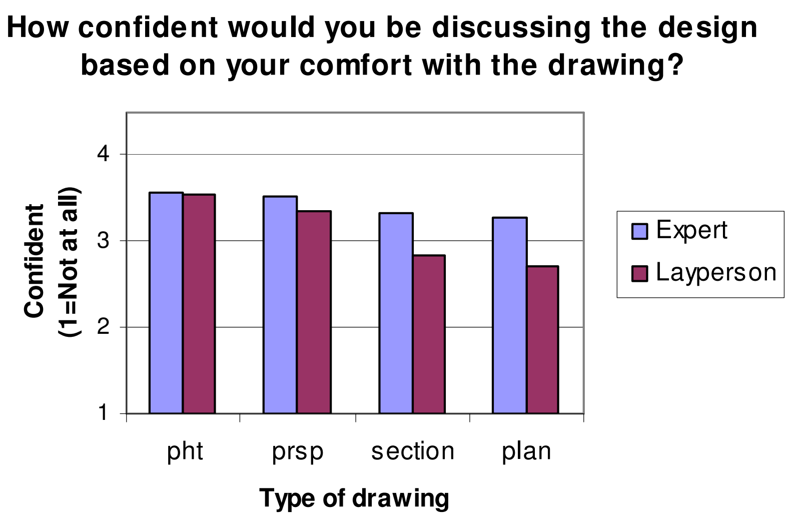


Figure 7.8 Experts' and laypeople's confidence by drawing type (where pht = photorealistic; and prsp = perspective)

Table 7.7
Mean Ratings of Confidence by Drawing Type

Drawing type	Group	N	Mean	Std. Dev.
Photorealistic	Expert	91	3.56 [1]	0.87
	Layperson	404	3.54	0.81
Perspective	Expert	91	3.52 [1,2]	0.80
	Layperson	404	3.35	0.78
Section	Expert	91	3.32*[2,3]	0.99
	Layperson	404	2.83*	0.82
Plan	Expert	91	3.29*[3]	0.86
	Layperson	404	2.71*	0.76

*Indicates significant difference between experts and laypeople at p<.001.
--For laypeople, mean differences for all pairs are significant at p<.05.
--For experts, mean differences for all pairs are significant at p<.05 except pairs sharing the same numeric superscript.

Comparing across drawing types for each level of expertise

When comparing drawing types, experts' confidence varied less than did laypeople's confidence across drawing types. Fewer significant differences were found between pairs of drawing types (Table 7.7, Figure 7.8). Experts rated both sections and plans lower on confidence than they did photorealistic drawings, and rated plans lower than they did perspective drawings. Otherwise, no significant differences were found for the remaining pairs of drawing types. By contrast, laypeople's confidence ratings were significantly different among all drawing types. Laypeople were most confident in discussing photorealistic drawings, followed by perspective drawings, sections, and then plans.

Comparing individual drawings within type for each level of expertise

There were also fewer significant differences within drawing type for experts than for laypeople. One notable finding was that Plan S was the only plan rated significantly different (higher) than the other plans, whereas, for laypeople, both Plan S (the highest) and Plan R (the lowest) were set apart from the rest.

Like laypeople, experts were as confident in discussing Section A as they were discussing Section M. However, experts were also equally confident in discussing Section A and Section T. These results are consistent with those found for understandability, thereby providing additional evidence that experts might not be as affected by unnatural colors of the trees as laypeople are.

Abstraction

In addition to the three main dependent variables, participants rated each drawing in terms of how abstract it was. Abstraction was defined as "lacking the concreteness found in real scenes." It was thought that there would be relatively little variability between participant groups, since abstraction can be considered an objective measure of the drawings.

Comparing experts and laypeople for each drawing type

Results revealed significant differences between the two group's perceptions of abstraction for two drawing types. Experts rated plan drawings less abstract than laypeople rated them (Table 7.8, Figure 7.9). These findings support the notion that experts can more easily visualize a setting depicted in a 2-dimensional drawing due to their experience with these drawings and the settings they represent. From a cognitive perspective, they have stronger connections between abstract and concrete concepts in their brain, making it easier for them to shift between the abstract features in the drawing and objects they represent in the world. As a result, they perceive the plan drawings to be less abstract than do laypeople.

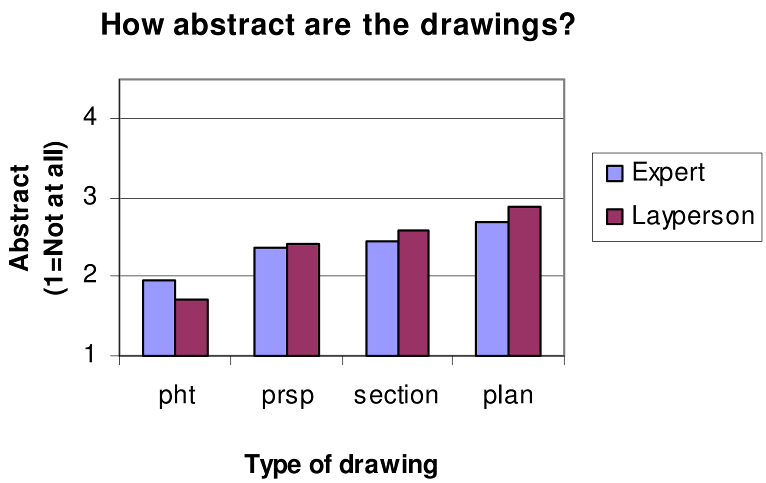


Figure 7.9 Experts' and laypeople's ratings of abstraction by drawing type (where pht = photorealistic; and prsp = perspective)

Table 7.8
Mean Ratings of Abstraction by Drawing Type

Drawing type	Group	N	Mean	Std. Dev.
Photorealistic	Expert	91	1.95*	.71
	Layperson	404	1.70*	.65
Perspective	Expert	91	2.37 [1]	.82
	Layperson	404	2.41	.84
Section	Expert	91	2.46 [1,2]	.83
	Layperson	404	2.58	.88
Plan	Expert	91	2.69* [2]	.81
	Layperson	404	2.89*	.87

*Indicates significant difference between experts and laypeople at p<.03.
--For laypeople, mean differences between drawing types are significant at p<.001 for all pairs.
--For experts, mean differences between drawing types are significant at p<.005 for all pairs except those sharing the same numeric superscript.

Experts also differed from laypeople in their ratings of abstractness of the photorealistic drawings. In this case, however, they rated the drawings as more abstract than laypeople. A possible explanation for this pattern would be the difference in how experts and laypeople approach design drawings based on their underlying goals. Experts view drawings as a means for communicating how a setting will be built, which might lead them to place greater emphasis on the relationship between the representation and the constructed setting. Further, given their experience with drawings, it may seem obvious when a drawing is embellished or altered through artistic expression. As a result, experts might consider photorealistic drawings to be less like reality than laypeople rate them.

