EFFECTS OF THE ARTISTIC DESIGN OF INTERPRETIVE SIGNAGE ON
ATTRACTING POWER, HOLDING TIME AND MEMORY RECALL

by

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ABSTRACT

Effects of the Artistic Design of Interpretive Signage on Attracting Power, Holding Time and Memory Recall

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The majority of visitors to interpretive sites receive information from non-personal interpretive media such as signs, exhibits and brochures. In this study, attracting power, holding time and memory recall were measured to evaluate two versions of an educational interpretive panel on display at the Ancient Bristlecone Pine Forest (USFS). The original version featured artistic design elements common in traditional interpretive signage. The manipulated version was created using the best practices of artistic design, as defined by research in museums and interpretive settings and cognitive theory. Components of the sign that were manipulated in this study include layout, typography, color, graphics, contour, and the inclusion of a multi-sensory flip-panel. The text copy remained the same for both versions. The manipulated version of the sign resulted in a significantly greater attracting power and holding time. More subjects were able to recall the main message of the manipulated sign, however there was no difference between the two versions in subjects’ ability to recall specific details.
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INTRODUCTION

Interpretation is used to communicate with visitors at naturally and culturally significant places such as national parks and forests, zoos, aquaria, botanic gardens and museums. Freeman Tilden (1957, page 8) suggested in his landmark book *Interpreting Our Heritage* that interpretive communications aim to “reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information.” Since Tilden’s original work, the field of interpretation has continued to develop. Ham (1992), identified four key qualities of interpretive communications: the message must be *pleasurable* for visitors to receive, *relevant* to visitors’ lives and experiences, *organized* in a way that makes sense and is easy to understand, and *thematic*, meaning that all of the information given revolves around one central message.

Interpretive communications may be personal or non-personal in nature (Ham, 1992). Personal (face-to-face) methods of interpretation include ranger-led hikes, campfire programs, patio talks, roving and answering questions at the visitor center. Non-personal interpretative communications include self-guided media such as visitor center exhibits, self-guided trails, wayside signage and other types of printed materials.

Many more visitors are reached through non-personal interpretation methods than personal ones. According to a report published by the National Park Service in 2003, only 22% of all park visitors talked to a ranger or participated in a ranger-led program
during their visit (Forist, Littlejohn, Baxter, Machlis and Gramann, 2003). Non-personal interpretive communications reached a significantly higher proportion, with park visitors reporting that they had viewed park brochures (64%), visitor center exhibits (54%), wayside exhibits (35%) and participated in self-guided tours (33%). Additionally, more than 20% of all visitors reported using audio-visual programs, park newspapers and bulletin boards (Forist et al., 2003).

Exhibits, signs and labels using the interpretive approach to communication are widely used as a regulatory technique, to orient visitors and to educate the public. For the purposes of this paper, interpretive exhibits, labels, panels and signage will be used interchangeably to refer to two-dimensional flat panel signs. These panels are found in a variety of shapes and sizes, with and without interactive components and may be found indoors or outside.

The two aspects of interpretive sign design are the conceptual component and the artistic component (Ham, 1992). The conceptual component refers to the design of the text copy. Interpretive writers face the challenge of communicating complex messages by using engaging, yet clear and concise wording that is pleasurable to read and requires minimal effort for visitors to understand. The artistic component encompasses numerous factors including layout, typography, illustrations, photographs and other graphics, inclusion of multi-sensory components, color choice and the physical shape and dimensions of the sign. Together, the conceptual and artistic components must spark
visitor interest, encourage visitors to pay conscious attention and communicate the message effectively.

Theoretical Framework

Interpretation can be used to change attitudes and behaviors, particularly with regard to the environment and our natural and cultural heritage. The conceptual framework for attitude and behavior change by means of interpretation is based upon theory in cognition and social psychology. Attitudes are defined by Taylor, Peplau and Sears (2003, page 133) as “the categorization of a stimulus along an evaluative dimension, based on affective, behavioral, and cognitive information.” Affective components of attitudes explain emotions and feelings, while behavioral components explain what a person is used to and how they have behaved with regard to the stimulus in the past. Cognitive components include facts, knowledge and beliefs that a person has toward the stimulus of interest (Taylor et al., 2003). Interpretive communications target the affective and cognitive attitude components, educating visitors and provoking them to feel a personal connection to significant objects, places and cultures.

The theory of reasoned action (Ajzen & Fishbein, 1980), replaced by the theory of planned behavior (Ajzen, 1985) explained attitudes as a precursor to behavior change. In the theory of planned behavior, behavioral beliefs lead to attitudes that people hold about different stimuli (see Figure 1). Behavioral beliefs are what a person considers to be true about the world based upon what is learned from direct experience and education.
Figure 1. Ajzen’s Model of Planned Behavior shows that behavioral beliefs, which are created by a person’s education and direct experience, are antecedents to behavior (Modified from Ajzen, 2002).
According to Ajzen, attitudes combined with subjective norms (what one perceives others to believe), and perceived behavioral control (how much power a person believes to have over their own behavior) lead to behavioral intentions, which are believed to be the immediate antecedents of behavior (Ajzen, 1985).

Many studies applying Ajzen’s theory of planned behavior to environmental attitudes and behavior have been conducted (Kaiser, Wölfing & Fuhrer, 1999; Groff, Lockhart, Ogden & Dierking, 2005). Kaiser et al. (1999) supported the theory by establishing that environmental attitudes and values are a powerful predictor of how people will behave with regards to the environment. More recently Groff et al. (2005) found a positive correlation between employees working in an environmentally themed facility (like a zoo or botanic garden) and their conservation-related knowledge, attitudes and behavior.

In order for knowledge, including facts and information, to contribute to behavioral beliefs, the facts and information must first be processed and committed to memory (Ajzen & Fishbein, 1980). Cognitive theory explains how information is encoded in the brain, retained or stored, and how the information is later accessed by retrieval.

