AN ABSTRACT OF THE DISSERTATION OF

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Visitor Perceptions of Natural and Human Influence.

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This study explored park visitors' preferences for scenic vistas at Crater Lake National Park, and whether their scenic evaluations would be affected if water levels of Crater Lake changed. Three main areas were addressed in the study. The first tested park visitors' ability to perceive differences in the level of Crater Lake if it was lowered, and if the present lake level would be preferable to depictions showing reductions of 25, 75 and 125 feet. The second area investigated whether visitors would find alternative human uses of Crater Lake water acceptable. The third area considered the influence of information as it relates to natural variation and human influence on scenic perception at Crater Lake.

Study participants included 1202 visitors at Crater Lake National Park during summer and fall seasons of 1996 and 1997. A multi-method approach to scenic perception and preference was utilized in this study, including a visual experiment, an
attitudinal survey, and group interviews. Survey methods were based on photographs of three Crater Lake views depicting the current level and three lowered lake levels. The simulation of the visual change in photographs was created using a computer graphics program.

Results of the study indicate that visitors prefer views of the lake that reflect Crater Lake with water levels at their present level. This was true when visitors had no information about the changing lake levels, and was more pronounced when visitors were informed about the lowered levels. Results also indicated that when respondents were informed that lake levels were changing due to human uses of Crater Lake water, the information had a more negative affect on respondents’ preferences than other types of information. This was consistent with the results on visitor attitudes toward alternative uses of Crater Lake water as expressed in the survey and interviews.

The sensitivity of public attitudes toward national park preservation and natural scenery is well documented in the literature. Results from this study at Crater Lake confirm that park visitors’ scenic evaluations can be negatively influenced by perceived changes in scenery, and that potential human use of Crater Lake water is unacceptable.
Scenic Quality at Crater Lake National Park:
Visitor Perceptions of Natural and Human Influence

by

David B. Rolloff

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Chapter 1. INTRODUCTION

This study explores visitor perceptions of the scenic quality of Crater Lake National Park. In particular, the role of information implying natural and human change is explored as it affects visitors’ scenic evaluations of the lake. Visitor attitudes toward potential human influence of Crater Lake were also investigated.

Recognition of quality scenery as a valued natural resource is a notable development in the field of natural resource management (Cubbage et al., 1993; Dearden, 1985). Indeed, the 1990 Resources Planning Act Program Update (in Galliano and Loeffler, 1995) indicated that viewing scenery had the highest participation rate of any recreational activity in the United States. The Program Update reported that over 20% of Americans participate in viewing scenery as part of their leisure activities. While the intangible “amenity” value of scenery has often placed it in a priority below commodity values such as timber, mining, and tourism development, scenery has become recognized as a significant natural and recreational resource (Daniel et al., 1989; Magill, 1992). While viewing scenery as a recreational priority of many Americans is recognized in the Program Update, other studies indicate that viewing scenery is an important subcomponent in recreational activities such as fishing and hunting (Allen, 1988). Scenic management and preservation are
subsequently playing an ever increasing role as an integral part of natural resource and recreation management, particularly where water resources are concerned (Taylor et al., 1995).

An abundance of scenic resource issues face land managers. The preservation of historic natural scenes (such as national parks), creation of additional scenic vistas, monitoring of increasing real estate and tourism development, and protection of air and water quality are all considerations land managers should bear in mind. Maintaining awareness of scenic resources is critical, because managers' decisions about human influences can directly or indirectly affect the appearance of natural land features. However, even the most carefully planned management activities can be met with varied public acceptance, and negative reactions often take managers by surprise (Allen and Gould, 1986). Land managers not informed about social and scenic values can overlook the impact their decisions have on the appearance of public lands as well as their effects on the perceptions of people who view them (Shindler et al., 1993). Because beauty is in the eye of the beholder, public impressions of changes in the natural landscape can be extraordinarily difficult to describe, let alone predict or understand.

The research literature in scenic quality indicates that people's perceptions and judgments of scenic quality are complex, multi-leveled and often transient (Arthur et
al., 1977; Bourassa, 1990; Craik, 1983; Herzog, 1985; Meining, 1976; Schroeder, 1984). Because of the continual shifting of public values regarding natural resources, including values for scenic landscapes, continued research in scenic values is justified.

The eclectic and multidisciplinary field of scenic aesthetics has produced a volume of research in the fields of forestry, sociology, geography, psychology, anthropology, and landscape architecture. The study of scenic beauty has been the subject of much debate, revealing a rich variety of philosophical beliefs about the nature of beauty. Description and measurement of what is considered an intangible product of human interaction with the natural world has been a particular challenge for the sciences because the construct of beauty has no obvious physical referents upon which to base measurement (Hull et al., 1984).

Understanding the nature of the human aesthetic response to the natural world has been the subject of human interest for centuries (Taylor et al., 1987). However, within the last three decades, a variety of methodologies have been developed for use by land managers and researchers interested in describing the human perception of scenic beauty. Methods for measuring, describing, and predicting scenic preference can be found along the philosophical spectrum of scientific and aesthetic inquiry, from the objectivist orientation on one end to the subjectivist perspective at the other.
Motivation for Studying Scenic Quality at Crater Lake National Park

The water rights adjudication process in the Klamath Basin has prompted concerns that potential water withdrawals from Crater Lake could detract from park visitors' scenic experiences while in the National Park. The National Park Service requested a study of the scenic value of Crater Lake, and whether scenic value would change if water levels in the lake changed. The objective of this study was to explore the visual effects of such changes in Crater Lake on visitors' evaluations of lake views.

Study Design

This dissertation reports results of a study at Crater Lake National Park using psychophysical, attitudinal, and interview approaches. The goal of the study is to understand and predict park visitor values for scenic vistas and naturalness as part of their aesthetic experience at Crater Lake. The study was focused on the scenic views of Crater Lake from Rim Drive. Surveys and interviews were conducted using volunteer participants at commonly-visited park areas.

An additional part of the study explored the role of information on participants' scenic evaluations of the slide images. Five information treatments were designed to explore the potential informational influence of implied natural variation and human influence on visitors' scenic judgments of Crater Lake. In addition to
participating in the above visual experiment, study participants were also
asked to rate the acceptability of a number of potential human uses for the water in
Crater Lake.

A series of group interviews with park visitors was conducted as the final part
of the study. These interviews provide insights into park visitors' beliefs and attitudes
that were not available from the survey methodology used in the first two parts of this
study.

Study Goals and Objectives

**Scenic Perception and Preference.** Research questions relating to the natural
integrity of Crater Lake National Park are tied closely with scenic quality issues at
both theoretical and practical levels as discussed in the literature review in Chapter 2.
Information was needed at Crater Lake for exploration into how lake level changes
would affect participants' visual perceptions and scenic preferences for views of the
lake.

**The Role of Information.** Because national parks are sites of significant
interpretation regarding ecological and historical processes, additional research
questions focused on the role of information on scenic quality judgments.
Interpretive services at national parks typically provide visitor information that is
both visual (e.g., interpretive displays) and verbal (e.g., presentations by park rangers).
Information about the ecological condition of parks plays an important role in a park’s interpretive programs. In this way, understanding the role of information as it affects visitors’ perceptions can be a key part of the park managers’ role in facilitating the visitor experience. This visual-perceptual study explores how information can influence what visitors see within specific questions relating to Crater Lake water levels.

The following questions correspond to these issues:

1. Do park visitors detect differences in depictions of Crater Lake water levels at the scaled drops of 25 to 125 feet?

2. Does information regarding changing lake levels affect visitors’ abilities to perceive differences in lake levels?

3. Is there a difference between park visitors’ scenic preferences for current lake levels compared to images depicting lowered lake levels?

4. Does information regarding changing lake levels affect visitors’ scenic preferences?

5. Is there a difference between visitors’ scenic evaluations when they are informed verbally that the lake levels are changing, compared with visitors who were given no information?
6. Is there a difference between visitors' scenic evaluations when they are informed verbally that the lake levels are changing, compared with visitors who were given information via text in the slides explaining that lake levels were changing because of natural variation or human use of lake water?

7. Is there a difference between visitors' scenic preferences when comparing natural variation information with human use information?

8. When visitors complete a written survey question relating to specific human uses of Crater Lake water, is there evidence of a priming effect when this type of treatment is compared to human use information embedded in text format on the slides?

Attitudes Toward Human Use of Crater Lake Water. In addition to the questions relating to park visitors' perceptions of the lake, questions relating to visitor acceptability of potential human uses of Crater Lake water were proposed.

1. Are visitors generally opposed to potential human uses of Crater Lake water?

2. When visitors are questioned regarding specific potential human uses of Crater Lake water (for example: hydropower, industrial, commercial, municipal, agricultural or park visitor use), are some uses more acceptable to visitors than others?
Qualitative Insights. Research questions asked in the group interviews were used to explore the visual and attitudinal segments of the study, but they also provide insights into park visitors' beliefs and attitudes not available from the survey methodology. As Krueger (1988) notes, due to the inductive nature of group interview research, greater attention is directed to discovering the manner and way in which respondents perceive issues. In this manner, the second area of insight provided by the group interviews related to visitors' attitudes regarding their perceptions of natural change versus human influence in national parks. The research questions addressed in the interviews included:

1. Are visitors' scenic judgments after viewing photographic images based on the water level depictions, or are there other variables (such as perceived color differences) affecting their preferences?

2. What are park visitors' reactions to being informed that the lowered lake level images reflect changes due to human uses of the lake water?

3. Are there any potential human uses which participants find more appropriate than others?
Organization of the Dissertation.

Chapter 2 comprises a review of the research literature in scenic quality, as well as research into the effects of information on scenic beauty judgments. Specific areas relating to landscape aesthetic theory, policy mandates, research methodologies, and scenic quality research in the national parks will be included as part of the literature review. The methodological approaches represented in the three parts of this study will be described in Chapter 3. Chapter 4 will report the results of the visual experiment and information treatments, including information yielded by the group interviews. Attitudes toward potential human uses will also be described in Chapter 4. Results from the group interviews as they relate to participants' attitudes toward the potential uses will also be reported here. Chapter 5 will conclude the dissertation, with a discussion focusing on theoretical and management implications of this study.
Seven appendices are included: Appendix A contains the survey used on-site at Crater Lake for the experimental slide portion of the study as well as the attitudinal measures associated with potential human uses of the water in the lake. Appendix B provides a copy of the survey instrument used to compare participants from the Visitor Center sample with visitors at Rim Village. Instructions for the Visitor Center portions of the study are provided in Appendix C. Photographic images used in the visual portion of the study are contained in Appendix D. The interview protocol for the group interview portion of the study has been provided in Appendix E. Appendix F contains the survey form used in the group interviews. Appendix G provides additional analysis regarding visitors' preferences for higher lake levels.
The 20th century has been a period of rapid change in attitudes toward natural resource conservation and land management. The popularity of Aldo Leopold’s book *A Sand County Almanac* is emblematic of a broadened ecological sensibility which gained widespread influence over the values of post-World War II Americans. This heightened ecological awareness pushed Americans to reconsider the beauty of the land as more than skin deep. With many other factors, the popularity of Leopold’s work is symbolic of this period in history in that it showed how profoundly altered people’s views of natural resources had become. In turn, the way Americans interacted with their natural landscape reached the stage where quality scenery was not only considered important, it was deemed a vital national resource.

Motivated partly by an increased ecological awareness, the will of the American people eventually expressed itself in the passage of far-reaching environmental protection laws by Congress in the 1960’s and 70’s. One component of these mandates was the recognition that the intangible values of scenery and natural beauty were worthy of legislative protection. The laws passed recognized the scenic value of the natural American landscape and declared that scenery should be granted priority as a resource of national significance.
A Note on Scenic Quality Phrases

Amadeo et al (1989) note that in practice, people’s notions regarding what is “scenic” are likely to included a mixed and unknown assortment of their perspectives on many different aspects of natural environments. To the beholder, “scenic,” implies a concept that is at a high level of abstraction which can be perceptually transient in the beholder, flexible in its application, and potentially influential in the emotional response of the individual to physical settings (Blumenthal, 1977). The semantic dimension of quality as it relates to natural landscapes has been variously labeled as “scenic quality” (Brunson and Shelby, 1992; Craik, 1983; Daniel et al., 1973; Orland et al., 1996; Tips and Savasdisara, 1986; Zube, 1974), “aesthetic quality” (Cook, 1972; Pepper, 1937), “visual attractiveness” (Pitt, 1989), “visual quality” (Hull, 1988; Lien and Buhyoff, 1986; Manning et al., 1996), and “landscape preference” (Abbelo and Bernaldez, 1986; Buhyoff et al., 1983; Kreimer, 1977; Purcell et al., 1994). Daniel and Boster (1976) weighed alternatives and concluded that “scenic beauty” served the best purposes of most natural landscape quality which is motivated by environmental policy and public land management. Subsequently, the use of the phrase scenic quality has come to include most of the above. This study, particularly in the literature review, takes a broader view of the field and uses the terms “scenic quality”,.
"landscape quality", and "scenic beauty" on a relatively interchangeable basis unless otherwise stated.

Scenic Values Over Time

Origins of the Picturesque. The human fascination with nature has been a subject of interest since the Romantic Era, when humans began showing a sympathetic interest in the qualities of the natural world (Nash, 1968). One consequence of the romance period was that the notions of the sublime in nature gained recognition: beauty was no longer focused on the cultivated, pastoral, ordered and subdued nature, but encompassed the wilder and natural qualities of landscapes (Gilpin, 1792; Zube, 1992).

Previous to this century, the appreciation for natural beauty was more or less tied to the picturesque, (Hussey, 1927) rather than any intimate connection to evolutionary processes at play in the land itself (Callicot, 1992). The study of natural beauty in landscapes was most often undertaken by those concerned with the aesthetic and design values of landscape in art and architecture. However, as Gobster (1996) notes, the developed aesthetic preference for these scenes was not so much "natural" as it was a preference for "naturalistic" scenes. The aesthetics of naturalness were influenced as much by the preferences of designers and artists. In turn, this view of
nature furthered the idea that there is an ideal nature which is tidy, and unchanging (Wood, 1989).

The development of the 20th century ecological aesthetic required, according to Leopold, a higher understanding of the complexity of nature, and the cultivation of "a more refined taste in natural objects" (Leopold, 1953 pp. 32). With the development of the natural resource management fields and the passage of laws requiring the preservation and inventory of scenic resources, the desire to obtain an ordered, scientific understanding of the human appreciation for scenery became increasingly important.

The Land Aesthetic. Aldo Leopold's introduction of the concept of the land ethic into the field of natural resource management symbolized the shift in human ecological attitudes. Leopold's vision of land management encompassed more than technical manipulation of resources for commercial gain. He asserted that the 20th Century was the ground from which the human ecological conscience would rise. A new conception of resource conservation was developing which broadened professional and popular beliefs regarding which resources were worth preserving. Leopold maintained that, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community." (Leopold, 1949 p. 262).
Recently published essays of Leopold's from the 1930's contain a relatively unknown concept which he called the *land aesthetic*. The *land aesthetic* is increasingly recognized for exerting an even greater influence on the natural resource conservation movement than Leopold’s concept of the *land ethic* (Leopold, 1991). Callicot (1992) illustrates this concept by asserting that one of the main reasons certain natural areas (such as parks and natural areas) were preserved was simply because people considered them beautiful. As Callicot states simply, people believed places were beautiful and therefore had value, so they preserved them. However, this simple explanation hides a more complex understanding of beauty that Leopold implied. While visual appearance may have been critical in the preservation of special places, Leopold’s vision of natural beauty included more than the physical. For Aldo Leopold, the aesthetic natural experience was a dynamic involving human cognition with the sensory abilities of smell, sight, sound, and touch in an interplay with the physical landscape. He asserted that the land aesthetic included not only the appreciation of visual scenery, but also the evolutionary heritage, ecological processes, and natural integrity at play in the landscape.