Comparing across drawing types for each level of expertise

There was considerable variability in how abstract the drawing types seemed to be for both participant groups. However, experts perceived more drawing types to be similar to one another than laypeople perceived them to be (Table 7.8, Figure 7.9). Photorealistic drawings were the least abstract of all types. Experts perceived perspective drawings and sections to be equally abstract, as well as sections and plans.

Laypeople, on the other hand, rated all four types to be significantly different on abstraction. They perceived plan drawings to be the most abstract of the four drawing types with a mean of 2.9, almost at mid-scale on a five point scale. They rated photorealistic drawings least abstract, followed by perspective drawings, then sections.

Discussion

The main focus of this study was to determine how experts' and laypeople's perceptions differ on the effectiveness of design drawings. Two major themes emerged from the findings.

Expertise and drawing type matter.

This study provides additional evidence of the role expertise plays in perception. The findings indicate that experts view three of the four drawing types differently than do laypeople. For plans and sections – the drawing types that laypeople find most difficult to understand – experts were more likely to say they are understandable and engaging. Experts also felt they would be more comfortable discussing plans and sections than do laypeople. Their experience with 2-dimensional design drawings allows them to create rich mental representations of the setting, which laypeople likely find difficult.

With respect to photorealistic drawings, by contrast, experts indicate lower understandability and higher rating of abstractness than do laypeople. Experts' confusion seems to relate to the implementation of the drawing, or how the setting will be constructed or built. They also seem to recognize the limitations of these drawings; they know the constructed setting will differ in some respects from the setting depicted in the photorealistic drawings. Laypeople, on the other hand, appear to evaluate drawings based on their goal of envisioning the setting. The results suggest that laypeople approach design problems *and* design drawings differently than do experts. Laypeople and experts use drawings for different purposes, and interpret and evaluate the drawings in light of their goals.

The two groups also showed substantial differences in the variability of the ratings across drawing types. For experts, the range was considerably less than for laypeople. For understandability, confidence, and abstraction, the range in ratings across drawing types for experts was approximately half a point less than that for laypeople (Table 7.9). Also, more similarities within drawing type (i.e., comparing individual plan drawings) were reported by the experts. In other words, with respect to the dependent variables assessed in this study, experts found the drawings to be more similar to one another than laypeople perceived them to be. This too may be attributed to the experts' experience and skill in creating and interpreting all types of design drawings.

Table 7.9
Summary of Mean Ratings by Type and Expertise

Type	**Understanding**		**Engaging**		**Confidence**		**Abstract**	
	Expert	**Lay-person**	**Expert**	**Lay-person**	**Expert**	**Lay-person**	**Expert**	**Lay-person**
Photor.	3.79^	4.00^	3.36	3.44	3.56	3.54	1.95^	1.70^
Persp.	3.67	3.64	3.49	3.35	3.52	3.35	2.37	2.41
Section	3.59*	3.23*	2.82*	2.44*	3.32*	2.83*	2.46	2.58
Plan	3.34*	2.90*	2.90*	2.55*	3.29*	2.71*	2.69^	2.89^
Range	*0.45*	*1.10*	*0.67*	*1.00*	*0.27*	*0.83*	*0.74*	*1.19*

*Indicates significant difference between experts and laypeople at $p<.001$.
^ Indicates significant difference between experts and laypeople at $p<.03$.

Simplicity, coherence, and scale can enhance understandability of plans for both experts and laypeople.

Plans were lowest in understandability for both groups. At the same time, however, both experts and laypeople do not consider all plans to be equal. The range of ratings for plan drawings was close to the same – 1.9 for experts and 2.2 for laypeople. The most understandable plan (Plan S) was the same for both groups. In fact, experts rated this plan most understandable of all twenty drawings. It is neat, coherent, and simple in its representation of nature. The design is very linear with distinct edges, rows, and columns. Different areas of the park are easily distinguishable, and the spatial relationships among the elements are clear. Trees are represented with simple circles of the same color and size.

In contrast, Plan R, the lowest-rated plan for both groups, depicts the largest area in all of the drawings – a 363 acre park. The features in the drawing are very small and detailed. The scale is zoomed out so far that it likely was difficult for participants to know what they were looking at.

Conclusion

Design drawings can be powerful tools for helping people envision how a proposed landscape will look in the future. When they are understandable and engaging to the participants, they can stimulate discussion and provide useful feedback to the designer. However, knowing what is understandable and engaging to laypeople can be difficult for experts to predict, since their expertise prevents them from seeing things the way laypeople do. This study describes differences between experts and laypeople regarding the perceived effectiveness of different drawing types. However, while it investigates the individual perceptions of experts and laypeople, it does not address the designers' perception of how they think laypeople would rate the drawings. Such a study - one that tests designers' assumptions by comparing the expectations of the designers to the actual perceptions of laypeople - would be worthwhile, but must await future research.

It should be noted that the expertise group used in the study is self-designated by virtue of their answers to two questions regarding their level of experience with landscape architecture drawings and computer-generated drawings.

Beyond these measures, the extent of their design expertise or practice is not known.

Research that offers insight on how designers' perceptions differ from laypeople's perceptions is useful for a number of reasons. It can introduce a new way of looking at participants' behavior. This can help designers feel that they *can* make a difference in participatory situations where they otherwise might feel powerless. By being able to better interpret participants' comments (or silence), designers can alter their communication strategies accordingly or try different methods of inviting feedback.

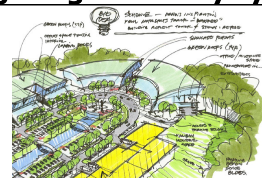
Designers' success in effectively sharing their design ideas with laypeople depends heavily on their assessment of where their audience is at in terms of design experience and skills. This knowledge is crucial in choosing appropriate terminology, examples, and visual media. The findings from this study might surprise designers or confirm their hunches. In either case, it provides crucial information to support the designers' need for testing their assumptions and creating accurate mental models of their audience and design drawings. People have a strong motivation to test their mental models or understanding of the way things work. The importance of these mental models cannot be overemphasized, since it is on these models that our thoughts and actions are based (S. Kaplan & Kaplan, 1982).

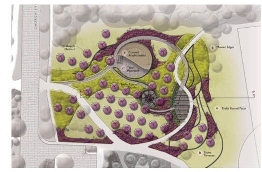
Helping designers know their audience can increase their confidence in seeking feedback and interacting with participants. Combined with mutual respect, this confidence and knowledge can lead to a more fruitful and enjoyable participation process for both the designer and participant. Designers *can* make a difference in creating an environment in which people feel competent and eager to participate.