Research conducted by Chaiken (1980) and Petty and Cacioppo (1986) examined how people process information depending on the situation. One route to information processing is the systematic (central) processing route. Systematic processing requires motivation and results in thoughtful consideration of information. The other less
cognitively demanding route is known as heuristic (peripheral) processing, and uses simple decision rules and mental shortcuts. Information processing by central or peripheral routes may play an important role in how it is then stored. Several experts in the field agree that central processing is more likely to end in long-term memory storage (Atkinson & Schiffrin, 1968; Langer, 1989).

Langer’s theory of mindfulness (1989) explains how certain characteristics of stimuli tend to encourage people to process stimuli intentionally, or “mindfully.” Moscardo (1999) applied Langer’s theory of mindfulness to recreation and tourism settings and made suggestions for encouraging mindfulness. As applied, this theory states that visitors will learn more and experience greater levels of satisfaction if they are encouraged to process an exhibit’s information centrally (Moscardo, 1999). Some components of exhibits that may encourage mindfulness are use of multi-sensory media, novelty, use of questions and good physical orientation. Repetition, lack of interaction, static exhibits and exhibits that appeal to only one of the human senses are some factors that will encourage mindlessness. Studies have confirmed that to maximize learning in educational settings, visitors must be encouraged to process things by intentionally exerting mental effort (Petty and Cacioppo, 1986; Carlson, 1995).

Three stages of memory are recognized by modern psychological theory (Atkinson & Schiffrin, 1968; Baddeley, 2002). Immediately after exposure to a stimulus, information is unconsciously committed to the fleeting “sensory memory” (Atkinson & Schiffrin, 1968). Out of all external stimuli that the sensory memory absorbs, a person
will then either consciously or subconsciously pay attention to select stimuli, which get encoded into the short-term (working) memory (Petty & Cacioppo, 1986; Baddeley, 2002). Finally, some of the information that makes it to short-term memory may be consciously encoded into long-term memory where it is stored (Atkinson & Schiffrin, 1968). In recent years, research has shown that information may also be committed to long-term memory without making conscious efforts to remember it (Baddeley, 2002).

Research on memory has shown that the ability to recall information is better for pictures than it is for words (Standing, 1973). In Standing’s research, an experiment was conducted in which subjects were split into three groups. One group was shown 1000 words like “dog” for example. The next group was shown 1000 ordinary pictures, like a picture of a dog. The third group was shown 1000 vivid pictures, like a dog with a pipe in its mouth. In his results, Standing (1973) found that on average, 615 words were recalled, 770 simple pictures were recalled, and 880 vivid pictures were recalled.

Another related realm in the cognitive sciences that is directly applicable to interpretation and exhibit design is the study of attention. Three principles of attention have been applied to interpretive exhibits (Bitgood, 2000). The first is selectivity, which means that an object or exhibit must attract attention by being distinctive, or “salient.” Early research in selectivity determined that people can pay conscious attention to only one stimulus at a time (Broadbent, 1958). Second, a successful label will encourage visitors to be motivated to focus their attention and processes the information centrally, or intentionally (Bitgood, 2000). Related to this idea, the more a person is motivated, the
more they will be able to concentrate (Easterbrook, 1959). Bitgood suggests that in order to motivate visitors to focus their attention and centrally process information, interpretive labels should minimize perceived effort to read, maximize cognitive and emotional arousal (make the label relevant and interesting for the visitor), and minimize other distractions (Bitgood, 2000).

The third concept that Bitgood (2000) suggested considering is based on the concept of limited capacity (Miller, 1956). Limited capacity refers to the fact that the human brain can retain only a certain amount of information in its short-term (working) memory before going into “overload.” Miller (1956) determined that when given a sequence of letters, the average adult could only recall a string of seven plus or minus two numbers or letters. By “chunking” information (presenting the numbers in groups instead of single numbers) people are able to store more information in their short-term memory, and are also able to recall more information (Miller, 1956). Recent research has found that without rehearsal, the average adult can actually only retain four chunks of information in their short-term memory (Cowen, 2001).

**Best Practices of Artistic Design**

Experts in interpretive settings have incorporated cognitive theory into their work for decades (Ham, 1983; Hammitt, 1984; Bitgood, 2000). By using what is known about cognitive processing and memory, interpreters can aim to maximize visitor learning. In one widely used guide on exhibit labels, Serrell (1996, page 9) writes “for long term
learning to occur, there must be short term learning; in order to have short term learning, there must be attention, and attention takes time.” In short, interpretive signage must first attract visitor attention before any further processing and subsequent learning may occur. It must also take into consideration the concept of limited capacity (Miller, 1956), and communicate messages while demanding minimal effort from the visitor.

One of the main challenges of encouraging mindful attention to interpretive labels in national parks and forests and other leisure settings is that the visitors are in a “non-formal” learning environment (Rounds, 2004). Non-formal learning (also referred to as “free-choice learning” and “learning in leisure settings”) describes educational opportunities that are outside of a formal learning setting such as a classroom. There may be no external motivations (money, privileges, or recognition of achievement) for learning in these situations, so the visitor must be highly internally motivated to learn on their own (Screven, 1992; Rounds, 2004). Examples of internal motivators are excitement, interest, curiosity, the prospect of social interactions with other visitors, and obtaining knowledge to be shared with others (Screven, 1992). In formal learning environments such as schools, people often learn to avoid negative consequences (like failing a class), but in free-choice learning environments, people may learn in order to make their experiences more positive. Although “lifelong learning,” often facilitated by non-formal learning environments is widely considered important for attitude and behavior change, much research is still needed in this realm to evaluate the effectiveness of attempts being made (Ballantyne & Packer, 2005).
Artistic design elements are used as tools to clearly and effectively communicate messages to visitors without words. Young and Witter (1994) found in their experiment on environmental education brochures, that information presentation and design (collectively, the artistic component) were the most important factors influencing visitor learning. In this study, they found that subjects learned more when exposed to a brochure that included color photographs, color-coded headings when compared to another less visually appealing brochure that had more carefully worded text.