**Scenic Preservation and Natural Resource Policy**

While the popularized ecological movements of the 1960’s and 1970’s contributed to the flurry of environmental legislation, there is much evidence of
public concern for preservation of scenic places in over a century of national park preservation activity prior to this. The preservation of Yosemite National Park in 1864 and the creation of the National Park Service in 1916 show that considerable interest in preservation of scenic resources had existed (Hendee et al., 1990; Nash, 1968), but the significance of these events rests in their foreshadowing of much broader resource protection to follow.

The passage of numerous landmark environmental protection laws by Congress in legislation during the 1960’s and 1970’s was evidence of the advancing ecological conscience of America. The inclusion of protection for scenic resources featured significantly in much of the sweeping environmental legislation of the era.

The protective clauses of individual environmental legislation were more significant for scenic preservation in that they called for the management of the aesthetic qualities of the land on par with commodity values. For example, beginning with the Multiple Use Sustained Yield Act (MUSY) in 1960, Congress directed the Forest Service to combine both economic and environmental considerations in forest administration, requiring the agency to consider forest aesthetics as part of its mission (Schafer, 1967).

The report of the Outdoor Recreation Resources Review Commission (ORRRC, 1962) contained a substantial list of recommendations for legislation to be
passed for landscape preservation. As a result of the ORRRC report, the National Wild and Scenic Rivers Act (1968) and the National Recreation and Scenic Trails System Act (1968) became law. Also in the 1960's, the Highway Beautification Act (1965) mandated that scenic reviews be conducted as part of transportation route construction. All these pieces of legislation called for land management agencies to carefully consider visual impacts in their planning.

Perhaps the most broad-reaching policy mandate covering scenic resources was contained in the National Environmental Policy Act (NEPA) of 1969. Section 102(2)(b) of NEPA mandated agencies of the federal government to

identify and develop methods and procedures...which will ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations.

In the 1970's, the Forest and Rangeland Renewable Resources Planning Act (1974) as well as the National Forest Management Act (1976) reinforced the mandates of earlier policies to consider aesthetic resources, and emphasized the evaluation of scenic quality tradeoffs among competing demands for national resources (Brown et al., 1983). Such policy statements directed land managers' attention to aesthetic impacts associated with forestry, recreation, and transportation. Mostly managers were required to identify and inventory scenic resources. At the same time, increasing
numbers of scientists became interested in the nature of the human aesthetic relationship to natural landscapes and ecological heritage.

Scenic resource protection has continued to receive attention in the formation of land management policies into the 1990's. For example, in the report of the Forest Ecosystem Management Assessment Team (FEMAT 1993), scenic values for natural appearing landscapes continue to emerge as key public concerns. The report also emphasizes that the creation (emphasis added) of more naturally appearing landscapes would be consistent with conservation objectives addressed by the FEMAT document. Citing the Oregon and Washington State Comprehensive Outdoor Recreation Plans, the FEMAT report indicated that increasing acreages of natural landscapes will be needed to meet projected demands by the year 2000.

**Scenic Quality Evaluation: Theoretical Developments**

Much landscape perception research derives theoretically from the field of psychometric measurement, which focuses on establishing quantitative relationships between physical features of environmental stimuli and human perceptual responses (Fechner, 1860/1966; Buyhoff, 1980). Usually this type of analysis focuses on rating exercises which produce numerical indicators of observers' perceptions of the relative position of one stimulus versus another along a specified psychological dimension representing scenic beauty (Brown and Daniel, 1990). This conceptual approach in
visual perception is derived from the Theory of Signal Detection as formulated by Green and Sweets (1966). Signal detection has its foundations in classical psychophysical scaling methods originated by Thurstone (1927), which was further developed by Torgerson (1958).

A review of the literature indicates that the applied nature of scenic beauty assessment has left a relatively limited number of attempts at outlining the area's theoretical underpinnings (Bourassa, 1990). Appleton (1975) asserted that theoretical understanding of aesthetic judgments is not just a scholarly endeavor but necessary for rationalizing applications of scenic quality analysis. Zube (1982) also contended that assumptions behind much of what is called landscape scenic quality have not been examined in an ordered fashion. For example, is scenic beauty an objective property inherent in the landscape or a subjective impression based on individual cognitive processes? Is scenic beauty a constant over time and between individuals? Indeed, Wohlwill (1976) questioned earlier whether researchers are measuring the same thing when describing scenic beauty. The debate has continued for over two decades with a degree of clarity settling into an understanding that both the physical landscape and human cognitive processes must be considered in an integrated fashion. Zube et al. (1982) summarize this integrated understanding when they suggest that scenic beauty evaluation should focus on the nature of human-landscape interactions and their
outcomes (which include preference, values, satisfaction, well-being, predictive equations, and salient physical landscape elements).

Scenic Quality Evaluation: Methodology

In response to the need for information relating to scenic quality, a considerable number of assessment methodologies were developed in the 1960's and 1970's. Numerous researchers explored the physical features which contribute to scenic quality and attempted to describe attendant scenic aesthetic values (Arthur et al., 1977; Daniel and Boster, 1976; Daniel and Vining, 1983; MacFarland et al., 1983; Zube et al., 1982). Research throughout the early years of scenic assessment was dominated by the field of landscape architecture. For example, Zube (1982) noted that in a 15 year period from 1965 to 1980, twice as many research articles concerning scenic quality were published by researchers in landscape architecture than in any other field.

The primary emphasis of most work in scenic assessment has been observer-based; that is, scenic value has been judged by either experts (such as landscape architects or land planners) or laypersons (landowners, recreationists, or other members of the public). Because the aesthetic value of a landscape logically resides in its visual desirability, a large amount of observer-based research has focused on the perceptual experience of the viewer. Much of this research descends theoretically
from the work of Ittelson (1973), who outlined three general principles regarding the nature of human perception: 1) perceiving is relatively free from direct control of the stimulus; 2) it is inseparably linked to and indistinguishable from other aspects of psychological functioning; and 3) perception is relevant and appropriate to the environmental context in which it occurs.

**Scenic Quality Assessment Approaches.** Arthur et al. (1977) separated scenic quality assessment approaches into two categories: the descriptive inventory and the public preference model. Descriptive inventories usually rely on judgments and standards of trained, highly skilled field experts. This expert approach makes several assumptions. First, that there are aesthetic qualities inherent in a given landscape which, when analyzed, would provide an objective, evaluative measure of its scenic quality. Second, the expert inventory assumes that with enough training and expertise, the preferences of the general public can be objectively determined without asking them. The expert approach presumes that there are a limited number of criteria which need to be met in order to analyze a scenic view for its aesthetic appeal. Much of the visual assessments conducted by the federal land management agencies have followed the expert approach. Efforts to systematically identify and classify scenic quality to promote sound resource management have resulted in the development of
such inventories as the Scenery Management System by the U.S. Forest Service (USDA, 1996).

A number of researchers (Arthur et al., 1977; Vining and Stevens, 1986) have been critical of the expert model of scenic assessment, arguing that the public preference model is appropriate when management considerations for public resources are in question. The public preference model is based conceptually on scenic preference as a function of the physical characteristics of the landscape in question, real or implied presence of management, as well as the attitudes, expectations and perceptions of the observing individual. This process-based, relational model of landscape assessment (Vining and Stevens, 1986) is diagrammed below in Figure 2.1.

Public Preference Subcategories. Zube (1982) separated the public preference approach described above into three subcategories: psychophysical, cognitive, and experiential. The psychophysical model often involves testing an experimental group of subjects in order to collect their perceptual evaluations of scenic qualities in a particular landscape. External landscape properties are assumed to carry a correlational, or stimulus-response relationship, to the viewer's evaluations of what is observed (Daniel and Boster, 1976). Numerical or statistical expressions of perceived aesthetic values are usually the focus of discussion in the psychophysical
Figure 2.1 Diagram of the Relational Model of Landscape Assessment

(Vining and Stevens, 1986)
approach (Hull et al., 1987; Magill, 1990). Much research in recreation and amenity values for natural resources has been conducted using techniques which can be classified as psychophysical in their methodology (Daniel et al., 1989; Shelby and Harris, 1985).

The cognitive model of landscape assessment involves a search for how information is received by the human observer in connection with past experience and future expectations. This information, along with sociocultural values, is combined into a meaning-filled, internalized representation. Human factors affecting scenic preference include education, personality, profession, involvement, and socio-cultural groupings (Buhyoff et al., 1983; Zube et al., 1982). Ratings of preference or levels of satisfaction-dissatisfaction are likely to be the focus of cognitive approaches to landscape assessment. Much of the work relating to the natural vs. human influence on landscapes has been conducted from the cognitive approach to landscape analysis (Calvin et al., 1972; Carls, 1974; Hodgson and Thayer, 1980; Ulrich, 1986).

The experiential or phenomenological approach considers humans to be active participants in the landscape as opposed to being merely observers. Landscape values rise from the interaction between the human observer and the landscape itself. This perspective approaches landscapes as repositories for human meaning and symbol (Greider and Garkovich, 1994). The experiential model goes further than the human
response to a visual scene and focuses on the product of human transformations of landscapes, both mental and physical. Researchers focusing on landscape values as an individual expression would be categorized within this approach, particularly those who work with the sense of place phenomenon in landscape inquiry (Mitchell et al., 1993; Owens, 1988; Proshansky et al., 1983; Schreyer and Roggenbuck, 1981; Tuan, 1976). The emphasis on literary and artistic endeavors as the analytical focus of landscape quality also comprises part of the experiential approach (Relph, 1976; Stegner, 1989) and is a growing area of inquiry (Snow, 1997).

The Integrated Approach. Seeing no reason to separate the psychophysical and cognitive approaches to analyzing scenic quality in landscapes, Vining and Stevens (1986) opted to study the association between the existence of physical traits in the landscape and the resulting perceptual response of the individual observer. Their orientation of theoretical psychophysics moves toward a combination of the physical environment and the observer's cognitive structure, as illustrated in Figure 2.1. Vining and Stevens asserted that the observer's response is a function of a complex and interactive process. Interpretation of observer responses should acknowledge the operation of processes such as judgment and decision making, the observer's frame of reference, and their distinctively individual experience.
The inclusion of more than an observer's perceptual response has often not been included within the traditional psychometric method. More broadly, an integrated approach considers cognitive processes which mediate the response to a visual stimulus. While these invisible processes are not directly observable, this more complex view of landscape perception is more satisfying than merely studying and then constructing an inventory of what is visually perceived. That a response should acknowledge underlying cognitive processes such as environmental attitudes or acceptability of impact, as well as the observer's particular frame of reference, seems a necessary area of inquiry and worthwhile for research.

Evaluation Methods: The use of photographic representations

Visual representations have been used to model potential visual changes in the landscape since the beginning of the 14th century (Zube, 1986). Pictorial simulations are commonly used by planners and land managers for use in their assessment of the visual consequences of potential alterations to scenery (Orland, 1993). Not surprisingly, much research in the area of scenic quality has focused on natural scenes in the form of artist representations, slides, photographs, and computer digitized images. Scenic quality assessments have often utilized photographic representations of natural scenes in order to elicit perceptual and cognitive responses from participating
observers (Bishop and Hull, 1989; Bishop and Leahy, 1989; Manning and Lime, 1995; Nassauer, 1983).

Use of Photographs for Observer Judgments. A number of studies have reported high degrees of similarity between observer judgments made on-site compared with those derived from photographs (McKechnie, 1977; Nassauer, 1983; Shuttleworth, 1980; Stewart et al., 1984). The majority of these studies focused on observer preferences for natural landscapes (Bishop and Hull, 1989; Bishop and Leahy, 1989; Daniel and Orland, 1992). Other research has indicated that alternative forms of transmitting visual information are adequate substitutes for either photographic or on-site observation. For example, Shelby and Harris (1985) reported that evaluations based on written descriptions of wilderness campsites did not differ significantly from those based on actual visits to those sites. Comparisons of computer simulated images to the more traditional analytical medium of photographs have also indicated high degrees of correlation (Bishop and Leahy, 1989; Orland, 1988; Orland, 1993; Vining and Orland, 1989).

Challenging the Use of Photographs. A small group of studies have challenged the generally accepted notion that photographs and on-site observations are actually similar. The correspondence between experimental (photographic) and “real life” (on-site) contexts was questioned by Hull and Stewart (1992) who brought up the broader
question of ecological validity when photographic representations of visual scenes are used to analyze scenic beauty. Their concern echoed other studies which speculated that qualitative differences in the experience of the observer call into question the similarities found by previous research between various visual contexts (Ulrich, 1983; Wohlwill, 1976). The effect of factors such as novelty, surprise, variety and other sensory inputs (sound, smell) are characteristics of the on-site observer experience which photographs cannot convey.

Hull and Stewart’s (1992) results were mixed regarding the differences between individual participant’s on-site and photo-based scenic judgments, with indications implying a limited level of correlation between the two. They attributed their findings to differences in meaning, novelty, and mood between the visual contexts, but the primary difference they found was in the units of analysis. Their scenic quality analysis focused on the individual rater as the unit of analysis, as opposed to group averages, or standardized scores. For example, they noted that when group averages were examined, on-site scenic beauty ratings were highly similar to the average photo-based ratings, but when individual raters were compared, there were considerable differences in their scenic judgments.

Relevant Dimensional Aspects. Several studies have asserted that the validity of photographs as surrogates for field observation depends on the degree to which
relevant aspects of the environment are represented in the photographs (Sheppard, 1989; Stewart et al., 1984) and that visual aspects are more important and relevant than peripheral aspects of experience. Relevant dimensional aspects of the environment would include clarity, color, border, viewpoint, and cloud cover. Stewart asserted that the validity of photographs as visual alternatives to on-site judgments depends on the following characteristics: 1) vision is the dominant sense used to gather relevant information 2) observers are stationary when the judgments are made 3) relevant visual information is located far from the observer 4) visual information out of the observer's field of view should be irrelevant to the judgment 5) observers are trained to make sound visual judgments 6) visual distortions (e.g. color) in photographs are replaced by other information of equivalent value.

**Effects of Information on Scenic Quality Judgments**

People endow meaning to landscapes and it is through analysis of individual preferences and attitudes that people can offer clues about the value they assign to scenic quality. The aesthetic philosopher S.C. Pepper (1937) proposed that knowledge of the context and meaning of an object can intensify the emotional appreciation of that object. Fazio and Zanna (1981) demonstrated that attitudes toward an object are stronger and more accessible when they are based on direct, behavioral experience with the attitude object (in this instance, a scenic national park). Magill (1990; 1992)
noted that understanding meanings and attitudes associated with landscapes is particularly important in terms of the influence that human activity might have on the scenic appearance of natural areas, especially if those activities are related to management activities. Despite the volume of research into the dynamics of scenic beauty judgments, there is relatively little research in the literature relating to effects of real or implied human influence on scenic vistas. Indeed, only four studies could be found that make up the core of published inquiry into this area.