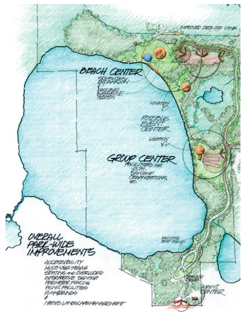
Appendix 7.A
Design drawings organized by type*

PLANS


Plan A


Plan K

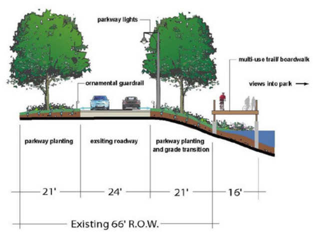

Plan M

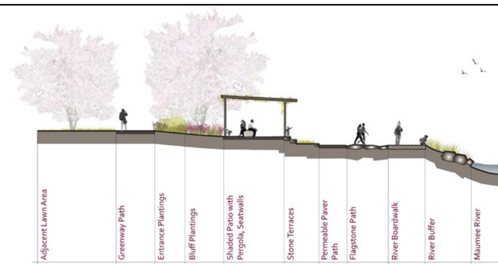

Plan I


Plan S

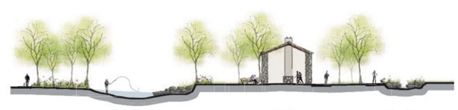

Plan R

SECTIONS

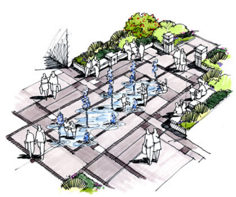

Section M


Section T


Section Y


Section A

PERSPECTIVE DRAWINGS


Perspective F


Perspective T


Perspective J


Perspective P

PHOTOREALISTIC DRAWINGS


Photorealistic L


Photorealistic B


Photorealistic C


Photorealistic F


Photorealistic R


Photorealistic W

* Names of the drawings were derived from the original names provided by the designers.

CHAPTER 8

EVIDENCE-BASED APPROACHES TO PARTICIPATION IN DESIGN

As part of the design process, designers seek input on their ideas from the people for whom they are creating the design. Input may be sought at various stages of the process and in a variety of formats. While public meetings may be the most visible venue, the input process is perhaps most often achieved with a small group of people representing the client. In these contexts there may be considerable exchange of ideas often over an extended time. When the input of a larger group of participants, be it potential users of the future place or public citizens, is sought, participation calls for different approaches. These require the designer to communicate design ideas to a large group and get their feedback in a relatively short amount of time, possibly without any face-to-face exchange.

In such cases where larger scale participation is desired and there are fewer or no opportunities for one-on-one discussions, it is even more critical that the methods chosen to communicate the design ideas and acquire feedback are easy for laypeople to understand. It also is important that these methods engage participants and encourage participation with little guidance from the designer. This is a tall order, particularly since little is known about the effectiveness of participatory approaches from the layperson's perspective (Chapter 5). The research presented in the current chapter addressed this need. The chapter describes a guiding framework, Kaplan and Kaplan's (2009) Reasonable Person Model (RPM), for evaluating participatory approaches from the participants' perspective. It then presents findings from three studies that used RPM as a framework to evaluate a variety of participatory approaches. Finally, it describes implications of the studies' findings for designers, participants, educators, and researchers in terms of the main components of RPM.

Three studies were carried out to test the effectiveness of a variety of participatory approaches in terms of the layperson's understanding of design options, engagement in the process, and sense of meaningful participation. The first two studies evaluated two participatory approaches, the design session and the photoquestionnaire, in the context of a design project for nature trails at a medical campus in the Midwestern U.S. The third study was a systematic investigation of the effectiveness of different types of design drawings traditionally used by designers to communicate design ideas.

In all three studies, the design projects represented small-scale nature settings, such as parks, nature trails, and outdoor seating areas. While the visualization of larger-scale planning or architecture projects may present different challenges, many of the findings from this research can be applied to participation in these contexts as well. Also, although the focus of the research is on large-scale participation, some of the findings will benefit communications between designers and participant groups of all sizes, including one-on-one interactions with a client.

At the same time, the studies contribute to environmental psychology research intended to learn more about the kinds of environments that bring out the best in people. A theory of these supportive environments is provided in Kaplan and Kaplan's Reasonable Person Model (RPM) (S. Kaplan & Kaplan, 2003; 2009). It emphasizes the important role that information and the environment play in people's behavior. While the model, described in more detail in the next section, has been supported by anecdotal evidence and makes intuitive sense, it has never been tested empirically. This research presents an application of RPM and tests the predictions of the model in the context of participation in design. The evaluation criteria chosen in the study are derived from the three main components of the model, thereby allowing the relationships predicted by RPM to be tested.

Background

Approaches to participation in design

The most common approach to large-scale participation in design is an information session or public meeting with a design presentation and comment period. A great deal has been written about the shortcomings of this approach (Baker, Addams, & Davis, 2005; Brody, et al., 2003; Irvin & Stansbury, 2004; R.

Kaplan, et al., 1998; King, Feltey, & Susel, 1998). There is also an extensive literature on other methods for incorporating participation in design. Many of these are available from the International Association of Public Participation (2006), which not only provides a long list of ways to seek feedback, but also examines ways in which they can go right or wrong. In addition, Sanoff (2000) provides an in depth discussion of participatory approaches, including design workshops or charettes, walking tours, surveys, game simulation, and interactive computer programs simulating the site. Other less common approaches such as the photoquestionnaire have been used with great success in landscape planning and design (R. Kaplan, 1977, 1993; S. Kaplan & Kaplan, 1989; Ryan, 2002, 2006).

Benefits of large-scale participation

Attempts to gather feedback from a wide range of potential users can have important benefits during the design process. Providing opportunities to participate can increase people's cooperation in the project, since people greatly appreciate being asked for their input in design projects that affect them (S. Kaplan & Kaplan, 1978, 1982). It also can help decrease people's anxiety about anticipated changes by reducing some of the unknowns and offering them an opportunity to share their views (Carpman & Grant, 1993).

There are also a number of potential long-term benefits of participation. First, by taking their concerns and preferences into account, the final design is likely to better meet the needs of potential users and increase the likelihood that they will use the outdoor setting. Also, user involvement can increase participants' sense of ownership, possibly leading to their serving as volunteer stewards of the setting after its completion (Phalen, 2009). Thus, participation can improve the design of the setting and promote its long-term use and maintenance. Finally, participation can create a sense of community by bringing together people who may not normally work together to solve a common problem. This can open the lines of communication and provide opportunities to discuss organizational policies and other issues (Carpman & Grant, 1993). These personal relationships could last long after the design process is over.

A successful participatory process benefits the designer as well. First, user participation can introduce new ways of thinking about a design problem, thereby expanding designers' problem-solving skills (R. Kaplan, et al., 1998). Also, positive feedback and recognition from participants for a job well done can increase designers' confidence and satisfaction in their work. Everyone can relate to the positive feelings that come with doing something well and meaningful.