Research in museum settings widely supports the idea that labels must be distinct in order to attract attention (Alt & Shaw, 1984; Nelson & Klutas, 2000). Through early research efforts, Alt & Shaw (1984) found that vivid exhibits that displayed short messages attracted more visitors in the British Museum of Natural History. Bitgood (2000), an interpretation expert who has written about the role of attention in exhibit labels, suggested that the most important factor is that the display must be novel and distinct. In a recent study, this idea of vividness and distinction was supported when Nelson and Klutas (2000) found that people tend to direct their attention to those aspects of a perceptual scene that stand out rather than those that blend in to the background or setting.

Particular design elements that may increase vividness or distinctiveness are size of label (the larger, the more attention is given to it), contrast with the background (labels that don’t blend in gain more attention) and presence of multi-sensory characteristics
(smell, sound or touch) (Bitgood, 2000). Signs with novel attributes attract more attention and arouse more curiosity than less distinct and unique signs.

Color is an important component to legibility, understandability and subsequent learning (Farley & Grant, 1976; Screven, 1992; Wolf & Smith, 1993; Young & Witter, 1994; Cota & Loomis, 1997). Farley and Grant (1976) found that subjects exposed to a color slide presentation learned more than their counterparts, who were shown the same presentation in black and white. Wolf and Smith (1993) demonstrated that color contrast has a significant effect on legibility. In their study, they found that black letters on white background provides the best contrast, making it easier for people to read. Cota and Loomis (1997) supported Wolf and Smith and demonstrated that color contrast additionally has a significant effect on memory recall. Research in interpretive publications has determined that use of color-coded headlines increased learning (Young & Witter, 1994). Young & Witter (1994) compared several different versions of a brochure. They found the most effective brochures had many “headings,” that were set apart from the rest of the text by using color and different typefaces.

Typography is another aspect of design that influences how legible a sign is and therefore affects overall understandability of the message. In addition, typography plays an integral role in the overall aesthetics and mood of an interpretive exhibit (Serrell, 1996). Legibility becomes of utmost concern with body text because messages must be communicated very quickly and be easily understood. Typefaces may be either serif or sans serif styles. Serif typefaces have ornamentation at the ends of the main strokes
Sans serif typefaces do not have ornamentations (Ariel, for example). Sans serif typefaces allow for faster reading, and so are preferable in interpretive signage (Trapp, Gross & Zimmerman, 1999).

A considerable amount has been written on conceptual (text) components of exhibits that encourage central processing (Ham, 1983; Hammitt, 1984). Far less has been written on artistic aspects of exhibit design that encourage central processing (Moscardo, 1999; Bitgood, 2000). One that has received a fair amount of attention, however, is the use of hands-on and multi-sensory components (Bitgood, 2000; Arndt, Screven, Benusa and Bishop, 1993; Moscardo, 1999). Arndt et al. (1993) found that visitors interacting with flip-labels in a zoo exhibit exhibited more knowledge gain than others who were exposed to the same exhibit but without the flip-panels. This knowledge gain is commonly attributed to the curiosity aroused by the flip-labels and by engaging kinesthetic senses (Carlson, 1995; Moscardo, 1999; Bitgood, 2000). Another component of the artistic design that may lead to conscious processing of information is the use of vivid pictures versus illustrations (Standing, 1973).

Another concept that must be considered in the artistic design of interpretive signage is to prevent information overload. Studies done on exhibit labels in museum settings show visitors are far more likely to pay mindful attention to bulleted lists, outlines, and chunked paragraphs than one continuous paragraph (Screven, 1992; Bitgood, 1994; Cota & Loomis, 1997; Moscardo, 1999). Chunking, which in this context refers to breaking up one large paragraph into smaller bits of information, makes it easier
for visitors to remember information because entire messages are broken down into more manageable pieces (Miller, 1956; Ham, 1983; Cota & Loomis, 1997). Another reason to use chunking is that interpretive signage is non-linear, that is, the conceptual components are written so that they can be read in any order or quantity and still make sense to the viewer (Serrell, 1996). Chunking has been shown to increase average viewing time of an exhibit label (Bitgood, 2000).

Exhibit Effectiveness

Exhibit effectiveness is commonly evaluated in museum settings (Borhegyi, 1965; Falk, 1982; Peart, 1984; Donald, 1991; Cota & Loomis, 1997; Diamond, 1999; Fernandez & Benlloch, 2000; Sandifer, 2003). Exhibit effectiveness is far less commonly evaluated in national parks, forests, or other interpretive settings (Arndt, Screven, Benusa & Bishop, 1993; Bitgood, 2000; Hughes & Morrison-Saunders, 2002).

The amount of time a visitor spends viewing an exhibit, knowledge gain, and an exhibit’s ability to increase visitors’ thinking and problem solving are general realms that are studied in exhibit evaluations (Donald, 1991). Specific measures that are commonly used are attracting power, holding time/power, and short-term knowledge gain (memory recall) (Falk, 1982; Peart, 1984; Cota & Loomis, 1997). Peart (1984, page 221) described attracting power as “the number of subjects from the target population who stop and look at an exhibit, expressed in percentages.” Attracting power is an indicator of selective attention. Holding time and holding power are useful in estimating the
amount of information that could possibly be absorbed by the audience. These two measures are based on the assumption that time and learning are positively correlated. Holding time is simply the number of seconds a visitor spends actively looking at the display. Holding power is a ratio of the holding time divided by the minimum amount of time it would take to process that sign (Peart, 1984). The minimum amount of time it takes a person to view the content of the sign is figured by averaging the time it takes a sample population to process the entire sign.

Memory recall is an indicator of short-term knowledge gain, which is a precursor to long-term knowledge gain (Serrell, 1996). Many interpretive sites and museums use surveys and interviews to understand what messages are being effectively communicated, and which ones are not (Arndt, Screven, Benusa & Bishop, 1993; Hughes & Morrison-Saunders, 2002, Sandifer, 2003). By using surveys and asking visitors to recall information about an interpretive sign or an exhibit, researchers are able to determine whether a short-term knowledge gain has occurred (Donald, 1991). The results of these studies have far-reaching implications for the field, and several interpretive specialists have combined these findings in books that provide guidelines for effective artistic design (Serrell, 1996; Falk & Dierking, 2000).