By the 1970’s, researchers began examining the effect of direct or implied human influence on scenic quality (Zube et al., 1975). Carls (1974) asserted that the character of the landscape is determined by natural conditions of the site and visual artifacts of human activity. Using color photographs as representatives of landscape scenes, he investigated the influence of people and human-influenced conditions on preferences for outdoor recreation settings. His study used the presence of recreational developments as evidence of human influence. Carls’ findings suggested that as landscapes change to reflect increased levels of development there will be an attendant decrease in observers scenic quality ratings. However, the results from his study are somewhat limited in that they seem to imply more about people’s preferences for recreational developments than the effect of human influence on a natural setting.
Hodgson and Thayer (1980) demonstrated the negative effects of implied human influence on natural settings by changing the labels on landscape photographs to imply human influence. They found that photos with natural labels attached (lake, pond) were ranked higher in scenic quality than photos with labels implying human influence (reservoir, irrigation). The researchers agreed with Leff (1974) who asserted earlier that at least some of the beauty inherent in the physical environment derives from the observer's knowledge about the place in question.

Another study which explored the social factor of information effects on scenic quality was conducted by Anderson (1981), who investigated the effect of land use designations on scenic judgments in forest landscapes. Anderson found that observers judgments were sensitive to the labels on scenic slides as well as information provided while on-site. She concluded that for scenes of high scenic quality (such as in national parks and wilderness areas), an enhancing natural label can raise aesthetic values, but a detracting label implying human influence had only a slightly detrimental effect.

Scenic Quality Research in the National Park System

Previous research has indicated that viewing natural scenery is one of the primary reasons visitors travel to the national parks (Lee and Brown, 1992; Rolloff et al., 1996). Therefore, understanding scenic values should be especially important to managers in the National Park Service. The exploration of visitors' scenic values has
been particularly useful in visual quality assessment within the Park Service, and the predominance of research within the parks has often been focused on the observed experience of the park visitor (Bromley, 1980). Visual assessment techniques have been commonly utilized by researchers and managers for studying visitor perceptions of existing natural and environmental conditions (Rowe and Chesnut, 1983).

Park visitors generally place value on the quality of naturalness as part of their park experience (Bonnicksen and Stone, 1985). Subsequently, much of the research in national parks investigates visitors' levels of satisfaction with varying levels of scenic degradation. The majority of visual perception studies relating to national park visual resources have considered park air quality and visibility (Burdge et al., 1983; Greene et al., 1982; MacFarland et al., 1983; Malm et al., 1981; Schultze et al., 1983), but general scenic beauty evaluations have also been the focus of scenic research with park visitors (Call et al., 1981; Steinitz, 1990). Through their participation in such research, national park visitors have played an important role in providing park managers and planners with important scenic feedback (Bromley, 1980). This has been the case particularly in studies relating to visitors' current values for scenery (Taylor et al., 1995) as well as visitors' reactions to potential changes in the appearance of scenic views (Johnson and Haspel, 1983).
Scenic Quality and Preservation Values at Crater Lake National Park

Recognition of Crater Lake as a scenic resource is long-standing. Reports of the first white explorers' visit to Crater Lake in 1853 account their amazement at the water's scenic beauty, which they first named “Deep Blue Lake.” By the late 19th Century, Crater Lake was recognized as a site of national importance, due in part to its scenic value (Cranson, 1982).

By the late 1800's, increased appreciation for the nation's natural wonders involved both scenic and commercial values, creating conflicts over the preservation and use of national scenic treasures (Nash, 1968). For example, in response to the conflict between commercial and preservation value, the federal government protected the natural wonders in northwest Wyoming by creating Yellowstone National Park in 1872. The enabling legislation of Yellowstone National Park included provisions for the preservation of the natural setting, ensuring “their retention in their natural condition.”

Efforts aimed at preserving Crater Lake had developed by the 1880's, with petitions appealing to President Cleveland for protection of the area as a public park. In recognition of the preservation value of the site, Cleveland withdrew from the public domain ten townships of land surrounding Crater Lake in 1886. In 1902,
President Theodore Roosevelt signed a bill into law giving Crater Lake national park status. This law stated that the Secretary of Interior should

cause adequate measures to be taken for the preservation of the natural objects within said park, and also for the protection of the timber from wanton depredation, the preservation of all kinds of game and fish...and the prevention and extinguishment of forest fires.

(16 USC 122)

In the first decades of this century, maintaining natural scenes for their aesthetic values was reaffirmed in the creation of the National Park Service. In establishing the National Park Service with the Organic Act of 1916 Congress made clear the fundamental purpose of the park system was to conserve scenery and natural and historic objects. The Park Service was called to

promote and regulate the use of the Federal areas known as national parks... by such means and measures as conform to the fundamental purpose of said parks...which purpose is to conserve the scenery and the natural and historic objects... therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

(16 USC 1)

Since its establishment, the National Park Service has recognized the importance of providing for the use and enjoyment of park visitors as well as the
preservation of park resources. The centrality of scenic opportunities at Crater Lake is illustrated in the fact that by 1918, a road had been completed around the rim of the lake for visitors to travel. The importance of the condition of Crater Lake has been a long-standing concern of researchers; its remarkable blue color and extreme water clarity was the focus of early research in the park (Pettit, 1936). Providing for the preservation of scenic opportunities based on landscape features at sites such as Crater Lake has remained one of the primary tasks of the National Park Service for over 80 years. However, the varying disciplines of National Park Service managers (landscape architects, biologists, and engineers) have historically produced conflicting interpretations of the meaning of “unimpaired” (Sellars, 1997).

Theoretical and Applied Issues

Leopold’s conceptualization of the land aesthetic has relevance for current park management in that it lies at the heart of an understanding of modern American environmental sensibilities: the desire for quality scenery in a landscape with its natural integrity intact. But when do people begin to notice change when it is occurring and do such changes represent a threat to the natural integrity of a view? Is there more to the beauty of the land than what appears on the surface? Do people value landscapes less when they know more about the naturalness, or unnaturalness, of what rests before them in a scenic view?
The issue of whether or not scenic beauty is an objective quality inherent in the landscape or a subjective impression based on individual human perception remains open to investigation. The duality represented in past research by the separation of objectivist and subjectivist approaches to scenic quality has become increasingly criticized as limited and fragmentary by researchers (Bourassa, 1990; Vining and Stevens, 1986). An integrated approach needs to be utilized for both theory and application to progress. This integration would include salient physical landscape characteristics partnered with human preferences, values, and predictive equations (Zube 1982). The inclusion of public preferences in analysis of landscapes of national significance (such as national parks, wild and scenic rivers, and wilderness areas) follows as an attendant characteristic of an effective integrated scenic quality analysis. Substantial research findings support the appropriate use of photographic representation of landscapes in public preference analysis. However, concerns relating to the representation of relevant visual dimensions in analysis remain in consideration as the field of landscape analysis has recently moved into the regular use of computer-generated visual images. The complexity of scenic quality analysis suggest that use of multiple methods will capture the dimensional aspects of perception, preference, and attitude (Egan et al., 1995).
Chapter 3. METHODS

Objectivist and Subjectivist Perspectives

Research associated with the objectivist perspective in scenic assessment has focused measurement of landscape parameters, largely based in psychophysical theory (Daniel and Boster, 1976; Fechner, 1860/1966; Hull et al., 1984). This approach has been dominated by the disciplines of landscape architecture, psychology, and sociology. Psychophysical techniques are commonly associated with those of the physical and quantitative sciences. These are based on the assumption that specific, measurable parameters contribute to the perception of beauty and therefore can be described and predicted. Visual elements, such as the presence of geological features (such as water or mountains), or evidence of land use patterns, are often the focus of empirical analysis. A good example of this approach is the Scenic Beauty Estimation method, the dominant landscape assessment tool used by the U.S. Forest Service (Daniel and Boster, 1976). The primary assumption of the Scenic Beauty Estimation method is that people are consistent in their perception of the physical characteristics of objects, which in turn become the physical referent upon which to base the measurement of the construct of beauty. Previous empirical research has documented
wide variation regarding what composes scenic quality (Dearden, 1985; Zube et al., 1987) and the debate has continued into the 1990’s as more techniques, such as the use of computer-imagery, have developed (Orland, 1994; Orland et al., 1996).

This approach represents the perspective that beauty is in the eye of the beholder, and that the focus of study is the individual perceiver, not the landscape itself. From this viewpoint, the landscape exists only as it is perceived by the individuals under scrutiny. Therefore, personal perception comprises the heart of this approach, with internalized attitudes and values comprising the units of study. Tools used from the standpoint of the subjectivist perspective in landscape assessment include interviews, participant observation, and insights obtained through observations in literature, art, and even postcards (Marsh, 1985). In recent years, the human sense of place and place attachment have gained attention from researchers studying scenic quality (Mitchell et al., 1993). In one example, Mitchell notes that the Limits of Acceptable Change process (Stankey et al., 1985) utilized by the U.S. Forest Service could be adopted by managers to identify limits of change for place attachments, or affection thresholds, as part of incorporating personal place values into planning endeavors.
The Transactional Approach

It is proposed that both the objectivist and the subjectivist perspectives will provide useful insights into the research questions considered in this study. Indeed, both approaches have their merits, with elements of each contributing to a broader understanding of the physical elements of landscape quality and the human perceptions of scenic beauty. From a psychological perspective, Ittelson (1973) theorized that environments and human behavior are based on an interactional process, which he calls the *transactional* view of landscape experience. Dearden (1985) suggested that beauty should be considered a *relational* force, with scenic quality functioning as a dynamic interaction between the observer and the landscape, rather than residing in one or the other. Because elements of beauty comprise both the external physical environment as well as internal perceptions and attitudes, it seems logical that both should be considered as components of scenic quality. This study adopts a relational, or *transactive* perspective and explores both from the standpoint of the visitor experience at Crater Lake.

Overall Study Design

Data collection for the study was conducted during 1996 and 1997 at Crater Lake National Park. During 1996, a visitor study was conducted at the park Visitor
Center (in the Steele Center) and at Rim Village. The Visitor Center portion of the study consisted of a cross-sectional attitude survey. The purpose of the survey was to make inferences regarding park visitors' scenic judgments of Crater Lake as well as their attitudes toward potential human uses of the lake water. At the same time, the Rim Village portion of the study tested the representativeness of the Visitor Center sample. The study conducted in 1997 consisted of a series of qualitative group interviews conducted at the Visitor Center. The purpose of the interviews was to explore visitors' scenic preferences and attitudes on an interactive, discussion-based level.

Scenic Preference and Attitude Study

Subjects. Individuals participating in the scenic preference and attitude survey during the 1996 portion of the study were 1,168 visitors to Crater Lake National Park during August and September. The population in the study is defined as all visitors to Crater Lake National Park during the study period. Participant characteristics from visitors in the 1996 study have been included in Chapter 4, Table 4.1.

1996 Survey Instruments. Two surveys were designed for the 1996 portion of study. For the Visitor Center study, a survey was developed for gathering information from park visitors on their scenic preferences for Crater Lake vistas as
well as their attitudes toward park resources. A copy of the Visitor Center survey has been provided in Appendix A. The second survey was a brief questionnaire used to investigate visitor characteristics at the most commonly visited area in the park, Rim Village. The Rim Village questionnaire has been included in Appendix B. The goal of these types of cross-sectional surveys is to provide a description of the park visitor population at a single point in time from which observations and inferences can be drawn.

A pre-test of the survey instrument used at the Visitor Center was conducted during the winter of 1996 utilizing students at Oregon State University, and again in July with visitors at Crater Lake National Park. From information gathered in these pretests, refinements were made in the photographic images and experimental design of the study. For example, adjustments were made to improve the color balance and saturation in the computer generated slide images. During the pretests, researchers also realized the importance of obtaining the same focal length of slide projector lenses for the two projectors used in the study so that image appearance, size, and focus would be as balanced as possible.

**Procedures.** Principal data collection for the Visitor Center and Rim Village portions of the study commenced on August 11 and concluded on September 14, 1996. The time frame for the survey included 16 randomly selected days for data collection.
The scenic preference portion of the study was conducted in the 50-seat auditorium at the Visitor Center. Administration of this part of the survey occurred between the hourly showing of an interpretive video. A total of 958 visitors participated in the Visitor Center portion of the study. The shorter survey conducted among visitors along the rim walkway at Rim Village, had 210 visitors participating. The purpose of this more limited survey was to gather socio-economic and visitation data from individuals at the Rim to determine if the people participating in the survey at the Visitor Center were representative of all visitors to Crater Lake National Park.

People at the Visitor Center were requested to participate in the study through two means. An invitation was made to visitors at the conclusion of the 18-minute interpretive video. Visitors were also invited to participate in the study through a general announcement in the Visitor Center lobby. Both invitations explained that information gained in the study would aid National Park Service managers by providing them with valuable information about visitors' attitudes toward Crater Lake National Park resources. In addition, the researcher explained that the study took approximately 20 minutes to complete. A participation incentive was offered to visitors in the form of a photographic viewbook of Crater Lake, *The Story Behind the Scenery* (Warfield et al., 1996). Participants were assured verbally and in written form that their responses were completely voluntary and confidential. Participation in all
parts of the study was limited to individuals who were 18 years of age and older.

Visitors in the Rim Village sample were approached individually by the study research assistant. During randomized sampling periods, participants were selected by approaching every other group that passed along the rim walk at Rim Village. Each group encountered using this sampling technique was invited to participate in a voluntary visitor study. No incentive was offered to visitors for this portion of the study. The total time used by visitors in filling out the Rim survey was approximately one minute. Visitors in the Rim Village sample were assured both verbally and on the survey form that the information they provided would be used only for research purposes and that their responses were anonymous and confidential.

**Sampling.** From information provided by National Park Service managers, it was resolved that sampling evenly throughout the day would give the best representation of daily visit distribution since no specific visitation frequencies were available for the current Visitor Center location (the last visitor studies were conducted before 1988 when the current interpretive center location was established). Hourly sampling of visitors began at 10:00 a.m. and concluded at 4:00 p.m. These hourly samples are hereafter referred to as "sessions" in the study. The scheduling of data collection was also designed to reflect the distribution of visitors during the park's high and low use seasons. The sampling framework reflects this distribution,
with 80% of the data collection during the high use season (before Labor Day) and 20% during the low use season (after Labor Day). While sampling dates were determined randomly, each day of the week was represented at least once during the data collection.

A goal during survey development was to depict views most commonly seen by visitors. From a previous study of visitor traffic patterns at Crater Lake (Shelby and Wolf, 1981), it was observed that 76% of visitors travel along the route between Rim Village and the northwestern corner of Crater Lake. Further, the report indicated that 90% of park vehicle traffic passed park headquarters at the Steele Center (the site of the present Visitor Center). This information was corroborated by present Park Service managers, who indicated that most visitors enter from the south and then exit through the north, or vice versa. The most regularly traveled segments of Rim Drive were taken into consideration when selecting which viewpoints to use in the study.