While including user participation in the design process is likely to require some additional effort, the added benefits of participation can far outweigh the costs. In fact, not including users could be more costly, time-consuming, and emotionally fatiguing in the end. An uninformed and unsupported design can result in project delays, requests for changes during or after construction, and lost productivity for users of the setting (Carpman & Grant, 1993; Dewulf & van Meel, 2002).

Guiding framework: The Reasonable Person Model

Despite the touted benefits of large-scale participation, there are times when the participation process fails. Designers may walk away from the process with little information about people's preferences or useful feedback about the design. Participants may feel frustrated if their concerns were not heard or their input did not seem valued. Experiences such as these can lead designers and participants to dread or avoid such participation processes in the future.

There are a number of reasons to believe that the choice of methods used to acquire user input matters. Besides anecdotal evidence, theories in environmental psychology can help explain why some participation processes are more successful than others. The Reasonable Person Model (RPM) provides a framework for evaluating participatory approaches and understanding participants' behavior. It also can be used by designers to guide their choices in how to facilitate a participation process that fosters information exchange and meaningful participation.

RPM emphasizes the importance of meeting three innate human needs in an effort to promote reasonable behavior.

Mental model building refers to people's strong motivation to understand how the world works so they can function effectively in it. The knowledge structures in their brain, called "mental models," are developed over time through many, varied experiences. They are critical in everyday functioning; they are used in making decisions, predicting what might happen next, and choosing how to act (S. Kaplan & Kaplan, 1982). People are highly motivated to test and expand their mental models, which change slowly over time to match their experiences in the world. Providing opportunities for understanding and exploration is critical in supporting mental model building.

Being effective addresses the satisfaction people receive when they can share their knowledge and use their skills effectively. It encompasses the importance of building competence and maintaining mental clarity to achieve one's goals. Attention, or being able to mentally concentrate, plays a crucial role in achieving clear-headedness. Recognizing that people's attention is limited and susceptible to fatigue has important implications for information-sharing. Also, knowing what people find fascinating and engaging can reduce the demand on attention and promote clear-headedness.

Meaningful Action refers to people's innate desire to participate in something meaningful and to make a difference. Gaining the respect of others and being heard are key ingredients in feeling that one's actions or participation is meaningful.

The three components were conceived as being interrelated rather than stand-alone concepts (S. Kaplan & Kaplan, 2003, 2009). For example, an approach that allows one to explore different design options can both enhance model building and engage participants, making it easier to concentrate on the task at hand. Also, participants' ability to provide their input will rely heavily on their ability to build a mental model of the design problem and visualize design possibilities.

Overview of the studies

Study 1 (Chapters 2 and 3): The first study evaluates a design session conducted early in the design process and involving a relatively small group of participants (n=28 employees). Landscape design students presented three design ideas for a proposed nature trail system at a medical campus using PowerPoint slides and a combination of different visual graphics. The approach also included a survey for participants to rate their preferences for the three design ideas and a photoquestionnaire where they rated preference for 16 scenes (see also Study 2). In addition, the participants also rated a number of items measuring the effectiveness of the design presentations and the photoquestionnaire as methods for gathering their input. The evaluation items represented three main dependent variables: understandability, engagement, and sense of participation.

Study 2 (Chapter 4): The second study evaluates a widely-distributed photoquestionnaire used to gain feedback on the same proposed nature trail project in Study 1. Sixteen full color photographs represented a variety of options for the nature trails, including paths of various widths and materials, man-made bridges, seating arrangements, and scenic views. Participants rated the photographs in terms of how much they liked the design option shown and had the opportunity to provide additional comments in the space provided on the survey. They also assessed the photoquestionnaire as a method for gathering their input using the same evaluation ratings described in Study 1. The study involved 154 participants, including employees, patients, and visitors of the medical centers on campus.

Study 3 (Chapters 5, 6 and 7): The third study, based on an online survey, used a systematic approach to test the effectiveness of four types of traditional design drawings: plans, sections, perspective drawings, and photorealistic drawings. The drawings represented a variety of small-scale nature projects that had already been completed. All drawings were presented in full color and in approximately the same size. Participants were asked to rate the drawings in terms of how understandable, engaging, and abstract they were. They also rated how confident they would be discussing the design with the landscape architect based on their comfort with the drawing. The results are based on responses from 404 people with little to no experience in design drawings or computer-generated drawings (Chapter 6). Their responses were compared to those of 91 participants who indicated having quite a bit to a lot of experience with design drawings or computer-generated drawings (Chapter 7).

Comparisons were analyzed using a linear mixed model procedure to account for the repeated measure design. The repeated covariance type used in the analysis was compound symmetry. Bonferroni adjustments were made for multiple comparisons of the estimated means. Items used to measure the dependent variables were tested for internal consistency using Cronbach's alpha coefficients and factor analyses. Relationships between the dependent variables were analyzed using bivariate correlation coefficients.

Dependent variables

The three main dependent variables across all three studies were understandability, engagement, and participation.

- **Understandability** addressed the participants' perceived understandability of the drawing or design option presented. A person with a good understanding of the proposed nature setting would be able to make sense of the visual graphics and the kinds of places they depict. They would be able to envision it from multiple perspectives, imagine movement through the setting, and have a sense of what it would be like to be there. In the first two studies, understandability also encompassed the knowledge gained regarding the range of design possibilities.

- **Engagement** refers to the extent to which the participatory design approach or drawings held the participants' attention. In the first two studies, it also included the ability to explore design possibilities and whether the material was relevant to their interests and concerns.

- **Participation** refers to the participants' perception of the ease in providing their input and their appreciation of being asked. Participation is more likely perceived as meaningful when participants feel their concerns were heard, their input was needed, and their participation made a difference. In the third study, participation was measured in terms of the participant's confidence in being able to discuss the design with the landscape architect based on their comfort with the drawing, if given the opportunity.

Results

Study 1: Design presentations (Chapter 2)

Participants generally found the three design presentations to be understandable and engaging and to promote meaningful participation, as indicated by the range of mean ratings from 4.0 to 4.5 on a five point scale (from 1, "not at all," to 5, "very well.") No differences were found among the presentations for engagement or participation. However, a significant difference was found between the most and least understandable presentation. A comparison of these presentations reveals the important role that presentation format, organization, and graphics play in understandability. The most understandable presentation was also the one with the fewest number of slides, each containing only three or four short bullet points. The least understandable presentation, on the other hand, included a great deal of information on each slide. The small font size and style of the text on some of the slides made it difficult to read. Also, in the most understandable presentation, less emphasis was placed on drawings with a plan view.

Study 2: Photoquestionnaire (Chapter 4, also see Chapter 2)

Participants found the photoquestionnaire to be an effective tool for providing their input on the design options. The task of rating the photographs was engaging and easy to do, and they had no trouble visualizing the settings depicted in the photographs. The photoquestionnaire particularly excelled in promoting meaningful participation. The items related to the participants' sense of participation had the highest mean ratings of all items. Participants appreciated being asked for their input and found it easy to provide their input. Also, the photoquestionnaire was successful in reaching a greater number and more representative group of potential users than the design sessions.