Label design affects readability, visibility, attraction, holding power and likelihood of use (Screven, 1992). Evaluation has been conducted on the combined conceptual (text) and artistic components of interpretive signs (Hammit, 1984; Young & Witter, 1994; Ham & Krumpe, 1996). Research has also been conducted on the textual
component of signs alone (Screven, 1992). Individual aspects of the artistic component such as typography, (McCarthy & Mothersbaugh, 2002), illustrations and graphics, (Peart, 1984; Young & Witter, 1994), and the use of multi-sensory components (Carlson, 1995) have also been examined to understand how they affect attraction, focused attention and subsequent learning. However, the combination of artistic elements has not yet been teased apart from the text copy to be evaluated for effectiveness. The purpose of this research project is to understand what effect, if any, the artistic component as a whole has on exhibit effectiveness.
METHODS

An experimental design was used for this study. Two versions of an educational interpretive sign were tested to evaluate the effect that artistic design as a whole, had on attracting power, holding time, and memory recall of information presented on the signs.

Data were collected in the vicinity of the Schulman Grove Visitor Center in the Ancient Bristlecone Pine Forest (ABPF) during the months of June, July and August of 2005. The ABPF is administered by Inyo National Forest and is located in the White Mountain range of Central–Eastern California. Schulman Grove Visitor Center is rurally located, approximately a 40-minute (37 km/23 mile) drive from the nearest town of Big Pine, near the intersection of California Highway 168 and Interstate 395. The road to the visitor center gains approximately 1829 meter (6,000 ft.) in elevation in the twenty-three miles from Big Pine. Once at Schulman Grove, visitors proceed along a boarded walkway to the visitor center building. The sign used in this experiment was located on the left side of the boarded walkway, as one approaches the visitor center from the parking lot.

A stratified random sampling schedule was created to assign treatment conditions, dates and times (Appendix A). The thirty-seven possible sampling days were recorded and broken up into three three-hour blocks of time. The three blocks were: 9:00am-12:00pm, 12:00pm-3:00pm, and 3:00pm-6:00pm. There were a total of 68 sampling blocks to be randomly assigned by drawing papers out of a hat. Forty-eight of the sampling blocks were devoted to observation in order to maximize the sample size for
attracting power and holding time. Half of the observation, interview and survey blocks were then randomly assigned to test the original design or the manipulated design.

One subject per visiting group was studied. A “visiting group” was considered to be any group of people that appeared to be on the site together—a family or group of friends for example. Out of each group, the subject was randomly determined by alternating between the first and second adult group member to cross a designated point in the walkway.

The purpose of the sign used in this experiment was to educate visitors about several distinctions between two local trees, limber pine (Pinus flexilis) and bristlecone pine (Pinus longaeva). Although artistic design elements were manipulated, the text copy (wording and punctuation) remained exactly the same for both versions (Appendix B). The existing sign was used as the “original design” for this experiment (Appendix C). The rectangular sign measured 46 cm (18 in.) tall by 51 cm (20 in.) wide and was made of darkened aluminum composite. Contrasting significantly with the dark aluminum background, an off-white color was used for the lettering and etchings of branches. The typographic characteristics of the original design included a serif typeface. The layout consisted of two main paragraphs (center justified), and bullet points of identifiable characteristics for each tree.

The “manipulated design” was created by using the best practices of artistic design, as identified by my literature review (Appendix D). Artistic elements that were
manipulated in the design were: typeface, color and size of text, color of background, use of vivid color photos, addition of flip-panels, and the shape of the sign.

Sans serif type was used for the presentation of the text, in order to allow for quick reading (Trapp, Gross & Zimmermann, 1994). It was presented in black letters on a white background in order to maximize legibility (Wolf & Smith, 1993). Headings were made distinct by using a different font and color (Young & Witter, 1994). Additionally, vivid photos were included in the design because they have been found to facilitate greater visitor learning (Standing, 1973). Two flip-panels were also added to the sign. All of the identifying characteristics of the bristlecone pine were under one flip-panel, and characteristics of limber pines were under the other panel. The flip-panels were added to increase novelty and distinctiveness (Moscardo, 1999; Bitgood, 2000) and to minimize the perceived effort that would be required to read the sign (Bitgood, 2000). An irregular contour cut was also made along the top border of the manipulated version with intention of increasing novelty (Moscardo, 1999; Bitgood, 2000).

A multiple method approach to data collection was used to test the effect of artistic design on attraction, holding time and memory-recall. Unobtrusive, on-site observations were conducted to evaluate attracting power and holding time. Additionally, visitor surveys and interviews were used to gather information on memory recall.

Subjects were discretely observed from a picnic table situated near the parking lot, approximately 15.24 m (50 feet) from the sign. Efforts were taken to ensure
participants were unaware they were being observed. These efforts included the observer wearing sunglasses and remaining at a distance. Observations were recorded on an observation log sheet (Appendix E).

Observation data were evaluated to determine whether there was a significant difference in attracting power and holding time between the two signs. Attracting power is defined as the percentage of all visitors walking by the sign that stopped at the sign for at least one second (Peart, 1984). Holding time, or the number of seconds that a subject attended to the sign, was also measured and recorded.

In order to evaluate memory recall, surveys and interviews were administered as a posttest, and were given to visitors immediately after they had viewed the sign. The researcher approached the target subject and requested that they fill out a survey or answer interview questions about the sign they just saw. They were asked to remain where they were stopped and not look back at the sign, or were escorted to a shaded picnic table that was not in sight of the sign until the questionnaire or interview was completed.

The survey (Appendix F) consisted of eighteen questions that were designed to obtain basic demographic data and assess short-term memory recall. Two questions on this survey were used to evaluate memory recall. An open-ended application question, “What was the main message of the sign?” was used to evaluate whether visitors remembered the theme. A fill-in the blank format was used to test subjects’ recall of specific facts. The question read “Please list the two trees mentioned on the sign,” and
was followed by two blanks. These types of questions have been widely used to evaluate memory recall in interpretive and museum settings (Diamond, 1999). The survey took most subjects between 3-5 minutes to complete.