The Survey Instrument. The three images chosen for the study represent commonly visited viewpoints of Crater Lake on the route along the lake's western rim (Figure 3.1). Common to all views was the presence of Wizard Island, a partially forested, 764 ft. cinder cone rising from the central-western side of the lake. The first view faces north from Rim Village toward Llao Rock. The second view faces
northeast from Discovery Point toward Llao Rock. From above Merriam Point, the third view faces south toward Rim Village at the northwestern edge of the rim. All three views have Wizard Island placed in the foreground. Viewpoints from Rim Village and Merriam Point are both 1.5 miles from the nearest shore of Wizard Island, while the view from Discovery Point is 1 mile distant from the shore of the island. Slides taken from Merriam Point and Rim Village have prominent views of Skell Channel between Wizard Island and the caldera wall (channel water depth 20 feet at the time of slide exposure). The image from Discovery Point (View 2) does not show Skell Channel. These rim views are at an elevation of approximately 7,100 feet above sea level, placing them just under 1,000 feet above the level of the lake. At the time the slides were taken, the elevation of the lake surface was 6,168 feet. Historically, Crater Lake levels have ranged from approximately 3 meters below to 2 meters above the lake level on September 5, 1995. From Crater Lake limnological studies (Redmond, 1993), a mean of 6,175 feet has been established for the lake level over the last century. Therefore, the level of 6,168 feet used in this study is within typical fluctuations of the lake level.
Figure 3.1. Location of Study Viewpoints

View 1. Rim Village

View 2. Discovery Point

View 3. Above Merriam Point

CRATER LAKE
Slide exposures used in the study were taken on September 5, 1995 between 10:00 a.m. and 2:00 p.m. A Nikon N5005 with a 28-200mm Tamron lens was fixed on a high-angle Gitzo tripod. Velvia professional slide film was used for the images. After the slides were processed, they were digitized and placed in CD-Rom format. Images in the CD-Rom were formatted at a high resolution (1536 X 1024 pixels) with a 24-bit color depth. Digitized versions of the lake views were edited with Adobe Photoshop software (Version 3) on a Macintosh PowerPC computer. Adobe Photoshop is commonly utilized software for creating images reflecting environmental changes such as those in this study (Orland et al., 1996). Consultants in the creation of the image sets included an oceanographer and an aquatic biologist who are members of the faculty of Oregon State University involved in the lake research program at Crater Lake. Additionally, a computer graphic artist was involved in the creation and editing of the image sets.

The elevation of Wizard Island and the contours surrounding the island were used as scale references in the creation of images reflecting lake levels dropping to 25, 75 and 125 feet below the original level shown in photos from September 5, 1995. Lake level changes were determined by using the height of Wizard Island as a reference point against the numeric scale on the top and bottom of the workspace in Adobe Photoshop. Information regarding the bathymetric contours surrounding Wizard
Island was used in combination with the known height of the island to determine the vertical change in lake level as well as change in shoreline on the island.

The three lake level changes were chosen after the pretest of the survey showed the extent to which people noticed different changes in lake levels. No images taken from the surface of the lake were included in the study because the scale of changes up to 125 feet did not lend themselves to available surface-level images. Park managers also noted that only 5% of Crater Lake visitors made the effort to walk down to the lake level for a boat ride. Therefore, researchers decided to use images taken from the elevation of Rim Drive, where the majority of park visitors view the lake.

**Slide Presentation.** Table 3.1 lists all slide views and lake level depictions created for the study. Photographic reproductions of each of the slide views have been included in Appendix D.

**Table 3.1 Slide Set Format**

<table>
<thead>
<tr>
<th>View 1</th>
<th>View 2</th>
<th>View 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rim Village</td>
<td>Discovery Point</td>
<td>Merriam Point</td>
</tr>
<tr>
<td>1. Average level</td>
<td>1. Average level</td>
<td>1. Average level</td>
</tr>
<tr>
<td>2. - 25 feet</td>
<td>2. - 25 feet</td>
<td>2. - 25 feet</td>
</tr>
<tr>
<td>3. - 75 feet</td>
<td>3. - 75 feet</td>
<td>3. - 75 feet</td>
</tr>
<tr>
<td>4. - 125 feet</td>
<td>4. - 125 feet</td>
<td>4. - 125 feet</td>
</tr>
</tbody>
</table>
Instructions from the scenic preference portion of the survey have been provided in Appendix C. Presentation format during data collection was organized so that each slide within the three views was paired with the other slides in the same view set. For example, the slide showing the original lake level in View 1 was paired with every other level in the View 1 slide set, the -25 level slide was paired with -75 and -125, and the -75 level was paired with -125 (a total of 6 pairs). Analogous pairings were done for the View 2 and View 3 slide sets, resulting in 18 slide pair combinations.

The systematic pairing of visual stimuli, or the method of paired comparisons, is a commonly utilized method for testing scenic judgments (Buhyoff and Wellman, 1979; Vining and Stevens, 1986).

**Instrumental Consistency.** One question which arose during the pretesting of the study was related to the consistency with participants rated the images in the slide portion of the survey. When forming judgments about the scenic quality from the slide views, would participants focus their attention on the changing lake levels, or would they focus on some other perceived difference in the paired slides?

To investigate the possibility that participants' visual judgments were focused on referents other than the water level, two "matched pairs" slide sets were included in the visual portion of the study, which increased the total number of pairs to 20. For example, a slide showing View 1 Level 1 would be matched with itself. In other
words, is it possible that study participants would see a difference when there is no difference in slide views presented to them? In addition to the matched-pair method, the consistency of participants' scenic judgments during the study were explored in qualitative fashion during the group interview phase.

**Slide View Survey Format.** As stated previously, visitors were instructed to provide two pieces of information for each slide pair they viewed. First, they were asked if they saw a difference between the two views. Second, they were asked to indicate their preference for one view over the other. The right and left position of lower and higher lake levels was randomly assigned throughout the slide pairs. Right and left carousel assignments were randomized between each slide session on each day of data collection. The order of the slide pairs was also randomly changed between survey dates.

As part of the instructions (Appendix C), study participants were asked to rate the scenic quality of the view in the slides, not the slides' quality. Each slide pair was shown for 20 seconds. After the slide portion of the survey, visitors were instructed to fill out the rest of the survey at their own pace. Assurance of the confidential and voluntary nature of the survey were made at the beginning and conclusion of the survey session and was also written in the text of the survey instrument itself.
Information Treatments. Effects of information on visitors' scenic judgments of the slide sets were also investigated. Respondents were randomly allocated to treatment groups throughout the sampling period, and each group was exposed to a different type of information about the slides they were rating (Table 3.2). The first treatment group received no information about the fact that lake levels were changing in the slides they were rating. The second treatment group received verbal information which alerted them to the changing lake levels (with no explanation of why the level was dropping). The third and fourth groups viewed slides which had labels in white lettering embedded in the slide image at the bottom of the picture. The labels contained information regarding the change in lake levels in feet, as well as the reason for the change. For example, the third group's labels stated “lake levels [25, 75, 125] feet lower due to natural variation,” while the fourth group’s labels stated “lake level [25, 75, 125] feet lower due to human use of lake water.” Instructions used by the researcher for these information treatments are included in the subtext of survey instructions in Appendix C. The fifth treatment group completed the survey question (#7) relating to various potential human uses of the water in Crater Lake prior to viewing the slide portion of the survey. The purpose of switching the order of the attitude and preference portions of the survey was to investigate the informational
Table 3.2. Information Treatments

<table>
<thead>
<tr>
<th>Group</th>
<th>Information Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No information</td>
</tr>
<tr>
<td>2</td>
<td>Verbal information</td>
</tr>
<tr>
<td>3</td>
<td>Natural variation information (slide text)</td>
</tr>
<tr>
<td>4</td>
<td>Human influence information (slide text)</td>
</tr>
<tr>
<td>5</td>
<td>Potential human uses information (priming effect)</td>
</tr>
</tbody>
</table>

priming effect of participants considering specific human uses of the lake water which would cause a lowering of the lake level.

Therefore, groups 2, 3, and 4 knew that they were rating their visual preferences for alternative lake levels, while the first group knew only that they were rating their visual preferences for different slides of Crater Lake. From comments during the pretest as well as comments from on-site study participants, it became clear that many in the first treatment group probably realized after a few slide pairs were shown that they were rating different lake levels, but this was never explicitly stated by the interviewer.

Scales of Measurement

Measurement of park visitor perceptions and attitudes was accomplished by the construction of different response scales for each part of the on-site survey. These
scales are similar to preference and attitudinal scales used in other social research, but were tailored specifically for this study. Comparative scales such as the one used in this study are a common format for measuring scenic beauty (Arthur et al., 1977; Brown and Daniel, 1986; Brown and Daniel, 1990).

Vining and Stevens (1986) note that the central purpose of response scales is to provide an observable indicator or response from which a scale of measurement may be derived. In measuring scenic quality, direct scales of measurement are not attainable because the property to be measured has no immediately definable physical scale. The concept of beauty does not automatically suggest a physical measure. As a result, response frameworks aim at creating an indirect measure which allows the construct to be quantified.

For the slide portion of the study, a method of paired comparisons (Torgerson, 1958) was utilized to compare changing conditions of the same visual scene. The first task for each participant upon presentation of the paired views was to detect whether or not the two views were different. Then scenic preference for the views was measured on a 5-point categorical scale: strongly prefer the left, prefer the left, no preference, prefer the right or strongly prefer the right.
Data Analysis

The results from the paired slide comparisons will be analyzed in three different ways.

Mean Response to Slide Pairs. The first method used to analyze participants' responses to the slides looks at the mean response to the 18 slide pairs used in the visual portion of the study. The data were recoded so that all higher lake levels corresponded to those on the left screen for the respondent. If the respondent stated that he or she preferred or strongly preferred the higher lake level, this response would be coded as -1 or -2, respectively. If the participant preferred or strongly preferred the lower lake level, this response would be coded as +1 or +2, respectively. If the participant stated that he or she preferred neither, the response was coded as a zero. The null hypothesis was that there was no preference for higher or lower lake levels (mean response = 0), and a t-test is used to assess whether mean responses were significantly different from zero.

Times an Individual Slide is Preferred. The second way to analyze the results of the slide preference ratings is to calculate the mean number of times that any given

---

1 Recall that the lower and higher lake levels were randomly assigned to the left and right screens during the interview process. An example of the recoding would be for the lower lake level that was presented on the right screen with the response of preferring the right to be recoded to show the lower lake level on the left and the respondent preferring the left.
slide was preferred to all the other comparator slides. Within each view, a participant compared each lake level with three other lake levels (e.g., average level vs. -25 feet, average level vs. -75 feet, average level vs. -125 feet). If the average level (the original lake level) was preferred to the other three levels by all of the respondents, then the mean number of times that level one was preferred would be equal to three. At the other extreme, if level one was never preferred to the other lake levels, the mean number of times that level one was preferred would be equal to zero. The null hypothesis would follow that the means between all four levels would be equal. At this point there was a concern that observations for each slide pair would not be independent of each other. A consulting statistician suggested that participants' responses to the slides could also be summarized across all 18 pairs to allow for a simultaneous discussion of all explanatory variables.

The Agreement Statistic. Summary statistics were created for both the difference and preference components of the visual portion of the study. These statistics were created from the participant's observed responses to each of the slide pairs. These summaries are a function of each participant's responses to the two parts from each slide pair: first, whether participants could detect a difference between the slide pairs, and second, whether participants had a preference for views depicting lake levels closer to normal, or average levels. This procedure reduces these multiple
responses to a summary response for differences noticed (the Dscore) and view preference (the Pscore).

Differences Noticed and Preferences for Lake Levels. A table of observed differences and preferences was constructed from each participant’s responses to slide pairs. These tables allow for quantifying how much a visitor’s perception and preference departed from an expected, or ideal, result. Green and Swets (1966) outlined the use of representing an “ideal” or optimal performance in the detection of visual or aural change in their work developing Signal Detection Theory. This ideal refers to the best possible performance in detecting signals under specified conditions. In this study, Dscores and Pscores provide insight into how the individual participants compared to an “ideal” performance, for example, one in which a participant is able to detect differences whenever they occur, and when a participant always prefers the slide showing a higher level in each slide pair presented.

Calculation of the two agreement statistics follows similar processes. However, as will be noted during the results section of this dissertation, a direct understanding of the calculation of the Pscore proved to be more complex than that of the Dscore, where defining an “ideal” response for the Dscore was calculated as either seeing a difference or not. The scaled nature of individual preferences for slide views (on a 5-point left to right preference scale) made the definition of an ideal response
problematic. Because of the interpretive difficulty with the Pscore, researchers determined not to include it in the main analysis of the study. Instead, an exploratory analysis and discussion has been included in Appendix G. The following section outlines how the expected and observed responses are treated for responses to the difference question.

Calculation of the Dscore

The disparities between different lake levels correspond to the following groups in Table 3.3.

Table 3.3. Scoring System for Correctly Perceived Differences.

<table>
<thead>
<tr>
<th>Score on table</th>
<th>Change in magnitude</th>
<th>Number of differences possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>For a 1 level change between levels 1 and 2, 2 and 3, 3 and 4</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>For a 2 level change between levels 1 and 3 or 2 and 4</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>For a 3 level change between levels 1 and 4</td>
<td>3</td>
</tr>
</tbody>
</table>

The following 2x3 table (Table 3.4) represents an “ideal” participant who correctly perceived differences whenever they existed in the slide pair presentation. In other words, the table represents an expected score for the participant who was able to
correctly detect all differences in each of the slide pair comparisons. In this manner, a response that relatively quantifies the participant's departure from the expected score, or "ideal," can be defined.

Table 3.4. Expected Counts Table.

<table>
<thead>
<tr>
<th>Is there a difference?</th>
<th>Change in Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>9, 6, 3</td>
</tr>
<tr>
<td>No</td>
<td>0, 0, 0</td>
</tr>
</tbody>
</table>

From each of the participant's responses, a separate observed response table was constructed based on their responses. The following tables represent two examples of observed counts for two participants. The first (Table 3.5) represents a score greatly departed from the expected score, while the second (Table 3.6) represents an example of a score closer to the expected score. Similar to the formula for standard deviation, computations for the departure from expected difference statistic (denoted as $DE_{ij}$ following each table) are calculated as follows:

$$DE_{ij} = \sum_{\text{over all 6 cells}} (\text{observed # in cell} - \text{expected # in cell})^2$$
Table 3.5. Observed Counts Table. (Far from expected).

<table>
<thead>
<tr>
<th>Is there a difference?</th>
<th>Change in Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
</tr>
</tbody>
</table>

The above observed counts table for the participant who had difficulty detecting differences when they existed in the slide pairs indicates that this participant's agreement score would be equal to 154, calculated as:

\[
DE_{ij} = (9 - 1)^2 + (6 - 3)^2 + (3 - 1)^2 + (0 - 8)^2 + (0 - 3)^2 + (0 - 2)^2 \\
= 154
\]

Table 3.6. Observed Counts Table. (Close to expected)

<table>
<thead>
<tr>
<th>Is there a difference?</th>
<th>Change in Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
</tr>
<tr>
<td>No</td>
<td>3</td>
</tr>
</tbody>
</table>

The above observed counts table for the participant who was more accurate at detecting differences when they existed in the slide pairs indicates that this participant's agreement score would be equal to 33, calculated as:

\[
DE_{ij} = (9 - 6)^2 + (6 - 5)^2 + (3 - 2)^2 + (0 - 3)^2 + (0 - 1)^2 + (0 - 1)^2 \\
= 33
\]
In order to assist in the understanding of these auxiliary measures, we will define a relative measure of DE. The greatest departure from the expected occurs if a subject sees no difference in any of the slide pairs. This is a "worst case" scenario, and the largest possible DE score would be achieved in this case. This response to the 18 slide pairs would result in the score corresponding to Table 3.7.

Table 3.7. Worst Case Counts Table. (Farthest from expected)

<table>
<thead>
<tr>
<th>Change in Level</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

DE = (9 - 0)^2 + (6 - 0)^2 + (3 - 0)^2 + (0 - 9)^2 + (0 - 6)^2 + (0 - 3)^2
DE = 252

The relative departure from expected follows by dividing the DE score by this maximum departure value:

RDE = DE / 252

From the example above, the score will be RDE = 252/252 = 1, similarly, for the "ideal" participant the relative departure from expected will be

RDE = 0 / 252 for a score of 0.