The photoquestionnaire was slightly less effective in providing a sense of the bigger picture of design possibilities. Participants' ratings for the ability to explore different design possibilities and their awareness of the range of choices were slightly lower at 3.8 and 3.9 on a 5-point scale (from 1, "not at all" to 5, "very well"). Also, the photoquestionnaire performed the lowest (3.76) on its relevance to the participants' concerns. It may have been difficult for participants to imagine that rating photographs could reveal their concerns and preferences. Being heard is an important component of meaningful action. Thus, providing opportunities for participants to express their concerns, possibly in a more traditional manner than rating photographs, may be needed in order for participants to gain the sense that they have been heard.

Items used to measure the RPM domains (Chapter 2, 4)

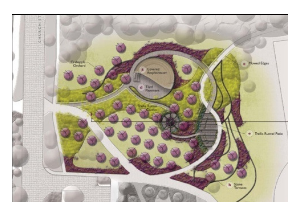
In the first two studies, tests of internal consistency were performed on the survey items used to measure the components of RPM as they related to the goals of this research. The measures for understandability and engagement performed quite well. On the other hand, the items used to measure participation were less reliable, thus, these items were analyzed independently. This may be due in part to the fact that there were fewer items (2-3) for participation than for understandability and engagement. Also, regarding the photoquestionnaire in the first study, participants may have found the wording of one of the items to be awkward. They may have had difficulty imagining the photoquestionnaire was capturing their comments. Research on RPM would benefit from exploration of other ways to operationalize or measure the components of the Reasonable Person Model.

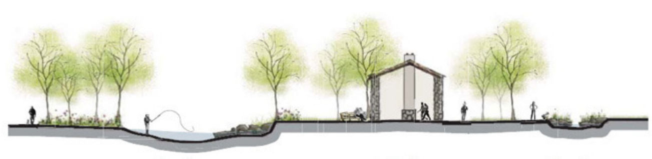
Study 3: Comparison of design drawings (Chapters 6 and 7)

The third study evaluated the effectiveness of four types of drawings: photorealistic drawings, perspective drawings, plans, and sections, with four to six examples of each (Figure 8.1). Mean ratings were based on a 5-point scale (from 1, "not at all" to 5, "very much"). Findings revealed laypeople generally found plans and sections less understandable and engaging than perspective drawings and photorealistic drawings (Table 8.1). Participants also indicated they would be less confident discussing the designs depicted in plans and sections if given the opportunity.


Photorealistic Drawing


Perspective Drawing


Plan



Section

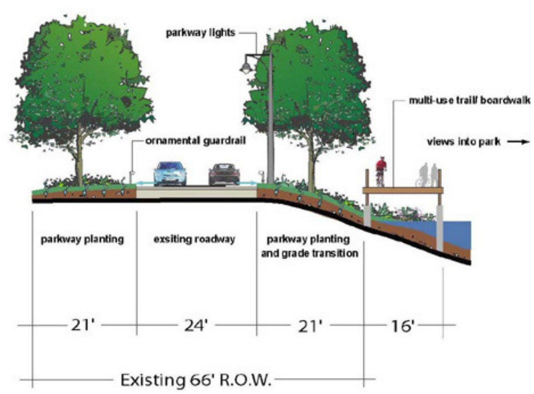
Figure 8.1 Examples of the four drawing types analyzed in the third study

Table 8.1 **Laypeople's Mean Ratings by Drawing Type (n=404)**						
	Understandability		**Engagement**		**Confidence**	
Drawing	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Photorealistic	4.00	0.75	3.44 [1]	0.82	3.54	0.81
Perspective	3.64	0.73	3.35 [1]	0.80	3.35	0.78
Sections	3.23	0.81	2.44 [2]	0.83	2.83 [a]	0.82
Plans	2.90	0.71	2.55 [2]	0.84	2.71 [a]	0.76

Mean ratings are based on a 5-point scale (from 1, "not at all" to 5, "very much".)
Mean differences between types are significant at $p<.001$ for all pairs within a variable except:
--the pair marked with an alphabetic superscript, which is significant at $p<.05$ ($p=.039$);
--pairs sharing the same numeric superscript, which are NOT significant at $p<.05$ where (1) $p=.217$; (2) $p=.093$.

However, an in-depth analysis of individual drawings revealed several instances where plans and sections did quite well (Figure 8.2). One plan drawing, in particular, was rated highly among all drawings and well above the rest of the plans for all measures of effectiveness. This was true for participants with design experience as well as participants without this experience.

Plan (mean = 4.1)



Section (mean = 3.8)

Figure 8.2 Plan and section drawings rated highly in understandability

What set these plans and sections apart from the rest? The findings provide useful insight into the characteristics that contribute to a drawing's effectiveness. Five key aspects emerged from the findings.

1. Amount of information in the drawing

The mean ratings for understandability for four of the six plans were below 3.0 on a five point scale. These drawings were highly detailed with relatively small features. The two lowest rated plan drawings were described by participants as being too messy or busy. One of these plans was the lowest rated drawing of all twenty drawings; it was characterized by many tiny features that participants seemed to have trouble interpreting. Results indicate that using many and/or very small features to represent different characteristics or details of a setting can reduce understandability. Too much detail can be overwhelming to the layperson, making it difficult to grasp what the details represent.

The most understandable plan was of a site less than two acres (left drawing in Figure 8.2), and the least understandable drawing was a plan representing the largest acreage at 363 acres (Figure 8.3). However, the other four plan drawings, which represented settings at small, mid-, and large-scales, performed equally well on understandability. Therefore, scale alone does not seem to be a determining factor for understandability. Understandability of plans seems to relate more to the amount of information or detail shown or to the size of the features in the drawing itself rather than to the scale of the actual site being depicted. For instance, a close view of a small area could be as effective as using simplified, large features to depict elements of a much larger scale setting.

Figure 8.3 Least understandable drawing (mean=1.9)

2. Simplicity in representation

Numerous findings from the third study lead to the conclusion that simplicity can enhance understandability and confidence in discussing the design. First, while most plans were low in understandability, the plan drawing that received the highest rating on understandability (Figure 8.2, left) differed in a number of respects. It used simple circles of a consistent size and color to represent the trees, organized neatly into rows and columns. The section drawing that fared quite well on understandability (Figure 8.2, right) was described as being "simple" and "straightforward." Although limited to 2-dimensions, it had easily identifiable features and seemed to provide an adequate level of detail.