For other subjects, on-site interviews were conducted to evaluate memory recall. Subjects were recorded with a digital voice recording device, and general notes were written on an interview log sheet (Appendix G). The interview consisted of nineteen questions and lasted an average of 2-5 minutes. After interviews were completed, the researcher reviewed the voice recordings and transcribed as much information as possible.

For the analysis of these questions, survey data and interview data were merged together in order to achieve a greater sample size. Data were then assessed by establishing a rubric with which the researcher coded responses into categories. The survey, interview guide and observation criteria were developed by using a panel of experts, consisting of three university professors.
RESULTS

The adult visiting population of Schulman Grove Visitor Center is comprised primarily of highly educated people (49% attended graduate school) who are with their families and are visiting for the first time (60% had no previous site experience) (Ward et al., 2006). Visitors spend an average of four hours and eighteen minutes on the site (Ward et al., 2006). Of the 122 subjects who participated in the survey or interview components of this particular study, 71.3% (87) of the participants reported visiting for the first time.

Effect of Artistic Design on Attracting Power

Observation data were examined to evaluate whether there was a significant difference in attracting power between the two versions of the sign. A Chi-Square ($\chi^2$) test was used to evaluate whether there was a significant difference in attracting power between the original design and manipulated design.

The attracting power of the two signs was found to be significantly different ($\chi^2=12.242$ at a significance level of $p<.001$). Out of the 74 individuals who were observed while the original design was being displayed, 56.8% of the visitors who walked by the sign attended to it for at least one second, while 83.3% of the subjects (n=72) walking by the manipulated design were observed attending to it (Table 1).
Table 1. Attracting power, expressed in percentages, of subjects viewing the original sign design and the manipulated sign at Schulman Grove, during the summer months of 2005.

<table>
<thead>
<tr>
<th>Attracting Power</th>
<th>Original Design (n=74)</th>
<th>Manipulated Design (n=72)</th>
<th>X²</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>56.8%</td>
<td>83.3%</td>
<td>12.242</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>
Effect of Artistic Design on Holding Time

Observation data were evaluated to determine the effect of the artistic design on holding time. The median holding time for subjects exposed to the original design (n=42) was 38 seconds, compared to 50 seconds for subjects viewing the manipulated design (n=60). Raw data for these timed observations were found to be non-normal, and were therefore transformed by taking the log of all values to achieve normality.

By conducting an independent samples t-test on the transformed data, a significant difference in holding time was found between the two designs. The t-test found that the difference in holding times between the two versions of the sign was significant with $t(100)=2.068$ at a significance level of $p=0.045$ (Table 2).
Table 2. Independent samples t-test for transformed data between the original design and the manipulated design at Schulman Grove between the summer months of 2005. Means and standard deviations (in parentheses).

<table>
<thead>
<tr>
<th></th>
<th>Original Design (n=42)</th>
<th>Manipulated Design (n=60)</th>
<th>t(100)</th>
<th>Significance of difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (holding time)</td>
<td>1.52 (0.367)</td>
<td>1.67 (0.333)</td>
<td>2.068</td>
<td><strong>p=0.045</strong></td>
</tr>
</tbody>
</table>
Effect of Artistic Design on Memory Recall

A significant difference was found in recall of the main message between the two groups. Answers were coded into three categories with a rubric. Answers were considered “correct” if the subject included in his/her answer that the sign described the difference between two trees, or identified that it was a comparison between two trees. Answers were considered “partially correct” if specific facts were mentioned, such as “bristlecones have prickly cones,” but failed to mention that it was a comparison between two trees. Answers were considered “too vague/incorrect,” if they said things that were difficult to tie to the conceptual message of the sign at all, like “high altitude” or “brown sign.”

Descriptive statistics showed that about half (50.8%) of the subjects exposed to the original sign design were able to correctly recall the main message, while nearly three-quarters (71.4%) of subjects exposed to the manipulated design were able to do so (Table 3). A Mann-Whitney U revealed that recall of the main message was significantly better for the group exposed to the manipulated design, with a z value of -2.388 at a significance level of p=0.017. Previous site experience was not determined to be a significant confounding variable.
Table 3. Frequencies and percentages (in parentheses), of subjects who answered the question “What was the main message of the sign?” at Schulman Grove during the summer months of 2005. Results of Mann-Whitney U Test, z value and significance.

<table>
<thead>
<tr>
<th>Category</th>
<th>Original design (n=65)</th>
<th>Manipulated design (n=56)</th>
<th>Z value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>33 (50.8%)</td>
<td>40 (71.4%)</td>
<td>-2.388</td>
<td>p=0.017</td>
</tr>
<tr>
<td>Partially correct</td>
<td>21 (32.3%)</td>
<td>12 (21.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect/ too vague</td>
<td>11 (16.9%)</td>
<td>4 (7.1%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A Mann-Whitney U test was conducted to determine whether there was a significant difference between subjects exposed to the original and manipulated sign designs in their ability to recall the two trees mentioned on the sign. Out of the 65 subjects exposed to the original sign design, 61.5% of them were able to correctly identify both the bristlecone pine and the limber pine (Table 4). For subjects exposed to the manipulated design, 70.2% were able to correctly identify both trees. Memory recall between the two versions of the sign design was not found to be significant, with the Mann-Whitney U-test indicating a $z$ value of -1.015 at a significance level of $p=0.310$. Previous site experience was not found to be a significant confounding variable.
Table 4. Frequencies and percentages (in parentheses), of subjects who answered “What were the two trees mentioned on the sign” at Schulman Grove during the summer months of 2005. Result of Mann-Whitney U Test, z value and significance.

<table>
<thead>
<tr>
<th></th>
<th>Original design (n=65)</th>
<th>Manipulated design (n=57)</th>
<th>Z value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>40 (61.5%)</td>
<td>40 (70.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partially correct</td>
<td>20 (30.8%)</td>
<td>14 (24.6%)</td>
<td>-1.015</td>
<td>p=0.310</td>
</tr>
<tr>
<td>Incorrect/ too vague</td>
<td>5 (7.7%)</td>
<td>3 (5.3%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

Ham (1992, page 236) wrote in his chapter on self-guided interpretive media, “Communication is more a matter of conceptual design than it is artistic design.” However, research in the field has supported the idea that the artistic design elements, not the conceptual text elements, play a vital role in gaining and holding visitor attention. This study investigated what effect the artistic design had on effectiveness of an interpretive sign, with the hopes of gaining further insight into creating the most effective exhibits possible.