In order to make the scale more intuitive, where 1 indicates a perfect response...
and 0 indicates a worst score, the following calculation is given a positive numerical orientation such that 0 would represent the worst score and 1 would represent the ideal score. Therefore, for the agreement score (Dscore$_{ij}$):

$$Dscore_{ij} = 1 - RDE$$

Therefore, Dscore$_{ij}$ is the response of interest, the agreement statistic, which indicates the participant's ability to see differences in the lake levels.

A between-subjects analysis of variance utilizing a nested (or hierarchical) factorial design (Kuehl, 1994) will be conducted to understand the character of participants' Dscores and Pscores. Whether there are informational treatment effects and session effects will also be investigated. Interactions which might affect participants' abilities to detect differences in the paired slides, as well as their preferences for slide views, will also be examined. The design in this study is nested in that the individual sessions conducted with visitors occurred within the individual sample dates and had no relationship with sessions on other treatment dates. Individual participants are nested in similar fashion in that visitors in the study participated within an individual session.
Focused Interview Study

Study Participants. Participants in the 1997 phase of the study were visitors to Crater Lake National Park during the fall season. A pre-test of the group interview was conducted using a small number of residents of Corvallis, Oregon in the summer of 1997. The onsite sample for this part of the study was comprised of 4 group interviews with a total of 34 visitors participating. The sample of interviews followed guidelines suggested by Krueger (1998) who stated that conducting 3 or 4 group interviews to determine if additional groups or information are needed to explore the research questions.

Volunteers for the group interview portion of the study were invited to participate in the study in the same manner as in the previous year’s study; an invitation was made to visitors at the conclusion of the 18-minute interpretive video and through a general announcement in the Visitor Center lobby. In addition, the researcher explained that the interview would last for approximately 30 minutes. A participation incentive was offered to visitors in the form of a small photographic viewbook of Crater Lake. Interviewees were assured that their participation was completely voluntary, confidential and anonymous.

An interview guide was developed for gathering qualitative information from participants regarding their impression of the slide instrument used in the scenic
portion of the study, as well as their scenic preferences for Crater Lake vistas. As part of the group interviews, visitors' attitudes toward natural and human influences in the park were explored in an interactive fashion. The interview guide has been included in Appendix E. This type of qualitative survey provides descriptive information which is used to inform the quantitative parts of the study and provide phenomenological insights.

**Procedures.** Once visitors agreed to participate in the interview, the slide portion of the study was shown in the same manner as in phase one, but a more open-ended response framework was utilized. The data collection form from this portion of the study has been included in Appendix F. First, participants were asked to indicate whether or not the paired views looked the same. If they saw a difference, visitors were asked to write about the difference seen in the slide pairs as well as to indicate if they preferred one view over the other. In this way, another indication of what people were viewing in the slide pairs can be gained, and more information is provided regarding the study instrument.
Chapter 4. RESULTS

Study Sample

Because the primary data collection for this study occurred at the park Visitor Center, there was some concern that the nature of the sample could be different from one representing park visitors to Crater Lake in general. Recall that two random samples of visitors were taken, one from the Visitor Center and one from Rim Village. The purpose of the Rim Village survey was to gather socio-economic and visitation data from individuals at that commonly visited area to investigate whether the people participating in the survey at the Visitor Center were representative of all visitors to Crater Lake National Park. Socio-economic and visitation characteristics were then compared between the two groups.

Details for visitor and trip characteristics are presented in Table 4.1. Results indicate that in most respects the two samples were not significantly different from each other ($p < .05$). Gender, age, and income were not significantly different, while level of education was slightly different ($p = .072$). The main difference was that a higher percentage of Visitor Center respondents had more than high school education. The two groups were not significantly different in terms of whether this was their first trip to Crater Lake, nor whether Crater Lake was the primary destination.
Table 4.1. Participant Characteristics and Trip Information

<table>
<thead>
<tr>
<th>Category</th>
<th>Visitor Center</th>
<th>Rim Village</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respondent Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>49.5 years</td>
<td>46 years</td>
</tr>
<tr>
<td>18-29</td>
<td>11.6%</td>
<td>11.7%</td>
</tr>
<tr>
<td>30-39</td>
<td>16.2%</td>
<td>25.5%</td>
</tr>
<tr>
<td>40-49</td>
<td>24.8%</td>
<td>48.3%</td>
</tr>
<tr>
<td>50-59</td>
<td>15.8%</td>
<td>20.7%</td>
</tr>
<tr>
<td>60-69</td>
<td>36.3%</td>
<td>34.4%</td>
</tr>
<tr>
<td>70-79</td>
<td>9.5%</td>
<td>4.8%</td>
</tr>
<tr>
<td>80+</td>
<td>1.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>54%</td>
<td>52%</td>
</tr>
<tr>
<td>Male</td>
<td>46%</td>
<td>48%</td>
</tr>
<tr>
<td><strong>Income Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Less than $15,000</td>
<td>5.7%</td>
<td>6.3%</td>
</tr>
<tr>
<td>$15,000 to $24,999</td>
<td>7.4%</td>
<td>7.8%</td>
</tr>
<tr>
<td>$25,000 to $29,999</td>
<td>4.8%</td>
<td>2.6%</td>
</tr>
<tr>
<td>$30,000 to $34,999</td>
<td>8.8%</td>
<td>6.3%</td>
</tr>
<tr>
<td>$35,000 to $49,999</td>
<td>21.7%</td>
<td>23.4%</td>
</tr>
<tr>
<td>$50,000 to $74,999</td>
<td>25.4%</td>
<td>26%</td>
</tr>
<tr>
<td>$75,000 to $99,999</td>
<td>11.7%</td>
<td>16.7%</td>
</tr>
<tr>
<td>$100,000 or more</td>
<td>14.6%</td>
<td>10.9%</td>
</tr>
<tr>
<td><strong>Educational Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 9th grade</td>
<td>1%</td>
<td>0.5%</td>
</tr>
<tr>
<td>9th to 12th grade, no diploma</td>
<td>3.0%</td>
<td>4.3%</td>
</tr>
<tr>
<td>High school graduate</td>
<td>8.7%</td>
<td>17.1%</td>
</tr>
<tr>
<td>Some college</td>
<td>22.3%</td>
<td>20.4%</td>
</tr>
<tr>
<td>Associate degree</td>
<td>6.8%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>21.5%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Some graduate school, no degree</td>
<td>11.1%</td>
<td>9%</td>
</tr>
<tr>
<td>Graduate or professional degree</td>
<td>25.5%</td>
<td>25.6%</td>
</tr>
<tr>
<td><strong>Have Previously Visited Park</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>66%</td>
<td>60%</td>
</tr>
<tr>
<td>Yes</td>
<td>34%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Crater Lake as Primary Destination</strong></td>
<td>Visitor Center</td>
<td>Rim Village</td>
</tr>
<tr>
<td>No</td>
<td>65%</td>
<td>60%</td>
</tr>
<tr>
<td>Yes</td>
<td>35%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Distance From Home</strong></td>
<td>Visitor Center</td>
<td>Rim Village</td>
</tr>
<tr>
<td>Average Miles</td>
<td>1105</td>
<td>836</td>
</tr>
</tbody>
</table>
of their trip. There was a difference between the two groups regarding their distance of residence from Crater Lake, with Rim Village respondents reporting a mean of 836 miles and Visitor Center respondents 1105 miles. However, both of these represent a substantial distance from the park, so in practical terms these differences are probably immaterial. Although statistical results from the sample at the Visitor Center can only be extrapolated to the Visitor Center population, the closeness of the sample to the Rim Village sample suggests that all Crater Lake visitors will have socioeconomic characteristics substantially similar to those who stop at the Visitor Center.

An additional issue involving the study sample is whether the sample of Visitor Center respondents represents the population of people who stop at the Visitor Center. Because the characteristics of the overall population are not known, it is not possible to determine whether the study sample represents the total population. However, by designing a random sampling strategy, estimates of the population parameters can be made with a certain statistical degree of confidence.

Response Rates and Reasons for Non-compliance. With surveys, there is also the issue of nonresponse bias; of those contacted, some park visitors chose not to participate in the survey. If those nonrespondents are “random,” then we wouldn’t expect any bias in the result. But if the nonrespondents are systematically different than the respondents, the study’s results would be biased. Again, without knowing the population characteristics, it cannot be known whether the sample is biased, but a
high response rate can be relied on to minimize the likelihood of nonresponse bias. The total response rate for the Visitor Center portion of the survey was 83%. Other studies on-site at national parks and protected areas have obtained similar response rates of 81%-85% (Hall et al., 1997; Hall and Shelby, 1994; Hall and Shelby, 1996; Lee and Brown, 1992). Considering the time requirement of the survey (25-30 minutes) and the average amount of time spent in the park (less than 4 hours as estimated by Park Service managers), the percentage of visitors agreeing to participate in the study was high. The response rate for the survey at Rim Village was even greater at 99%.

In order to understand reasons for not participating in the study, a sample of 40 individuals (17% of the total number of non-compliance) who were asked to participate in the study but declined were interviewed briefly by the researcher. Results from this sample suggested two primary reasons for not participating in the survey. The visitors often reported that they had young children with them and generally felt the children would not be able to sit through the 20 minute survey. Other non-responding visitors explained they were simply in a hurry to see the lake. Because no socio-economic or visitation data were collected from these individuals, a check for non-response bias in the Visitor Center survey was not possible. However, the relatively small number of non-respondents would tend to minimize any bias that might be present in the study. Indeed, Borg (1971) noted that if a sample attains at
least an 80% response rate, the potential for nonresponse bias to be sufficiently great to alter the results is highly unlikely.

**Instrumental Consistency**

As part of evaluating the effectiveness of the survey instrument, criteria for consistency were explored through techniques described in the methods chapter. For this study, there was a concern that individual participants were basing their judgments on stimuli other than the visual changes in the lake levels as depicted in the slides. An investigation of how participants used the study’s instrument will enhance the confidence that the measurements obtained reflect visual changes in the slides.

**Matched Slide Pairs.** Recall that matched pairs were introduced into the visual experiment in order to understand if participants were basing their responses to slide pairs on lake levels, as opposed to other perceived differences. Upon exposure to paired slide images, participants were asked to indicate whether they saw a difference between the two views. Presumably, if participants saw no differences in these matched pairs, the consistency of the slide instrument would be high. If participants saw differences when there were none, then the consistency of the paired images would be low.

When the matched pairs were analyzed separately from other pairs in the presentations, 64% of the respondents indicated that there was *no difference* when they were shown identical views while 36% indicated that they saw a difference when there
was, in fact, none. This difference is statistically significant across all information treatments in the study \( (p = .003) \). The range of proportion of responses in which no difference was perceived across treatments ranges from 57% of participants in Treatment 5 to 75% in Treatment 3.

Additionally, each of the three views used in the slides (from Rim Village, Discovery Point, and Merriam Point) was analyzed separately, and results are inconsistent between views. For example, in View 1 (Rim Village) participants seemed to correctly identify when no difference is present in the pairs when water levels are depicted at normal levels and at the -125 foot change. Participants are evenly split for seeing differences in the slide depictions of drops of -25 and -75 feet. This means that for these middle levels, half saw a difference when there was none.

In addition to indicating whether they saw a difference between the two slides in the slide pairs, participants were also asked to indicate if they preferred one slide view over the other. Participants who indicated that they saw a difference in the matched slide pairs also provided information relating to their scenic preference of the views in this manner. There is strong evidence of an interaction between the information treatment and the slide view \( (F = 3.64, p = .0001) \). This indicates that participants' mean preference depends on the information treatment and the slide simultaneously. When mean preference scores are analyzed by treatment group and by individual slide, however, participants consistently rated their preferences near the
middle "neutral" category on the 5 point preference scale. This suggests that, although participants may have wrongly indicated that they saw a difference, the similar nature of views explains the neutrality of their preference responses. The neutrality of their preferences implies that while visitors' perception of difference may have been off-base, their neutral preferences reflect a focus on the lack of visual changes in the slides.

**Group Interviews.** Another review of the study's instrument validity occurred during the group interview phase. Open-ended formats were used to elicit information from participants regarding their visual impressions of the slide pairs.

First, participants were asked to describe in written format what they saw in the slide views. Although the sample of interviews was small, results from written responses provide insight into what participants viewed in the slides. Responses were generally consistent in the qualitative study, with most respondents reporting no difference when matched-pairs were included in the presentation.

Written descriptions of the differences interview participants detected reveal that a variety of visual stimuli influence observations in the pairs. Many of the differences participants attributed to the pairs early in the slide presentation were view- and color-related. For example, one comment stated a preference for one view (the one depicting higher water) because of "the deeper color of the water." Another observed that "the view in the left seems sunnier and the island looks bigger." One participant wrote, "The left seems grander, with a more sweeping vista."
Responses from the open-ended format indicate that most visitors began noting the differences in water level depictions early in the order of slides, usually by the 3rd or 4th slide pair. One visitor noticed that “the water level is lower on the right” and that the view was “prettier with more water.” Another remarked, “I prefer the left view (with Wizard Island) as an island because it looks more ‘volcanic’ and isolated.” Indeed, by the third slide pair, everyone in the third interview group indicated a preferences for the higher level slide. For example, the third group (in which the higher water level was on the left), provided the following reasons for their preferences in response to the sixth slide pair.

Visitor A. The separation of water and mountain looks better.

Visitor B. The left has more lake showing.

Visitor C. Higher water makes a more attractive picture.

Visitor D. The left has more water.

Visitor E. The left is better, clearer.

Visitor F. The left is a better perspective.

Visitor G. Wizard looks better as an island.

At times, participants’ comments suggested that they believed that human-influence was responsible for the change in views, even when no such suggestions
were made by the researcher. For example, several observers attributed the increasing shore of Wizard Island in the lower lake levels to timber harvest on the island. These findings are similar to those observed by Magill (1994), who found in one study that observers believed mountain meadows were clearcuts and subsequently gave the scenes negative evaluations.

Open-ended questions in the interview following the slide presentation were also used to explore participants' observations of the slide pairs. Again, participants’ remarks indicate that the detection of the visual changes in the slides was relatively prompt. Indeed, one participant noted that

There seems to be a difference in the water levels of the lake. Some of the slides have lower levels of water, with greater exposed shore, while the other slides have greater volumes of water and seem to cover up some of the underlying parts of the island. It also changed the shape of the shoreline of the island with the amount of water.

Other responses during the interview indicated that some participants saw differences in the slides which were in contrast, but perhaps related, to the depictions of water levels. For example, this exchange occurred between two participants in the first interview group.

Visitor A. In some of them, particularly the first one, the water seems much bluer. Yes, that was the one. See the difference?

Visitor B. No, it's just the water level difference there. You can see that building on the beach [on the island] that shows you how much beach is being exposed when the water drops. There's just less blue.

Visitor A. Makes you wonder if the lake is drying up.
Participants’ attributions relating to potential human influence surfaced in the interviews. One participant commented,

Seems to me on several of them there had been man-made changes to the shoreline in particular. Especially in the first one you can see the difference in the shoreline. It looks like it has been logged and then dug off and then maybe a harbor has been put in there, or some sort of man-made change is taking place.

Mean Responses to Slide Pairs

Recall that participants in the 1996 phase of the study indicated their preferences on a five-point response set: strongly prefer the left, prefer the left, neutral, prefer the right, and strongly prefer the right. The null hypothesis was that there was no preference for higher or lower lake levels (mean response = 0), and t-tests were used to assess whether mean responses were significantly different from zero.