Results from the analysis investigating the role of abstraction in a drawing's effectiveness also point to the importance of simplicity. While more abstract drawings were generally more difficult to understand than less abstract drawings, a closer examination of individual drawings revealed cases where more abstract drawings performed better than less abstract drawings. For example, one plan drawing, ranked fourth overall on understandability, was rated more abstract than half of the other drawings. Simplicity and coherence were major factors in explaining the success of this drawing. Also, the correlation coefficients between abstraction and the effectiveness variables, while significant, were relatively low, ranging from -.24 to -.49 across drawing types. Thus, the relationship between level of abstraction and effectiveness may be weaker than expected.

Finally, abstractness with respect to representing people in a drawing also deserves discussion. Both the ratings and comments participants provided suggest some differences in opinions regarding the effectiveness of the different methods used to represent people. There is some indication that using abstract representations of people can be as effective as using photographs. With respect to understandability, some drawings with simple outlines of people (Figure 8.4, left and middle) performed as well as black and white photographs of people superimposed into a color scene (Figure 8.4, right). Drawings with people presented in full color,

Mean understandability = 3.81

Mean understandability = 3.80

Mean understandability = 3.71

Figure 8.4 Examples of drawings with people represented.

however, seemed most effective for understandability. Some people found the white silhouettes helpful since they could imagine themselves there. Others found the silhouettes "ghostly" or "strange."

The analysis of individual drawings within type revealed important observations about the effectiveness of simple, abstract drawings. However, since these observations are based on a few key drawings, another study that includes a greater number of simple, abstract drawings would be useful in further investigating the role that simplicity and abstraction play in understandability. It also could shed more light on what contributed to these drawings' effectiveness in this study.

3. Coherence and legibility

A design drawing is coherent when one can distinguish areas or features of the setting and understand the spatial relationships among them. The elements in a coherent drawing seem to fit together well. Legibility refers to the ability to read any writing or labels in the drawing and identify the features in the setting. In terms of a legible environment, it also can be defined as having clear paths, landmarks, and other features that enhance one's ability to find their way through the setting.

The results of this study indicate that both coherence and legibility are important factors in enhancing understandability. In general, the most understandable drawings had clear paths and easily identifiable features. Areas within the pictured setting could easily be distinguished from one another through the use of distinct edges or colors. The most striking difference in coherence was between the most and least understandable plan drawing (Figure 8.2 and Figure 8.3).

Some of the plan drawings had stylized handwriting that some viewers found to be illegible. Otherwise, the text labeling features of the design seems to help participants understand the drawings, according to their comments.

4. Using colors consistent with common perceptions

Based on the responses of participants with little design experience, plan drawings and sections that used colors consistent with common perceptions fared better than those that did not. Drawings depicting green trees (e.g., plan drawing in

Figure 8.2) were more understandable than those with pink trees (e.g., plan drawing in Figure 8.1). According to comments, some participants also had trouble with the combination of black and white photographs and color scenes. The results indicate that color accuracy in representing nature features and overall consistency in the use of color within a drawing can enhance laypeople's understanding of drawings.

5. Complexity

While the previous issues were particularly pertinent with respect to understandability, complexity appears to be an important factor for engagement. Complexity refers to variations in the colors, textures, and patterns in a drawing, which could represent the diversity of plants, landscapes, and natural features. In this study, drawings with a full spectrum of vibrant colors were more engaging than drawings dominated by light colors such as pastels or grays.

However, results from this study also suggest that maintaining a balance between coherence and complexity is an important factor in how understandable and engaging a drawing is. Providing complexity by using a variety of patterns and colors to represent different textures, vegetation, and materials can enhance engagement, as indicated by the top rated drawings on engagement which included mostly photorealistic and perspective drawings. At the same time, too much information can overwhelm participants. Many of the lowest rated drawings for understandability were complex in terms of the number of features depicted and the patterns used. They were described by participants as being too messy or busy. Thus, coherently organizing the drawing into distinct regions or elements, as a means of handling increased complexity, is key to creating an understandable and engaging drawing.

Interrelationships among the RPM domains (Chapters 3 and 6)

Relationships among the components of RPM were tested in two of the three studies. In the context of design presentations, the relationship between understandability and engagement was strong across all presentations, whereas the relationship between participation and the other two variables were more variable (Table 8.2). Findings indicated that for presentations that were generally well understood, a small amount of difficulty understanding the presentation did not seem to affect the participants' sense of participation. All of the presentations used the same approach for gathering input -- verbal comment period, preference ratings on survey, and space for comments on the survey. The results suggest that multiple avenues for people to ask questions and provide their input may reduce the negative effects of confusion on participation.

Table 8.2
Relationships Among the Variables by Presentation: Correlation Coefficients

Design Presentation	Understandability x Engagement	Participation x Understandability	Participation x Engagement
E	0.77	0.36[1]	0.56
S	0.80	0.72	0.73
W	0.74	0.49	0.60

Correlations are significant at p<.01 for all except the one marked with a numeric superscript, which was not significant at p<.05.

The third study provides evidence that understandability, engagement, and confidence discussing the design are strongly related in the context of evaluating the effectiveness of drawings. As shown in Table 8.3, correlation coefficients across variables and drawing types range from 0.64 to 0.80. In the context of this study, the relationship between confidence and understandability was strongest for all drawing types. In other words, being able to make sense of the drawing was highly related to feeling confident in being able to discuss the drawing with the designer.

Table 8.3
Relationships Among the Variables by Drawing Type: Correlation Coefficients

	Understandability x Engagement	Confidence x Understandability	Confidence x Engagement
Photorealistic	0.67	0.76	0.71
Plans	0.76	0.80	0.76
Perspectives	0.73	0.78	0.74
Sections	0.64	0.78	0.70

All correlations are significant at p<.01.

The relationship between understandability and engagement was weaker relative to the other relationships, but was still fairly strong. For example, some section drawings were considered understandable but not as engaging relative to the other drawings. The opposite was found for photorealistic drawings in some cases. Some of these drawings ranked better for engagement than understandability. The results indicate that drawings that capture the audience's attention can fall short on understandability. In addition, plans and sections that are relatively effective in communicating design ideas can be considered quite boring. In other words, engagement and understandability did not always go hand in hand for drawings. Additional studies that explore this relationship could be useful in determining situations in which this might be the case.

Towards creating a people-friendly participation process

A main goal of this research is to provide insight into ways in which designers can create a people-friendly participation process. The Reasonable Person Model (RPM) has been recommended as a conceptual framework to guide designers' decisions in facilitating the participation process. However, the likelihood designers will use the model is slim if they are unfamiliar with it. This section aims to provide additional imagery of RPM by describing the usefulness of the studies' findings in terms of the three components of RPM - mental model building, being effective, and meaningful action. Each component is considered from the perspectives of both the designer and participant.