There were three main findings of this study. First, the artistic design was determined to have a significant effect on attraction, showing that people are more likely to attend to a sign based upon artistic design regardless of the text content. Second, a significant effect was found on visitor holding time between the two versions of the sign. This indicates that by manipulating the artistic component exhibit designers may be able to increase the average viewing time. These results were in line with expectations based on the literature (Alt & Shaw, 1984; Peart, 1984; Screven, 1992; Arndt et al., 1993; Serrell, 1999; Bitgood, 2000). Results of memory recall indicated that artistic design had an effect on visitors’ ability to recall the main message of the sign, but it did not have an effect on visitors’ ability to recall specific details from the text.

The finding that the artistically manipulated version attracted more attention than the original sign is consistent with research studies that have evaluated aspects of the artistic component individually. Some of these attention-getting components are the use
of color (Farley & Grant, 1976; Wolf & Smith, 1993), vivid pictures (Standing, 1973) and the presence of flip-panels (Moscardo, 1999; Bitgood, 2000). Many exhibit researchers have lumped these aspects together, and generalize that exhibits that are more novel or distinct result in greater attracting power (Screven, 1992; Moscardo, 1999; Bitgood, 2000).

Comments from visitors participating in the survey and interview confirmed the importance of the artistic elements in getting their attention. When asked the first thing they noticed when approaching the sign, many of the subjects exposed to the original design of the sign reported first noticing graphic elements with answers like, “the pictures,” or “the pine cone drawings.” Most of the subjects who viewed the manipulated design cited the interactive flip-panels as the first thing they noticed, with graphic elements also commonly mentioned.

The importance of attracting visitors’ attention can not be overstated. It is the first essential step in the communication process between the managing agency and the visitor. After all, if visitors do not attend to an interpretive sign, the opportunity to relay an educational message to them is lost.

Another significant finding in this study was that subjects spent more time at the manipulated artistic version than they did at the original sign. An exhibit’s ability to hold visitors’ attention is important because in order for learning to occur, visitors must spend enough time at the sign to read and absorb the information. Results indicated that visitors spent a median time of 38 seconds attending to the original sign design, compared with
50 seconds for the manipulated version. When a sample population was tested to see how long it took them to read all of the information on the sign, the mean time required was 51 seconds. The significant increase in holding time is consistent with current literature in the field. Holding time has been shown to increase with the presence of a flip-label (Arndt et al., 1993). The use of a multi-sensory component, bright colors, vivid pictures, and other “novel” qualities have also been theorized to increase holding time and visitor learning, as explained by Moscardo (1999), in her writings on mindfulness.

Although a significant increase in holding time was expected based upon the literature, the average viewing time was found to be much longer than would be expected. Visitor studies have shown that, in general, a very small fraction of visitors will stop and read an entire sign, with the majority of them reading only about one-third of the text (Shiner & Shafer, 1975; Shleyer, 1987). The findings of this experiment are somewhat surprising when compared with these earlier studies, because the median viewing time for the manipulated sign (50 seconds) was only a second less than was determined to be the average required viewing time for this sign (51 seconds). Also interesting is that visitors who viewed the original version spent 38 seconds, or nearly three-fourths of the required time, attending to the sign.

There are several possible explanations for these unexpected findings. They may be partially explained by the concept of limited capacity (Miller, 1956). Perhaps visitors viewed the sign so long because it was the first one they saw, and they were therefore less fatigued than if they had already viewed many signs. Another possible explanation for
this finding is that the visitors to Schulman Grove are unique in comparison to visiting populations at large. A recent technical report by the U.S. Forest Service indicated that over 49% of visitors to Schulman Grove Visitor Center have attended some graduate school (Ward et al., 2006). This percentage is much higher than would be expected at most other interpretive sites, and may be indicative of a highly intrinsically motivated population of visitors. Other factors that may have contributed are the high elevation (over 10,000 ft.), which may cause individuals to act slower than usual due to decreased oxygen levels, and the fact that visitors had just driven nearly 30 minutes off the highway to get there. Perhaps they spent more time at the first few signs simply “taking it all in.”

The third goal of this experiment was to evaluate the effect that the artistic design had on memory recall of information presented on the sign. A significant difference in the ability of subjects to correctly recall the theme of the sign was found. However, no significant difference in the ability to recall the names of the two trees discussed in the content of the sign was found.

One possible explanation for the difference found in the ability to recall the theme of the sign is the use of color in the lettering. Color has been shown to increase memory recall in presentations (Farley & Grant, 1976). Nelson & Klutas (2000) found that objects that “stick out” of the perceptual field were more likely to be remembered. This helps to explain my findings. The phenomenon that color-coded titles and headlines increase memory recall has been demonstrated by Young and Witter (1994). The original design of the sign in this experiment featured only one color used for the theme, sub-
theme, body text and etchings. Since the manipulated design included a red theme “Discover the Difference” and green subtitle “The trees at Schulman Grove” and black typeface for the body text, the results from this study support Young and Witter’s findings. Another possible explanation is that visitors had to expend less effort to read the sans serif typeface that was present on the manipulated version, as opposed to the serif type on the original design (Trapp et al., 1994). Of course, it may also be attributable to the overall novelty and distinctiveness created by the use of color amongst many other single-color signs (Moscardo, 1999; Bitgood, 2000).

No significant difference was found in the ability of visitors to recall the specific names of the trees. This finding may be partially explained by the theory that color attracts more attention than black and white (Farley & Grant, 1976, Nelson & Klutas, 2000). That is, people do not pay as much attention to words in black and white writing when faced with the option of attending to color. It could be logically inferred that text presented in color may actually serve as a distraction to viewers. These findings raise questions about whether the artistic design elements have an effect on the memory recall of specific details.