As discussed in the methodology section, the respondents were randomly divided into different treatment groups. Figures 4.1 through 4.3 show the mean responses for each pair of slides in the first treatment group. In all cases the mean response is negative, meaning that on average, respondents preferred the higher lake levels. In 14 of the 18 cases the results are significantly different from zero (p < .05). All of the nonsignificant results are for comparisons of lake levels adjacent to each other, i.e., average level vs. -25 feet, -25 feet vs. -75 feet, -75 feet vs. -125 feet.
Figure 4.1 View 1 (Rim Village)
No information on lake levels

Figure 4.2 View 2 (Discovery Point)
No information on lake levels

Figure 4.3 View 3 (Merriam Point)
No information on lake levels

* denotes statistically significant difference (p < .05)
Four of the ratings without information were not significantly different from each other. These were: Level 1 v. Level 2 in View 1, Level 3 v. Level 4 in View 1 and View 3, and Level 2 v. Level 3 in View 3. In these cases, it cannot be said with 95% confidence that visitors preferred the higher lake level. However, note that all comparisons are significantly different in at least one of the views (Level 1 v. Level 2 is significant for View 2 and 3, Level 2 v. Level 3 is significant for View 1 and View 3, and Level 2 v. Level 3 is significant from View 2). Therefore, because visitors see the lake from all of these viewpoints, they would perceive the difference in lake levels from at least one of the viewpoints and would prefer the higher level.

Figures 4.4 through 4.6 show the mean responses from treatment group 2, in which participants received verbal information telling them that some of the slides depicted lowered lake levels in Crater Lake. Consistent with treatment group 1, these results are also all negative, showing a preference for higher lake levels. In 17 of the 18 cases the results are significantly different from zero (p < .05). The only nonsignificant result is the comparison of the original lake level with the -25 feet level in View 1. In all cases, the mean responses for treatment 2 are more negative than those for treatment 1, although only 5 of those differences are statistically significant (p < .05). Significantly more negative responses for treatment 2 would indicate that verbal
* denotes statistically significant difference (p < .05)
information about changing lake levels affected respondents' preferences. In most cases, the information did not have a significant effect.

Figures 4.7 through 4.9 show the mean responses from treatment 3, which had the slide labels embedded in the images with the lake level depicted, stating that the drop in lake level was due to natural variation. All mean responses were again negative, showing a preference for higher lake levels. All 18 of the results are significantly different from zero (p < .05). Thirteen of the 18 responses from treatment 3 were more negative than responses from treatment 2, but only 2 of these differences were statistically significant. Sixteen of the 18 responses were more negative than those from treatment 1, and 12 of those differences were statistically significant. This shows that the effect of information printed on the slides (treatment 3) is not much different from verbal information (treatment 2), but it has more of an effect when compared to no information (treatment 1).

Figures 4.10 through 4.12 depict the mean responses from treatment 4, which included slide labels that attributed the lower lake levels to human uses of the lake water. All mean responses were again negative, suggesting a preference for higher lake levels. All 18 of the mean responses are significantly different from zero (p < .05). When compared to treatment 3, 17 of the 18 mean responses were more negative, and 14 of those differences were statistically significant. When compared to treatment 2,
Figure 4.7 View 1 (Rim Village)
*Natural Variation* Slide Text Information

![Bar chart for Rim Village showing lake level comparisons.](chart1)

Lake Level Comparisons

Figure 4.8 View 2 (Discovery Point)
*Natural Variation* Slide Text Information

![Bar chart for Discovery Point showing lake level comparisons.](chart2)

Lake Level Comparisons

Figure 4.9 View 3 (Merriam Point)
*Natural Variation* Slide Text Information

![Bar chart for Merriam Point showing lake level comparisons.](chart3)

Lake Level Comparisons

* denotes statistically significant difference (p < .05)
17 of the 18 mean responses were again more negative, and all of those differences were significant. When compared to treatment 1, all of the mean responses from treatment 4 were more negative, and 17 of the 18 were significant. These results indicate that information which informed respondents that lake levels were changing due to human uses of Crater Lake water had more effect on respondents' preferences than other types of information.

Finally, Figures 4.13 through 4.15 show the mean response from treatment 5, in which participants completed the question regarding potential human uses of Crater Lake water before going on to the slide portion of the study. All mean responses were negative, showing a preference for higher lake levels. Seventeen of the results are significantly different from zero (p < .05). Three of the responses from treatment 5 were more negative than treatment 4, and two of these differences were statistically significant. Fifteen of the 18 responses from treatment 5 were more negative than responses from treatment 3, and 7 of these differences were statistically significant. Fifteen of the 18 responses from treatment 5 were more negative than responses from treatment 2, and 12 of these differences were statistically significant. Finally, seventeen of the 18 responses from treatment 5 were more negative than responses from treatment group 1, and 15 of these differences were statistically significant. This suggests that the effect of human influence information is similar
Lake Level Comparisons

* denotes statistically significant difference (p < .05)
Figure 4.13 View 1 (Rim Village)
Participants primed with potential human uses

Figure 4.14 View 2 (Discovery Point)
Participants primed with potential human uses question

Figure 4.15 View 3 (Merriam Point)
Participants primed with potential human uses question

* denotes statistically significant difference (p < .05)
between treatments 4 and 5, while there is a greater difference between human influence in treatment 4 and natural variation information in treatment 3. Similar to treatment 4, these results indicate that considering information related to potential human uses of Crater Lake water had more effect on respondents' preferences than other types of information, and an even more pronounced effect when compared to no information being provided.

The Mean Number of Times a View was Preferred

A second way to analyze the results of the slide preference ratings is to calculate the mean number of times that any given slide was preferred to all the other comparator slides. Within each view a participant compared each lake level with three other lake levels (i.e., Average Level vs. -25 feet, Average Level vs. -75 feet, Average Level vs. -125 feet). If Level one (the average, or normal lake level) was preferred over the other three levels by all of the respondents, then the mean number of times that Level one was preferred would be equal to three. At the other extreme, if Level one was never preferred over the other lake levels, the mean number of times that Level one was preferred would be equal to zero.

Table 4.2 shows the mean number of times each lake level was preferred within each treatment group. The results show that the lower lake levels were preferred less often over their higher lake level comparison slides. In other words, the slides
Table 4.2 View Preferences.
Numbers represent the mean number of times each view was preferred (3 possible).

<table>
<thead>
<tr>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
<th>Treatment 4</th>
<th>Treatment 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Level</td>
<td>No Information</td>
<td>Verbal Information</td>
<td>Natural Variation Information</td>
<td>Human Use Information</td>
</tr>
<tr>
<td>Slide View 1 Rim Village</td>
<td>Average 2.43</td>
<td>2.47</td>
<td>2.69</td>
<td>2.79</td>
</tr>
<tr>
<td>- 25 feet</td>
<td>1.85</td>
<td>1.76</td>
<td>1.73</td>
<td>1.94</td>
</tr>
<tr>
<td>- 75 feet</td>
<td>1.20</td>
<td>1.15</td>
<td>1.17</td>
<td>1.18</td>
</tr>
<tr>
<td>- 125 feet</td>
<td>1.01</td>
<td>0.91</td>
<td>0.70</td>
<td>0.34</td>
</tr>
<tr>
<td>Slide View 2 Discovery Point</td>
<td>Average 2.09</td>
<td>2.32</td>
<td>2.40</td>
<td>2.42</td>
</tr>
<tr>
<td>- 25 feet</td>
<td>1.64</td>
<td>1.73</td>
<td>1.88</td>
<td>1.80</td>
</tr>
<tr>
<td>- 75 feet</td>
<td>1.42</td>
<td>1.19</td>
<td>1.16</td>
<td>1.13</td>
</tr>
<tr>
<td>- 125 feet</td>
<td>0.94</td>
<td>0.74</td>
<td>0.61</td>
<td>0.60</td>
</tr>
<tr>
<td>Slide View 3 Merriam Point</td>
<td>Average 2.30</td>
<td>2.33</td>
<td>2.45</td>
<td>2.60</td>
</tr>
<tr>
<td>- 25 feet</td>
<td>1.74</td>
<td>1.74</td>
<td>1.72</td>
<td>1.83</td>
</tr>
<tr>
<td>- 75 feet</td>
<td>1.08</td>
<td>1.26</td>
<td>1.23</td>
<td>1.23</td>
</tr>
<tr>
<td>- 125 feet</td>
<td>0.85</td>
<td>0.58</td>
<td>0.61</td>
<td>0.36</td>
</tr>
</tbody>
</table>
depicting levels closer to the existing average lake level were preferred more frequently. The differences between these four means are all statistically significant (p < .05).

To find whether the information treatment had an effect on the mean number of times any lake level was preferred, the means were compared across treatment groups. Based on the earlier results, it was expected that information on lake levels, especially the information that changing lake levels were caused by human uses of lake water (treatments 4 and 5), would cause the highest level (Level 1) to be preferred more often and the lowest level (Level 4) to be preferred less often. The expectation for the two intermediate lake levels is indeterminate because sometimes they are compared to higher lake levels and sometimes to lower lake levels. When being compared to the higher lake levels, it was expected that the information would lead to lower means, and when being compared to lower lake levels, that the information would lead to higher means. The opposite effects would cancel each other out.

For the two cases where the effect of information should be consistent (Level 1 and Level 4), the results show that in all cases except one, the mean number of times a slide was preferred went up for Level 1 and down for Level 4 as we moved from treatment 1, to 2, to 3, to 4. The only exception to this increase was the comparison of treatment 2 with treatment 3 for the slide with View 3, level 4. In this case the mean number of times this slide was preferred was .58 in treatment 2 and .61 in
treatment 3, a difference which is not statistically significant. The effect of treatment 5 did not follow the pattern set by the first four treatments. While Level 1 was preferred over the other levels, these results suggest that the effect of treatment 5 did not have as much influence over the mean number of times a slide was preferred as when human influence information was displayed on the slide image.

**Perceived Difference in Crater Lake Levels**

In the visual portion of the study, there were two primary goals. The first was to test whether participants could detect differences in lake level drops in Crater Lake, and the second was to elicit participants' preferences for lake views. The following section explores participants' visual perceptions of the differences between slide views as they relate to the summary statistic created for each participant's responses. These summary statistics are referred to as the difference score, or $D_{score}$, test statistic.

**The Agreement Statistics: Results from the difference score.** Recall from Chapter 3 the summary statistic created from participants' observations of differences between the slide pairs. Referred to as the difference score, or $D_{score}$, it represents an individual participant's departure from what would be expected if she or he was able to detect all differences in the slide pairs correctly. In brief, the $D_{score}$ is calculated

$$D_{E_{ij}} = \sum_{\text{over all 6 cells}}^{\text{(observed # in cell - expected difference # in cell)}^2}$$
To obtain the participant’s relative departure from the expected number of differences follows as

\[ RDE = \frac{DE}{252} \]

and then RDE is converted to the agreement statistic indicating the participant’s ability to see differences in lake levels

\[ D_{score_i} = 1 - RDE \]

For testing whether study participants’ abilities to detect differences in the lake levels in the slide images were influenced by information given to them about the lake views, the null hypothesis is that information treatments do not affect participants’ perceptions of differences between the slide views depicting lake level drops.

In order to investigate whether a participant’s difference score is dependent on the information they received about the slide views, effects of the 5 information treatments were explored using the analysis of variance (ANOVA) procedure for nested factorial designs. Results have been included in Tables 4.3 and 4.4.

From the initial analysis of variance, it was necessary to assess the role of experimental factors to determine which is responsible for components of the partitioned variation. In this instance, there was variation due to the individual session within treatment groups and variation due to participants within the session and treatment groups. If mean squares are similar in magnitude, this means that it can be assumed that the variation present is due to the participants and not the sessions.
Table 4.3. Analysis of Variance Table for Difference Scores.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Model</td>
<td>4</td>
<td>0.422</td>
<td>0.105</td>
<td>3.07*</td>
</tr>
<tr>
<td>Error</td>
<td>1156</td>
<td>39.749</td>
<td>0.034</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1160</td>
<td>40.171</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Table 4.4. Mean Difference Scores for the 5 Treatment Groups.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>D score LS Mean</th>
<th>Std Err LS Mean</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.885</td>
<td>0.0108</td>
<td>0.864 - 0.906</td>
</tr>
<tr>
<td>2</td>
<td>0.888</td>
<td>0.0119</td>
<td>0.865 - 0.911</td>
</tr>
<tr>
<td>3</td>
<td>0.891</td>
<td>0.0128</td>
<td>0.866 - 0.916</td>
</tr>
<tr>
<td>4</td>
<td>0.916</td>
<td>0.0122</td>
<td>0.892 - 0.940</td>
</tr>
<tr>
<td>5</td>
<td>0.936</td>
<td>0.0134</td>
<td>0.910 - 0.962</td>
</tr>
</tbody>
</table>

From the initial analysis, it was determined that the error for the variable sessions within treatment group and the error for participants nested within sessions and treatments were approximately the same. The variation between sessions within treatment is .034 and the mean square for participants nested within sessions and treatments is .033, so the ratio is effectively equal to 1. In this way, it is assumed that the participant to participant variation is the same as the session to session variation. Therefore, this term was removed from the model and the analysis of the effect the treatment had on the participants' scores continued. A more precise measurement of
error was derived and more power was gained in the increased degrees of freedom to
detect a statistical difference in treatment effects since it is assumed that the subjects
are the experimental units. The net effect of such a pooling is that the F-test associated
with testing for the treatment effect gains a larger number of degrees of freedom
associated with the denominator, thus gaining greater accuracy.

There is strong evidence of an informational treatment effect on participants’
abilities to detect differences in the lake levels between the slide images (Table 4.3).
This indicates that the Dscore means of at least two of the five groups in the
informational experiment are not equal. In addition to mean agreement scores and
their standard errors, 95% confidence intervals for the difference scores are indicated
below in Table 4.4. Least squares means for the Dscores are close to 1 for each
treatment, providing evidence that participants were generally able to detect
differences between slides with increasing difference scores suggesting differences in
treatment effects. Mean scores close to 1 indicate that, even without information
(Treatment 1), participants in the experiment show a strong tendency to be able to tell
the difference between slide views, with a strong mean difference score of .885.

**Further Exploration of Informational Effects on the Dscore.** To investigate
the specific sources of variation between the five treatment groups, contrast
comparisons were made using combinations between information treatments. The
contrast procedure was useful because contrasts may be used to test hypotheses
involving more than two means. Table 4.5 contains results from the analysis of variance for various treatment combinations as they corresponded to the study hypotheses which follow. A reference for the informational treatments is provided in the previous chapter in Table 3.3.

Table 4.5. Contrast Table for Treatment Comparisons Relating to the $D_{score}$

<table>
<thead>
<tr>
<th>Comparison</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 vs. T2</td>
<td>1</td>
<td>0.002</td>
<td>0.05</td>
</tr>
<tr>
<td>T2 vs. T3 and T4</td>
<td>1</td>
<td>0.036</td>
<td>1.04</td>
</tr>
<tr>
<td>T3 vs. T4</td>
<td>1</td>
<td>0.069</td>
<td>2.01</td>
</tr>
<tr>
<td>T1 vs. T3 and T4</td>
<td>1</td>
<td>0.061</td>
<td>1.78</td>
</tr>
<tr>
<td>T4 vs. T5</td>
<td>1</td>
<td>0.041</td>
<td>1.32</td>
</tr>
<tr>
<td>T5 vs. all others</td>
<td>1</td>
<td>0.266</td>
<td>7.74**</td>
</tr>
<tr>
<td>T1 vs. T5</td>
<td>1</td>
<td>0.302</td>
<td>8.80**</td>
</tr>
<tr>
<td>T2 vs. T5</td>
<td>1</td>
<td>0.241</td>
<td>7.02**</td>
</tr>
</tbody>
</table>

$**p < .01$

Several null hypotheses can be stated at this point which can be tested to investigate any differences between the treatment groups.