Enhancing mental model-building

Participants' mental models

In order to provide useful feedback in the participation process, participants must be able to visualize design alternatives and explore the range of design possibilities. Consequently, the material provided by designers must enable participants to build mental models of the design options so they can consider them in light of their needs and concerns, be able to anticipate what might happen there (e.g., potential uses, maintenance), and express their preferences. Before these studies, little was known about the effectiveness of different types of drawings and participatory approaches from the participants' perspective (Chapter 5). The studies contribute to filling this research gap, thereby revealing a number of ways in which designers can help participants visualize alternative design options.

Designers' mental models

In the context of gaining useful feedback from potential users and citizens, designers need to build their own mental models of design graphics, participation approaches, and the ways participants approach the task. Knowing the available tools and their appropriateness to a given situation is critical to making the process effective and insightful. This research provides valuable information for designers to test their assumptions and adapt their mental models as needed to better match reality.

1. Design drawings

Designers' mental models of design drawings are formed through years of training and experience. They have learned the purpose of different types of design drawings and the time and effort required in creating them. Their drawings are easily understood by others who share their training. However, communicating with laypeople may require different considerations. While many designers trust that their drawings effectively communicate, they rarely have the opportunity to test the effectiveness of design drawings from the layperson's perspective. Three assumptions related to design drawings are tested in this research; the results might be surprising to some designers.

Assumption #1:

Designers and researchers generally believe that plans and sections are harder for laypeople to understand than perspective drawings and photorealistic drawings (Lawrence, 1983, 1993; Mahdjoubi & Wiltshire, 2001; Pietsch, 2000). While the third study confirmed this assumption, it also demonstrated that there is more to the story (Chapter 6). Plans and section drawings were found to communicate design ideas quite well, and even better than perspective drawings and photorealistic drawings, if they meet certain criteria. The ones that participants found understandable were simple, neat, coherent, legible, and matched common perceptions. (Please see Results section above and Chapter 6.)

Results from the first study suggest that sketches may not be as readily understood by laypeople as by fellow designers (Chapter 2). Furthermore, an emphasis on plan drawings, which are critical for design and construction, may be less effective than other drawings in presentations to help laypeople visualize the setting. The third study points to the usefulness of photorealistic and perspective drawings in helping people visualize the setting (Chapters 6 and 7).

Assumption #2:

Abstraction is believed to play an important role in how effective a drawing is (Bates-Brkljac, 2009; Pietsch, 2000). Many researchers are interested in determining the appropriate level of realism, or how close drawings need to be to the real setting, for people to be able to effectively judge the design (Chapter 5). Some researchers believe drawings should strive to match the real setting as closely as possible, and that abstraction leads to inaccuracies in a drawing and subsequent assessment (Appleyard, 1977; Sheppard, 1989). Other researchers contend that abstraction, or simplification in the representation of a setting, can enhance understandability (S. Kaplan & Kaplan, 1982; Pietsch, 2000).

Results from the third study indicate that the relationship between abstraction and effectiveness is weaker than researchers may have expected (Chapter 6). There was a weak negative relationship between abstraction and each of the main variables – understandability, engagement, and participants' confidence in discussing the drawing. Correlations ranged from -0.24 to -0.49. In other words, as abstraction increased, the effectiveness slightly decreased. However, there were a number of instances where a simplified yet more abstract drawing (e.g., plan or section) fared better than a less abstract photorealistic drawing. Thus, low abstraction was not always associated with higher understandability.

Assumption #3:

One might expect those with design experience to rate the effectiveness of all types of drawings higher than laypeople would rate them. The third study found this to be true for plans and sections, but not for perspective drawings and photorealistic drawings (Chapter 7). Participants in the expert group found plans and sections to be more understandable and engaging than laypeople found them to be. The expert group also was more confident discussing plans and sections than the layperson group was.

On the other hand, laypeople rated photorealistic drawings to be more understandable and less abstract than experts rated them (Chapter 7). Comments from the expert group indicated some difficulty determining what aspects of the setting were being proposed and what aspects were already existing. Their perspective seemed to relate more to the implementation of the drawing, i.e., how the setting will be constructed. Designers are trained to convey design ideas in a way that communicates how it should be built or implemented. They may see photorealistic drawings as being limited in their capability of representing the setting; thus, they may have more questions about how the drawing will differ from reality. Laypeople, on the other hand, may be focused more on envisioning the setting and imagining their experiences there. This is supported by research revealing significant differences in the way laypeople and experts frame or approach design problems (Van Herzele, 2004). Experts and laypeople appear to have different goals or purposes for design drawings, which may be reflected in their assessment of the drawings' effectiveness and the inferences they draw from them.

2. Interpreting participants' responses

Designers have mental models of the participants and their behavior, which direct how designers interact with participants. These mental models are based on previous experiences with participants in the design process. The more designers see the same patterns of behavior again and again, the more confident designers become in their understanding of why participants act certain ways, as seen through the designers' eyes. However, expertise affects the way people perceive the world, which applies to interpreting people's behavior as well. Research that tests designers' common assumptions and perceptions of participants can help designers build more accurate mental models of their audience. As a result, designers can better interpret participants' behavior and alter their approach and choice of visual graphics accordingly. The following paragraphs provide a couple examples of various research methods that can be used to achieve this goal.

Previous experiences with public participation may have led designers to interpret silence on the part of those present in a participation context as acceptance of the proposed material. After all, people readily express their complaints. Also, in many government solicitations for public comments, no response is considered consent under common law. This could be another source of designers' interpretation of participants' silence. However, considering the informational and psychological needs of participants described in RPM, silence may reflect a lack of understanding or engagement. Participants may be overwhelmed by the complexity of the information presented and not feel comfortable (or perhaps not have the opportunity) to ask the designer questions. Their lack of confidence in the material could lead them to avoid opportunities to provide their input. Therefore, seeking the participants' perspective on issues of understandability, engagement, and sense of meaningful participation as part of the participatory design process would be valuable. Also, choosing participatory methods that match the participants' skills is important. Findings from the second study indicate that the photoquestionnaire could be an effective option for seeking feedback on design options, since participants found rating photographs engaging and easy to do (Chapter 4). Additional research testing approaches for gathering feedback and visual graphics used in such efforts on these RPM measures would be worthwhile.

Assumption#4

The first study also tested a common assumption among designers, the results of which might be eye-opening. One would naturally assume that participants' ratings of preference would reflect their liking of the design option. However, there are other factors at play as well. The first study found that the understandability of the design presentation was influential in participants' preferences for design options (Chapter 3). Understandability accounted for 64 percent of the variation in preference for one of the less understood presentations, and 26 percent of the variation in preference in the most understood presentation. The more difficulty participants had understanding the design presentation, the less they liked the design option presented. This highlights the importance of using additional measures (such as understandability, engagement, and sense of participation) when seeking people's preferences. Alternatively, or in addition, designers could choose a participatory approach that reveals participants' perceptions of which participants may not be aware, such as the photoquestionnaire (R. Kaplan, 1977; S. Kaplan & Kaplan, 1989).