Several limitations have been identified throughout the course of this study. First and foremost, is that this is only one rendition of a manipulated artistic design. Due to monetary and time constraints of this project, it was not feasible to test a variety of signs that had been manipulated artistically. The sample size was limited by the visitation to the Schulman Grove Visitor Center during the scheduled sample blocks. Approximately
58% of visitors had previous site experience (Ward et al., 2006), and therefore may have recognized that the manipulated version of the sign was different than they remembered, creating the possibility that attracting power and holding power results may have been affected. Due to the nature of unobtrusive observations, it was not possible to determine whether prior site experience was a significant confounding variable for attracting power and holding time. This experiment was limited to testing the adult demographic. Because of this, it is not possible to draw conclusions about the entire visiting population, including children and adolescents.

**Implications**

Several management implications arise from this study. Adequate time and effort should go into the artistic component of interpretive exhibit design. While the wording on an exhibit may be important to the understanding of material, artistic aspects are essential in attracting visitors, holding their attention and communicating the theme or “main message” of a sign.

A significant amount of money is spent by the National Park Service and other interpretive organizations each year to develop and install exhibits. According to Cindy Hall, Cost Estimator for the National Park Service, developing a single 24” x 36” interpretive panel can cost anywhere from $1,350-$5,500, depending its complexity and the material of fabrication. This amount includes $500-$1,500 for planning, another
$500-$1,500 for pre-production and $350-$2,500 for fabrication (Hall, 2006, personal communication).

In most interpretive planning guides (Ham, 1992; Trapp et al., 1994; Serrell, 1999), much attention is given to the conceptual (text) component of interpretive signage. Using “colorful” wording and making sure a theme is used are concepts stressed in most interpretive guides. When time and money are limited, it is important that managers realize the importance of the artistic design of signage and take its development seriously.

There are also several research implications of this study. Replicating this study in different settings and testing different demographics would be useful. For example, how would the efficacy of an exhibit change if the conceptual component was manipulated (keeping the same objectives) and the artistic design was held constant? Likewise, would similar results be found if a different sign was used and its artistic design was manipulated? Testing the different aspects of sign design in different settings would also be informative. For example, would similar results be found inside of an interpretive center compared to outdoors? How about in urban areas? Visitor demographics would also be of interest to consider. This study was limited to studying adult subjects who appeared to be 18 years of age or older. Would results have been different if children were being evaluated? How about senior citizens?

Another area that would be of interest to the discipline of interpretation would be to evaluate the effect that artistic design of interpretive signage has on distraction and attitudes. Do some aspects of the artistic design distract the visitor from learning the
intended message? Since attitudes and values are thought to be immediate antecedents to behavior (Ajzen & Fishbein, 1980), future studies might also consider how the artistic design of exhibits and signage affect visitor attitudes.

Visitors voiced concern about several other things that may be of interest to managers and researchers. Although many visitors voiced a preference for the colored panel, saying things like “I like the colorful sign because it is more fun,” and “The color pictures make it easier to understand,” several visitors voiced their preference for the traditional signs. One visitor explained their preference for the traditional one-color panel signs saying “I kind of like the lack of color. It stays with the natural look of this place because it’s not made of plastic.” Another person commented, “I much prefer the (traditional version) because it fits in with the surroundings and it looks more weatherproof.” Another important consideration is the target audience. Several comments suggested that perhaps the target audience was not clearly understood, saying, “The colored sign makes me feel like a juvenile,” and “The girl is distracting to me but might be attractive to kids.” Although comments like these were made, the overwhelming majority of visitors did not voice any concerns about the design of either version of the sign.

This study demonstrated that it is not only important what an interpretive sign or exhibit says, but also how this information is presented. With its found effects on attraction, holding power and memory recall, this study indicates that exhibit effectiveness may be increased by putting adequate research and effort into the artistic
design. Even though the effects of the artistic design on visitors’ ability to recall information were less telling than the other effects, we still know that attracting and holding visitor attention are essential precursors to visitor learning.

Interpretation aims to build public concern for our natural and cultural treasures. In this quest to attract and enlighten visitors, it is in our interest that credit is given where credit is due, for not only the wording of the message, but also for the artistic component of interpretive exhibits and signage.
WORKS CITED


PERSONAL COMMUNICATIONS

Hall, C. (2006). Personal communication. Harpers Ferry Center, P.O. Box 50, Harpers Ferry, WV 25425. Telephone: (304) 535-6082. E-mail: Cindy_Hall@nps.gov.
APPENDICES

Appendix A. Sampling schedule, indicating which sample blocks were used to collect observation, survey and interview data. Half of the sampling blocks were used to test the original version (A) and the other half were used to test the manipulated version (B).

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>9am-12pm</th>
<th>12pm-3pm</th>
<th>3pm-6pm</th>
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<tbody>
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<td>Saturday</td>
<td>Observation (A)</td>
<td>Observation (B)</td>
<td></td>
</tr>
<tr>
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<td>Sunday</td>
<td>Observation (A)</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>6/21/05</td>
<td>Tuesday</td>
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<td></td>
<td>Observation (B)</td>
</tr>
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<td>Interview (B)</td>
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</tr>
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<td></td>
<td>Observation (A)</td>
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<tr>
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<td>Tuesday</td>
<td>Observation (B)</td>
<td></td>
<td></td>
</tr>
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<td>Thursday</td>
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<td>Survey (A)</td>
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<tr>
<td>7/8/05</td>
<td>Friday</td>
<td>Observation (B)</td>
<td>Observation (B)</td>
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<td>Observation (A)</td>
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<td>Observation (A)</td>
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<td>Wednesday</td>
<td>Observation (A)</td>
<td>Interview (A)</td>
<td>Observation (A)</td>
</tr>
</tbody>
</table>

43
Discover the Difference

The Trees of Schulman Grove

The bristlecone pine and the limber pine are the only two trees able to survive the harsh environmental conditions here in the White Mountains. At first glance they seem similar, but look carefully and you will discover the distinct characteristics of each tree.

Pick up a pine cone along one of the trails here at Schulman Grove. Does it feel prickly? Is it full of slender bristles? If so, now you know why they are called bristlecones! Please remember to put the cone back where you found it for others to enjoy.