1. There is no difference in participants' scenic preferences in treatment group 1 (no information) when compared to group 2 (verbal information).

2. There is no difference between participant's scenic preferences in treatment group 2 (verbal information) and groups 3 and 4 (slide text information).

3. There is no difference between scenic preferences of group 3 (slide text - natural variation information) and group 4 (slide text - human influence information).
4. There is no difference between scenic preferences of group 4 (slide text - human influence information) and group 5 (information priming effect of potential human uses).

Results from the analysis of variance do not suggest a statistical difference between any of the comparisons in these hypotheses. As a result, it is not possible to reject any of these null hypotheses.

An additional null hypothesis states that there is no difference between scenic evaluations of group 5 (priming effect of potential human uses) and other treatment groups. There is strong evidence of a treatment effect when treatment group 5 is compared to other treatment groups combined. \((F = 7.74, p = .006)\). In terms of the simple comparison between treatment groups 5 and 1, evidence also suggests a difference \((F = 8.80, p = .003)\). A comparison between treatment groups 5 and 2 also shows evidence of a significant difference. \((F = 7.02, p = .008)\). These statistically significant differences suggest a strong treatment effect is present when participants in the study consider potential human utilization of Crater Lake prior to viewing the slides in the visual portion of the experiment. This treatment effect is in contrast to the previous analysis section, in which there was no statistical evidence that effects in treatment 5 influenced the mean number of times a slide was preferred.

As was noted in Chapter 3, a straightforward understanding of the results from the summary statistic for participants’ visual preferences, the Pscore, proved to be
more complex than the more direct calculation of the Dscore. The scaled nature of individual preferences for slide views (on a 5-point left-right preference scale) made the definition of the ideal preference response problematic. Because of the interpretive difficulty with the Pscore, it was decided not included the analysis of the Pscore in the results section of this study. An exploratory analysis and discussion of the Pscore has instead been included in Appendix G.

Attitudes Toward Use of Crater Lake Water

1996 Participant Attitudes. During the Visitor Center survey, participants were asked a series of questions regarding alternative uses of Crater Lake water. These questions involved potential utilization of the lake water for commercial, industrial, hydropower, domestic, geothermal, agricultural, municipal, park visitors, and generally stated “human purposes.” A series of statements were made regarding the acceptability of such uses of Crater Lake water and respondents were asked to state whether they agreed or disagreed. In order not to bias respondents into thinking that all uses were either acceptable or not acceptable, the statements for each use varied (Figure 4.16). This was an attempt to avoid response sets as an artifact of similar scale arranged in the series format of this question. The response frequencies to each individual scale item have been provided in Appendix A, question 7.

In all cases, over 60% of the respondents disagreed that any of these uses were appropriate for Crater Lake water. Commercial, industrial, park visitors, and general
Figure 4.16 Visitor Attitudes Toward Use of Crater Lake Water

Visitors were asked to state whether they thought lowering the lake level is or is not appropriate for the following activities:

- Not appropriate for commercial use
- Appropriate for industrial use
- Not appropriate for hydropower
- Appropriate for domestic water supplies
- Appropriate for geothermal resources
- Not appropriate for agriculture
- Appropriate for municipal water supplies
- Not appropriate for park use
- Appropriate for human purposes

Response percentage:

- Agree
- Neutral
- Disagree
- Don't Know
"human purposes" were all opposed by over 75% of respondents. The alternative with least opposition (63%) was to use Crater Lake water for geothermal purposes, but this use also had the most "don't know" responses (12%). None of the human uses was considered acceptable by more than 14% of respondents.

Responses to the neutral point on the acceptability scale provide some insight into the ambivalence of participants' attitudes toward the types of utilization in the question. As noted above, geothermal resources had the least opposition of all uses, but also the highest level of ambivalence. Use of lake water for domestic and municipal water supplies were comparable in participants' neutral responses, with 9% each. The least ambivalence was in the categories of industrial and commercial use, with 3% and 2% indicating neutral feelings, respectively. The rest of the human uses have a neutral range of 7% (park visitor) to 8% (hydropower).

Group Interview Participant Attitudes. Park visitors who participated as members of the interview groups also provided information relating to attitudes toward human use of Crater Lake water. After the slide portion of the interview, these visitors were asked what their reactions would be if informed that lake levels were changing because of human use of the lake water.

All verbal responses to such a scenario showed opposition. For example, from the fourth interview group, comments included, "Unbelievable. I wouldn't want to
hear that,” as well as “Disturbing,” and “I’d be horrified. I’d wonder why, and if use
was being controlled at all.”

Interview participants were asked if there were any imaginable situations they
could think of that would be necessary before use of Crater Lake water for human
purposes would be acceptable. Most of the ideas produced by the groups involved
some sort of catastrophic event, such as drought or forest fire. Indeed, all four groups
interviewed indicated some acceptance of the use of lake water for forest fires.
Reasoning which sees fires as unnatural events destructive to park resources was
evident in remarks such as the following.

The forest fires are starting to be catastrophic. They’re no longer able
to do controlled burns. Yellowstone was catastrophic; it burned all the
way through the park and there was no way to stop it. There was too
much fuel to burn so if it’s a catastrophic fire then somehow we need to
be able to put it out and for me it would be okay to take water from
Crater Lake, because it’s 1900 feet deep so if it lost 4 feet from this it
would be acceptable.

Study participants showed disappointment, but general resignation, when asked what
they thought of changing resource conditions because of natural variation. “A shame,
but what are you going to do about it?” asked one participant, displaying an attitude
common toward natural events such as earthquakes or volcanic activity affecting lake
levels. Another participant commented, “Well, there’s nothing you can do about a
natural change. A human change there is.” Participants’ understanding of forest fires as natural events was an area not covered by the scope of the group interview.

After some discussion, the researcher asked the groups what their decision would be if they were appointed as members of a committee which needed to decide about this matter by the year 2000. The groups consistently came to general agreement that extracting water for human purposes was inappropriate, even in most drought conditions. One discussion involving conditions of drought and the needs of increasing population illustrates participants’ feelings about other sources being utilized before considering use of Crater Lake water:

Visitor A: No, I wouldn’t agree that we could use it [the lake] for drinking water. We could find alternative groundwater sources elsewhere. And the unique thing about this lake is that it’s not replenishable. If you deplete it, it’s just going to go down because the replenishment is in an equilibrium now and some might come back, but it wouldn’t continually come back. It’s not like Lake Shasta where you have drainage from all the mountains around it that keep it filled.

Visitor B: I think that’s what man-made lakes are for. Because those are replenishable.

Visitor C: If people know that the area is growing and you know what the water needs are, those things can be projected and then people need to conserve. If they aren’t willing to conserve and aren’t willing to learn how to do with less, which people have done forever, if they live someplace where there isn’t a lot of water—for example, taking the entire contents of the Colorado River and pumping it into Los Angeles—those people that water their lawns and go on like that. The thing is that if you know these things are going to be needed, then you have to stop your wasteful practices and start making do with what you have because this is something that has been here for thousands of years that
was made by nature which cannot ever be replaced once it’s been sullied by man.

Visitor B: Besides, I think this is more than a local resource. This is a national treasure and it really should be off limits.

Visitor C: Conservation is a thing that hasn’t been properly explored or used. There has been research done in some places where waste water is able to be recycled as well, as a conservation measure, and conservation has limits as well. But it’s another thing where people’s attitudes have to be changed. I think people think more about conserving water now than they did earlier.

Other comments made by interview participants suggested that they had paid attention to interpretive displays at various points in the park. In several instances throughout the group interviews, the influence of interpretive information was apparent from comments made by participants. Indeed, the knowledge that participants had regarding water inputs into Crater Lake as well as its historic stability influenced discussion, and in turn seemed to influence group opinion. For example, in a discussion of whether or not inputs to the lake would balance with any removal of water for human purposes, a visitor in one group reported, “The information in one of the signs at the Rim says that snowfall and rain are the only inputs into the lake.” Several references were made to the interpretive displays in the Visitor Center, and along the walk at Rim Village. In two instances, participants had generally accurate knowledge of the height of Wizard Island. For example, when asked if they had any
idea how high the island was above the lake, a respondent in the first group said, “It said out there on the interpretive display 600 something.”

Modeling Perception of Differences

The final stage of the analysis investigated potential associations that visitor demographic and attitudinal measures might have on the study participants' ability to detect differences in the slide views. Demographic characteristics included age, income, education, the size of the community in which participants grew up, as well as the size of their current community. Characteristics of participants' visit to Crater Lake included if the park was their final destination, whether they had seen the lake before, taken a boat ride previously, if they had attended a Park Service interpretive presentation, and if they planned on either taking a boat ride or attending an interpretive session. Also included in the initial models were participants' attitudes toward the various potential uses of Crater Lake, including commercial, industrial, hydropower, domestic, geothermal, agricultural, municipal, park visitor, and general human purposes.

Table 4.6 contains the results from the regression analysis with Dscore as the dependent variable. There was no evidence of an association between the Dscore and most of the demographic and trip variables described above. Additionally, there was no association between any of the participants' attitudes toward use of the lake water and their Dscore. However, evidence suggested a relationship between participants'
Dsore (their ability to detect differences between the views) and their age, income, and attendance at an interpretive presentation.

After accounting for differences due to information treatments and visitors’ final destination, there is evidence of an association between participants’ Dscore and their age, income, and if they had attended an interpretive session (Table 4.6). As a participant’s age increases, their score of agreement (whether they saw a difference) decreases by 0.0018 units. As a participant’s income increases, their Dscore increases by 0.0153. With increasing age, a decline in visual ability seems understandable. The increase in ability to detect differences with an increase in income may also be related

Table 4.6. Final model from the Dscore.

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<tr>
<th>Variable</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
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<td>3.06</td>
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<table>
<thead>
<tr>
<th>Variable</th>
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<th>Parameter Estimates</th>
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</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>4</td>
<td></td>
<td>0.28</td>
<td>0.094</td>
<td>2.71*</td>
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<tr>
<td>Destination'</td>
<td>1</td>
<td>-0.0002</td>
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<td>0.014</td>
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<tr>
<td>Age</td>
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<td>-0.0018</td>
<td>0.538</td>
<td>0.538</td>
<td>15.51**</td>
</tr>
<tr>
<td>Income</td>
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<td>0.0153</td>
<td>0.506</td>
<td>0.506</td>
<td>14.58**</td>
</tr>
<tr>
<td>Interpretive Presentation</td>
<td>1</td>
<td>0.0209</td>
<td>0.152</td>
<td>0.152</td>
<td>4.39*</td>
</tr>
</tbody>
</table>

*p < .05  ** p < .0001

Note: The variable representing final destination is not significant, but is used in this analysis to control for the difference in a participant’s purpose at Crater Lake.
to the fact that older participants (who are more likely to be retired) likely have more limited incomes. Finally, if a participant attended an interpretive session, their Dscore increased by 0.0209. The effect of interpretive information corroborates with suggestions from the group interviews that information gained from interpretive sources has an effect on a visitor's ability to detect differences in the lake level depictions. For example, these visitors knew that there is limited variation in lake levels or that the water in the lake is a balance of rain and snowfall with evaporation.

Finally, 95% confidence intervals can be calculated to show the effect of a one unit increase in each of the statistically significant explanatory variables. For example, to describe the range of effect of a one unit increase in participants' Dscore, the following calculation produces this range for a 95% confidence interval.

\[
95\% \text{ CI} = \text{estimate} \pm (1.96)(SE(\text{estimate}))
\]

\[
= -0.0018 \pm 1.96 (0.0005)
\]

\[
= -0.00278, -0.00082
\]

The interval of (-0.00082, -0.00278) represents a 95% confidence interval for age on the Dscore. In other words, for an increase of one year in age there is little corresponding change in the Dscore, from -0.00082 to -0.00278 units (95% CI).

Using the same approach for income, the interval of (0.0075, 0.0231) represents a 95% confidence interval for income on the Dscore. An increase in a one level change
of participants' total household income (see Appendix A, question 6 of the
demographic questions in the onsite survey) would have a slight corresponding change
in the Dscore from 0.0075 to 0.0231 units. The effect of a one unit change in whether
or not participants attended an interpretive session is contained in the 95% confidence
interval from 0.000812 to 0.041188 units.

The best fit model for predicting participants' ability to detect differences
including the variables from above is represented by the equation

\[ \mu(Dscore \mid Treatment, Destination) = \beta_0 + \beta_1 age + \beta_2 income + \beta_3 interp + \varepsilon \]

and subsequently,

\[ \mu(Dscore \mid Treatment, Destination) = 0.857 - 0.0018 age + 0.0153 income + 0.0209 interp + \varepsilon \]

It should be noted that the scale used to measure attitudes relating to potential
uses of the lake water has a range of five, with ordered responses making this an
ordinal variable (categorical with order), so it is within reason to treat these variables
as continuous explanatory variables. This is advantageous in that the effect can be
measured with more precision in the case of this study. Indeed, Borgatta and
Bohrnstedt (Borgatta and Bohrnstedt, 1981) argue that such social variables are
continuous at the latent level and thus, when other assumptions are met, do not pose
serious problems for the social sciences. Prior to undertaking the analysis, the data set
was checked for normality through the use of boxplots.
Chapter 5. DISCUSSION

Overall Implications

This study addressed three main areas. The first was related to the effect that changing lake levels have on visitors' scenic perceptions. Research questions focused on lake levels explored whether visitors to Crater Lake National Park would perceive a difference in the level of Crater Lake if it was lowered, and if views depicting the present lake level would be preferable to those showing reductions of -25, -75 and -125 feet. The second area investigated whether visitors would find human uses of Crater Lake water acceptable. If visitors had strong perceptions, preferences, and attitudes regarding lake levels, then future changes in lake levels would likely affect the quality of visitors' aesthetic experiences. The third area explored the influence of information as it related to the role of natural variation and human influence on scenic perception. Information relating to lowered lake levels was included during the visual portions of the study in both verbal and textual formats. Perceptions of natural variation and human influence as part of scenic evaluations were also explored in the group interviews.

While this study's findings cannot be generalized beyond visitors to Crater Lake National Park, they indicate that visitors are sensitive to changes in lake levels,
even when no information is present identifying change. These findings are consistent with other studies exploring landscape change and human influence. Theoretical implications of this study support the idea that landscape perception is a transactional, or interactive process involving salient landscape features as well as visual-perceptual responses. For park managers, the findings of this study indicate that attitudes and perceptions of members of the public are sensitive to changes in the landscape, even when visitors are not informed of the visual changes taking place. Evidence indicates that the implication of natural change has a negative effect on viewer evaluations. There is also evidence that, when informed that visual changes are due to human influence, visitors' scenic evaluations are negatively influenced to a greater degree.

Visual Perception and Preference

Perception of Differences in Lake Levels. Overall, participants in this study were able to detect differences when they were shown slide views of varying lake levels. This was true when visitors had no information about the slides they were viewing, and was more pronounced when visitors were told that the views depicted alternative lake levels. Results from matched pairs in the slide sessions, however, suggested that individual perceptions of differences are generally, but not always, consistent. There was evidence that age, income category, and attendance at an interpretive session had an effect on their ability to detect differences, but the impact
of these variables was slight. The findings of this study which related to the age and income levels of participants were consistent with previous work by Buhyoff (1983), in that human factors relating to scenic preference to some extent included these socio-economic groupings (age, income) as well as involvement (interpretive session attendance).