Educators' mental models

This research also contributes to building the mental models of educators in landscape architecture. It tests widely held beliefs about the effectiveness of a variety of visual graphics and highlights key factors influencing the understandability of design drawings. Incorporating a discussion of these key factors in the curriculum on design drawings is highly recommended.

Students are often taught to balance effort in creating a drawing with its expected effectiveness in communicating a design idea (Grese, R., personal communication). The findings from this research provide support for using some of the simpler drawings to communicate design ideas (Chapter 6). For instance, some section drawings, which are relatively easy to create, particularly for beginners, can be effective in helping people visualize the design if the features in the drawing are easily identifiable and are depicted in accurate colors (e.g., trees are green instead of pink). Using section drawings in combination with photorealistic or perspective drawings is likely to enhance effectiveness as well.

Photorealistic drawings are less time consuming than they used to be with the development of such computer programs as Photoshop, Sketch-up, Visual Nature Studio, and Illustrator (to name just a few). However, creating them still requires a certain amount of computer skill and visual acuity. Also, because photorealistic drawings can be highly convincing, designers need to be careful about how they depict the proposed setting so as to not mislead or deceive their participants (Bates-Brkljac, 2009; Pietsch, 2000; Sheppard, 1989; Wergles & Muhar, 2009). Based on the findings of this research (Chapter 6), training in creating photorealistic drawings and a discussion of the ethical use of these drawings seem worthwhile.

Landscape architects are rarely trained in methods of getting feedback from participants. The first study provides an example of an exercise intended for students to practice sharing their ideas and to receive feedback on their designs from laypeople (Chapter 2). Exercises such as these would be useful in building designers' confidence and skill in facilitating a participation process that meets the needs of the designer and participants.

Being effective

The second RPM domain is about being effective. People derive satisfaction from sharing their knowledge and using their skills effectively. This motivation is adaptive, since it leads people to seek situations in which they feel competent and avoid those in which they do not. There are also strong psychological effects associated with having a "clear-head." Consider the consequences when one's mental capacity, or ability to pay attention, is spent. It can lead to inability resisting distractions, missed social cues or other important information, trouble listening to others, irritability, or acting unpleasant in other ways (S. Kaplan, 1995; Kuo & Sullivan, 2001; Taylor, Kuo, & Sullivan, 2001).

Designers rarely have training in facilitating a participation process. Lacking such skills can make the process daunting, frustrating, and ineffective when participants do not seem engaged or fail to provide input that the designer finds valuable. Worse yet, if participants are vocal and hostile, the results can be discomforting for all involved. Research evaluating the effectiveness of different participatory methods can contribute to designers' confidence in their ability to facilitate a participatory process that promotes information-sharing. This research empowers designers in creating a participatory process that meets the cognitive and psychological needs of participants and leads to reliable, useful feedback.

The need for being effective highlights the importance of using participatory approaches that match participants' skills. Findings from the second study indicated that participants found the photoquestionnaire easy to do and promoted meaningful participation (Chapter 4). The photographs were understandable; participants had no trouble visualizing the setting. Thus, the photoquestionnaire offers another promising tool to designers in gathering feedback from participants.

Given the limited capacity of attention, it is also important to use methods that are engaging to participants. The results of the first study indicate that visual graphics and presentation style matter, particularly in understanding design presentations (Chapter 2). From a cognitive psychology perspective, it is not surprising that the amount of information and how it is presented play a role in people's ability to build mental models of the design options and visualize design alternatives. Presenting a great deal of information in an incoherent manner or without an overarching structure can overwhelm participants and make it easy to miss important points. Recognizing the limited capacity of people's attention by organizing the information into three or four main points and using consistent formatting can enhance understandability.

Promoting meaningful action

People are highly motivated to make a difference and gain the respect of others. Participants in the design process are more likely to feel they can have an impact when they are given the opportunity to participate, and feel their concerns are being heard and their input valued. The first two studies found that participants appreciated being asked for their input (Chapters 2 and 4). The photoquestionnaire particularly performed well on measures of meaningful participation.

Participants also come to the table with expectations and assumptions about designers and the participatory process. Anecdotal evidence suggests that some laypeople perceive designers to be arrogant and that they do not listen to people's concerns (*Putting our heads together: Diverse ways to bring out the best in people*, 2010). Important steps towards changing these negative perceptions about designers are to recognize participants' expertise, make a concerted effort to show genuine interest in participants' concerns, ask participants for input early in the process, present designs in preliminary stages to communicate that changes can easily be made, and provide feedback demonstrating the designer has listened to what the participants expressed.

The second study also highlights the importance of having been heard. A great benefit of the photoquestionnaire is its ability to reveal perceptions that participants may have trouble articulating or of which they are unaware. Participants may not make the connection between rating photographs and sharing these perceptions. They may feel their concerns have not been heard. In the second study, participants rated the relevance of the photoquestionnaire to their concerns the lowest of all evaluation items (Chapter 4), despite being given space on the survey to add their own comments. Additional structured questions and possibly other methods for people to express their concerns may be needed so they can feel they are being heard. Feedback from designers indicating their understanding of these needs and concerns also would be beneficial.

Likewise, designers gain satisfaction from knowing they can make a difference not only in the kinds of places they design, but also in the participation process. Like participants, they too want to feel appreciated and needed. The results of this research indicate ways that designers can make a difference in the participation process. Research that contributes to finding ways to improve the participation process can lead to positive feedback from participants to designers.

Conclusion

This research contributes to strengthening designers' knowledge and intuitions about the stakeholders, users, clients, or other participants from whom they seek input. It also presents evidence about the effectiveness of design drawings and approaches to participation in design. It provides potential new interpretations of participants' reactions or behavior, and uncovers differences in how designers and laypeople see things. It empowers designers by helping them see that they *can* make a difference in the participation process through their communication style and choices of visual graphics and methods of gathering input. Finally, it equips designers with the tools and knowledge for creating a people-friendly participation process in order to design places that meet the users' needs and concerns.

At the same time, the impact and value of this research also extends beyond the designer. Participants, educators, and students are expected to benefit from this evaluation of approaches to participation in design. In addition, researchers interested in applying and testing RPM are likely to find the variety of research methods used and measures of RPM useful. Even broader, this research can benefit anyone interested in bringing out the best in people, since it provides numerous examples of how to implement the Reasonable Person Model.

The great potential of the Reasonable Person Model lies in its portability and wide applicability. The components of the model and their relationships are intuitive and may even seem obvious once stated; yet there are all too many examples of participation efforts that did not fare well. Misunderstandings or lack of engagement have led to undesirable outcomes or missed opportunities for utilizing one's skills or participating in meaningful activities. Having a framework like RPM to guide decisions and actions can lead to more supportive environments, helping people to participate and designers to feel their efforts inform decisions. Small efforts like these can make a big difference in solving many of the problems we face in the world.

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