Great Basin Bristlecone Pine (*Pinus longeava*)

How to identify a bristlecone:
- Branchlets resembling curved foxtails
- Dark green, short curved needles in clusters of five growing along the branches
- Purple cones that grow at the tips of branches and fallen brown cones with a bristle on each cone scale.

Take a look at the Great Basin bristlecone pine standing in front of you.

Limber Pine (*Pinus flexilis*)

How to identify a limber:
- Very light bark on young trees
- Longer, grey-green needles in dense tufts at the ends of branchlets
- Cones without bristles

Watch for the stands of limber pines growing along the road. You can also see one in the parking lot island.
Appendix C. Original design of the interpretive sign “Discover the Difference,” showing aluminum composite background with white serif lettering and etchings depicting detail of leaves and cones.
Appendix D. The manipulated design of “Discover the Difference,” created using sans serif typeface, color-coded headings, vivid photographs, flip-panels and a contoured cut along the top edge. Below the sign is the content found under the flip labels.
Appendix E. Observation log

Observation log sheet

<table>
<thead>
<tr>
<th>Date</th>
<th>Informant</th>
<th>Time</th>
<th>Time at sign</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weather

# Seniors
# Adults
# Kids

Observed Gender | Age
Approach | PL | VC

Did target look at the sign? Y N
Did target interact with the resource? Y N Not observed
Did target lift lids? Y N NA
Did group approach sign? Y N NA
Sign type: Original Thesis
Appendix F. Survey

Ancient Bristlecone Pine Forest
2005 Interpretive Exhibit Survey

Thank you for taking the time to fill out this questionnaire. Your responses will be used to help improve outdoor exhibit design here and at other places. Please answer all questions as they relate to today’s visit here at the Ancient Bristlecone Pine Forest.

1. How many people are in your group?
   _____ # seniors (65 or older)
   _____ # of adults (under 65)
   _____ # of children (under 16)

2. How would you describe your group?
   __Alone
   __Family only
   __Friends only
   __Family and friends
   __Organized club
   __Other; please specify_____________________________________

3. Have you visited the Ancient Bristlecone Pine Forest before?
   __Yes    __No

   If yes, how many times? _____

4. Please describe the last sign on the boardwalk that you saw.
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________
Appendix F. Survey (continued)

5. Did you like the sign?
   __Yes   __No
Why or why not?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

6. What was the main message of the sign?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

7. What was the first thing you noticed when looking at the sign?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

8. Did you spend more time looking at the pictures or reading the message?
   __ Looking at picture  
   __ Reading text  
Why?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

9. How much of the text on the sign did you read? (circle one)

   None    Some    Most    All

10. Did you lift the flip-up panels?

    _____ Yes    _____ No
Appendix F.  Survey (continued)

11. Do you remember which two trees were mentioned on the sign? Please list them here:


12. List any differences between the two trees that you recall from the sign.


13. On a scale of 1 to 6, please rate this sign on overall appearance/attractiveness.
Not Attractive-----------------------Very Attractive

1  2  3  4  5  6

14. How credible do you think the information on the sign is?  Please circle corresponding number.
Not Credible-----------------------Very Credible

1  2  3  4  5  6

Please Explain.


15. What do you think would most improve the sign?


Appendix F. Survey (continued)

16. Do you feel that this sign is appropriate to the site?
   __ Yes  __ No
   Please Explain.
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

17. Circle the highest grade you have completed.
   Grade school  8 or less
   High school  9   10   11   12
   College  13   14   15   16
   Graduate school more than 16

18. Where do you live?
   __ United States
      If yes, which state? ____________________
      If California or Nevada, which county? __________
   __ Other country _________________________

   Other Comments
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

   Thank you
Appendix G. Interview guide

Ancient Bristlecone Pine Forest/ 2005 Exhibit Signage Survey

Informant #: _________  Date: __________  Time: __________

1. How many people are in your group? _____

2. How would you describe your group? ___ Alone
   ___ Family only
   ___ Friends only
   ___ Family and friends
   ___ Organized club
   ___ Other; please specify ______

3. How long was your visit here today?
   _____ # of hours
   _____ # of minutes

4. Have you visited the Ancient Bristlecone Pine Forest before?
   ___ Yes     ___ No

   If yes, how many times? _____

5. Please describe the last sign on the boardwalk that you saw.

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

6. Did you like the sign?
   ___ Yes     ___ No
Appendix G. Interview guide (continued)

Why /why not?

________________________________________________________________________

________________________________________________________________________

7. What was the main message of the sign?

________________________________________________________________________

________________________________________________________________________

8. What was the first thing that you noticed about the sign?

________________________________________________________________________

9. Did you spend more time looking at the pictures or reading the message?

________________________________________________________________________

________________________________________________________________________

10. Do you remember the two trees mentioned on the sign?

________________________________________________________________________

________________________________________________________________________

11. Can you recall any of the differences between these two trees from the sign?

________________________________________________________________________

________________________________________________________________________

12. Is there anything else that stands out in your mind about the sign?

________________________________________________________________________

________________________________________________________________________
Appendix G. Interview guide (continued)

13. On a scale of 1-6, please rate the sign on appearance/attractiveness.
   Not Attractive-----------------------------Very Attractive
   1    2    3    4    5    6

14. How credible do you think the information on the sign is?
   Not Credible-----------------------------Very credible
   1    2    3    4    5    6
   Why?___________________________________________________________________
   _____________________________________________________________________

15. What do you think would most improve this sign?
   _____________________________________________________________________
   _____________________________________________________________________

(Bring interviewee back to the sign and show them both versions.)

16. Which sign do you like better? What do you like about it?
   _____________________________________________________________________
   _____________________________________________________________________

17. Which sign do you find more credible?
   _____________________________________________________________________
   _____________________________________________________________________

18. New signs are being designed for this boardwalk. Which style of exhibit signage would you prefer to see here in the future?
   _____________________________________________________________________
   _____________________________________________________________________

19. Is there anything else you would like to say?
   _____________________________________________________________________
   _____________________________________________________________________