Findings which suggest a decline in participants' ability to detect changes with increasing age indicate that collecting observer responses to scenery solely from photographs may not be as reliable in the case of older individuals' perceptual abilities. These findings extend concerns raised by Stewart (1984) regarding the physical-dimensional aspects of photographs when they are used to represent real-life settings. Even when clarity, color, contrast, and viewpoint are carefully controlled by computer, participants in visual experiments can respond differently based on visual ability.

Similar to Egan (1995), these findings support the importance of using multiple methods in the study of scenic quality. Where one of the methods used in this study left some question regarding the focus of visual evaluation (in this case, the difference portion of the slide presentation), the other methods (attitudinal measures, group interviews) augmented the researchers' ability to draw conclusions about scenic preference beyond the difference measure. The complexity of attitudes and
preferences as they relate to scenery support the use of a broad range of research methods for eliciting sociocultural differences in landscape aesthetics (Hampe, 1988; Tips and Savasdisara, 1986).

Preferences for Lake Levels. Results from the slide portion of the study suggest that visitors are generally consistent in their preferences for views of Crater Lake that reflect water levels unchanged from the present. This consistency was evident from preference ratings in the matched pair part of the slide session. Responses to the matched pairs were more likely to be rated in the neutral category, indicating that visitors were seeing similar images and had fewer strong preferences than in response to other slide pairs.

There was evidence that Crater Lake as the primary destination of participants' trips affected visitor preferences for lake views. The reason for this difference is difficult to pinpoint from the data provided from this study. These results suggest that further inquiry in the area of environmental and recreation involvement (McIntyre, 1989; Moore and Graefe, 1994) is a worthwhile direction for future exploration of scenic values in national parks. For example, are highly involved visitors (defined as those who indicated that the park was their main destination) different from other visitors (defined as those for whom Crater Lake was a less important trip)?
Effect of Information

As noted previously, information relating to both natural and human influence affected visitor preferences for lake views, with a more pronounced negative effect on scenic quality when human use of Crater Lake water was indicated while visitors observed pictures of the lake. This effect was consistent with study results concerning visitors' attitudes toward a number of alternative human uses of Crater Lake discussed in the results section. In addition to statistical evidence for the affect of interpretive information on participants' ability to see differences in views, results from group interviews also indicates that visitors pay attention to interpretive facts at various sites around Crater Lake, and that they are able to recall them at a later time. The indication that visitors pay attention to resource-specific information provided through interpretive means suggests that visitors are inclined to utilize such information in the formation of impressions of the natural state of the park.

The findings of this study are consistent with the conclusions of Hodgson and Thayer (1980), which indicated that implied human influence on a natural setting reduced the scenic quality of that setting. Hodgson noted that when a landscape photograph implied human influence on the setting (such as calling a lake a reservoir), the setting is judged to be less beautiful. Informational findings from this study are more pronounced than those indicated by Anderson (1981), who noted that for scenes
of high scenic quality, a label implying human influence had only a slightly
detrimental effect. However, Anderson investigated land use designations, so there
may be contextual problems comparing this study to those findings.

Acceptability of Potential Human Uses of Crater Lake Water

Philosopher S.C. Pepper's proposition that context and meaning of an object
can intensify the emotional appreciation of that object is confirmed by this study's
findings as they relate to the on-site nature of the sample from Crater Lake visitors.
That is, the fact that people participating in the study did so on-site at a national park
could explain the general opposition of participants to potential human influence of
Crater Lake. People who make the effort to visit National Parks may be more
preservation-oriented than people who do not visit parks (Bromley, 1980; Rollins and
Chambers, 1990; Schreyer and Roggenbuck, 1981). The role of Park Service sites as
repositories of nationally symbolic landscapes is well-documented in the literature
(Clay, 1985; Schreyer and Roggenbuck, 1981; Sellars, 1997) and could account for the
crystallization of visitor attitudes toward potential human influence on resources in
national parks. Results from both the attitudinal survey as well as the group interview
attest to visitors' strong negative feelings toward potential human influence. This
supports Pepper's assertion regarding the setting and context of this study: a national
park of scenic and natural importance.
Study Limitations

The findings of this study are restricted to visitors at Crater Lake National Park. Investigation of visitor perceptions of changing resource conditions at other National Park sites would expand the knowledge base regarding people's preferences for natural scenery and ecological integrity. While a volume of research relating to air quality has been conducted in relation to its effect on the visitor experience, other issues such as water quality will undoubtedly arise as other water rights adjudication procedures commence near other National Park Service sites (Taylor et al., 1995).

From interviews following the slide sessions, there is limited but consistent evidence that a small number of participants in this study focused their attention on visual elements other than the lake levels. This was apparent in results from the matched-pair slides discussed above. This might explain some of the experimental error in the quantitative analysis of participants' ability to detect differences in the slides, as well as unexplained error involved with preference data for views. However, there is general indication of acceptable instrument validity based on the fact that the majority of participants correctly identified no differences in the matched pairs, and that their preferences for these pairs was more neutral than for other pairs. Findings from the group interviews, which indicated that scenic judgments were based on lake
levels after the first few slides were viewed, also support this study's instrumental validity.

A theoretical issue deserving continued attention concerns the dynamic between visitor attitudes and scenic preference. Visitor preferences for higher lake levels and visitor attitudes opposed to human use of Crater Lake water are shown to be predictable, and a direct relationship between the two is implied from the results of this study. Continuing to develop methodologies which would allow investigations of correlations between these the variables of attitude and preference would be particularly useful in an instance where the interplay of potential visual landscape alteration and public preferences could be mitigated by intervening attitudes toward natural resources.

**Future Research**

**Park Service Policy.** A recently published internal analysis of the National Park Service's approach to management has been highly critical of the agency's emphasis on recreation and scenic "facade" management (Sellars, 1997). A Park Service historian, Sellars is highly critical of the agency's leadership, but predicts a shift away from the present tourism and development-oriented leadership culture toward one of environmental preservation. Sellars notes that the agency imperative to leave parks unimpaired for future generations is increasingly understood as more than preserving
the scenic facade of nature, and is turning toward a concern for the ecological base that supports highly-valued scenery. However, Gobster (1996) observed that the more recent emphasis on biodiversity as a nonutilitarian benefit of natural resource management may also conflict with traditional aesthetic goals of managing agencies. In this regard, increased acceptance of major disturbances in forest ecosystems (such as large scale fires) can be at odds with previous visual quality management plans.

The National Park Service will continue to struggle with the duality of its mandate to preserve the natural state of the parks while at the same time ensuring their public enjoyment (Manning, 1998). Results from this study suggest that park visitors prefer scenery which reflects the visual integrity of Crater Lake as it presently exists. While other findings indicate that visitors are more accepting of change when it occurs because of natural events, they still are apt to evaluate views resulting from such changes as less acceptable. These findings confirm observations made by Wood (1989), who indicated that the idea of “natural” often is defined by a setting which is park-like, tidy, and static. However, this would counter Leopold’s idea of a land aesthetic as being more than what appears on the surface of the landscape, involving the integrity of the biotic community (Leopold, 1991).

The shifting management emphasis in the Park Service which Sellars predicts, as well as issues raised by this study, suggest numerous other possibilities for future
research. Exploration of park visitors' attitudes and perceptions as they relate to the open-ended directives in the National Park Service mission is one prospect. This is particularly the case when decisions are being made which affect the preservation of highly scenic and ecologically sensitive sites such as Crater Lake. Questions relating to how visitors understand the National Park Service's mission should be explored, particularly because if there is uncertainty regarding the consistency of park managers' versus park visitors' idea of what is "natural" in national parks (Manning, 1998). For example, what does the phrase "to promote and regulate the use of...national parks" imply for park users? What does it mean to visitors that the Park Service must "conserve the scenery and the natural and historical objects therein?" An investigation into the interplay of attitudes and perceptions as they relate to trade-offs between biodiversity and scenery would provide resource managers' valuable information as the directives of ecosystem and biodiversity management become integrated with National Park Service planning.

**Use of Computer Visualization Techniques.** The use of photographic images as representations of Crater Lake scenery proved to be an acceptable method for gathering park visitors' impressions of changes in lake levels, with some limitations. The cautionary tone expressed by Hull and Stewart (1992) relating to the ecological validity of photographs should be kept in mind while considering this study's results.
Participants' mixed abilities regarding their perceptions of differences (as reflected in the matched slide pairs in the study) warrant consideration. Comments provided by visitors in the interviews suggest that visitors can at times perceive differences when there are none present. Because this study utilized several measures of scenic perception, however, the influence of "visual error" is probably limited. Again, results from interviews indicated that participants generally were able to detect differences correctly by the third slide pair in the interview sessions. It is the researcher's assertion that relevant dimensional aspects of study views (including clarity, color, viewpoint) as outlined by Sheppard (1989) support the face validity of the slides.

Because of this study's visual control over changes in the slide images, researchers' ability to make inferences regarding park visitors' preferences was increased (Orland et al., 1994). Continued refinement of computer generated imagery, and the methodologies which utilize such images in the study of natural resource perception, an area where continued research will prove valuable. While this study used state-of-the-art computer digitized images, in order to present them as part of a visual experiment it was necessary to convert them to slide projection technology which is decades-old. As projection technologies catch up with production, the control of visual stimuli will become increasingly refined. Further research and simplified use of computer-aided photo images will make computer-aided visual
research an even more available tool for natural resource managers to utilize in their pursuit of information from the viewing public.

**Use of Qualitative Interviews.** A previous study by Schroeder (1988) suggests that an effective record of what people see in landscapes can be garnered from their verbal responses. There is increasing support for utilizing group interviews as a tool for gathering natural resource-related information from the public (Buchanan, 1992; Desvousges and Frey, 1989; Kingsley et al., 1988; Morgan, 1997; Steckler et al., 1992).

Insights gained from the qualitative interviews in this study show promise regarding the increased utilization of interactive interviews in scenic preference research. The richness of information yielded by group interviews in suggests that this methodology is a worthwhile vehicle for exploring the complexity of park visitor's perceptions of naturalness, as well as their attitudes toward management alternatives. Indeed, in his analysis of biodiversity and scenic aesthetics, Gobster (1996) asserts that more realistic and enriched analysis of potential visual changes could be found in open-ended questions and group discussions along with standard, scaled attitudinal analyses. In addition to understanding the perceptual and attitudinal processes of visitors, park managers should continue to explore visitors' beliefs about the balance of the Park Service's dual mission, particularly when biodiversity goals affect public enjoyment of scenery.
While a particular strength of this study rests in the predictive nature of the quantitative survey, the exploration of reasoning used by Crater Lake visitors provided valuable additional information which would not have been available had the study ceased after the first season in 1996. For example, the role that interpretive information plays in park visitor perception of resource condition was illustrated on a phenomenological level from the group interview results. During the course of the interviews it became apparent that visitors had garnered information from previous exposure to interpretive displays at the Visitor Center. A number of participants utilized their knowledge from interpretive data (relating to lake inputs) in reasoning about human uses of Crater Lake. In this instance the cognitive component of information processing appears to have mediated the responses of visitors to the visual stimuli in the slides. These findings suggest that the use of the positivist approaches represented by strictly quantitative analysis of scenic quality issues may limit researchers' ability to understand the dynamic nature of park visitors' perceptions.

Through the interactive approach of group interviews, future research could also explore how interpretive information relating to park resources becomes visitor knowledge, and how this knowledge informs visitors' understanding of the dynamic processes associated with park ecosystems. Implications from this study show that information regarding external influences on park scenery can affect what visitors seen
in a park setting. These findings underline the power that information plays in the hands of Park Service managers and interpreters as they work to inform visitors’ perceptions.

**Theoretical Implications**

One theoretical issue discussed in the literature review of this dissertation questioned whether scenic beauty is an objective property inherent in the physical landscape or a subjective phenomenon rising from individual perception. Results from this study support a theoretical consideration which connects the two. While visitors’ attitudes toward change of the visual scene at Crater Lake could have been measured without a visual, physical landscape referent in photographs, the inclusion of photographic representations facilitates the connection between visual standards of scenic beauty with attitudinal measures. Indeed, results from this study support the theoretical proposals of Zube et al. (1982) which focused on the interaction of visitor perceptions with physical changes. The outcomes from this study generated both descriptive and predictive equations relating to the outcomes of the human-landscape relationship at Crater Lake.
Implications for Park Management

The 1993 FEMAT report documented how ill-equipped land management agencies are in dealing with a variety of social issues, including cultural, recreation and scenic resources. User-based assessments in the evaluation of the scenic consequences of landscape change are particularly important when they concern areas of visual and ecological sensitivity, such as in national parks or wilderness areas (Vining and Stevens, 1986; Zube, 1992), but they could also serve in the broader function of landscape planning for less sensitive areas. Objective and subjective assessment of the public's perceptions of changes in scenery can be highly informative for considering management alternatives. However, a caveat relating to the cultural orientation of scenic values is necessary as it relates to the setting and subjects of this study. The findings of this study reflect the beliefs and assumptions of visitors to a national park in the western United States. While other studies have explored aesthetics as a cultural artifact (Clay, 1985; Hampe, 1988; Hull, 1989; Leikola, 1986; Zube, 1981), that was not the goal of this study. To generalize these findings as they relate to resource changes in countries other than the United States would be inappropriate.

Informed landscape management which integrates both physical and social elements is not only a policy directive in numerous protective environmental laws, it is particularly important in a time when such decisions are highly politicized and legal
challenges to agencies are commonplace (Allen and Gould, 1986). Visual scenic analysis, when combined with investigation of public preference, can be a particularly useful tool for the evaluation of management and legal questions. In turn, managers may minimize negative public responses with a better understanding of how changes in natural scenes will be perceived by the public they serve. For example, the sensitivity of the public toward water scenes is well documented in the literature (Cherem, 1973; Herzog, 1985; Kaplan, 1977; Litton, 1974; Pitt, 1989; Walker and Havens, 1973). Results at Crater Lake confirm the importance that managers remaining vigilant and informed when considering changes in valued landscapes, especially when their decisions have direct impacts on water scenes.

People’s perceptions and interactions with natural landscapes involve complex processes. As noted by Vining and Stevens (1986), the interpretation of observer responses to scenery must acknowledge processes such as preference, judgment, and the observer’s individual frame of reference. The results of this study agree with Vining and Stevens, who developed a conceptual landscape preference model based on the interaction of physical landscape characteristics, real or implied presence of management, and the attitudes, expectations, and perceptions of individual observers. In sum, when changes in scenery become evident, they can affect people’s scenic evaluations whether those changes are natural or human-caused. This is particularly
the case when visitors are provided with such information while they view scenic vistas. Surveys and interview data provided by this study indicate that people value a park landscape less when informed that its current state has changed. Indeed, these results show that beauty is both an objective quality inherent in the landscape (shown by responses to slide manipulations) as well as a subjective impression on the part of the viewer (shown in surveys and responses to potential human influence).
REFERENCES


APPENDICES
Appendix A:
VISITOR CENTER SCENIC PREFERENCE SURVEY
N = 960
**Oregon State University**  
**CRATER LAKE NATIONAL PARK**  
**SCENIC SURVEY**

**PART ONE**

For each set of slides, please tell us two things:

1. If you see a difference between the views shown (check ✓ one box).
2. Which view you prefer personally by marking ✓ in the corresponding box.

<table>
<thead>
<tr>
<th>SlideSet</th>
<th>First Is there a difference to you?</th>
<th>Second Strongly prefer the left</th>
<th>Prefer the left</th>
<th>No Preference</th>
<th>Prefer the right</th>
<th>Strongly prefer the right</th>
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</table>
PART TWO

1. Have you been to Crater Lake National Park before this visit? (check ✓ one)
   
   66% No
   34% Yes

   ▶If yes, please indicate how many times you’ve been to Crater Lake before this visit
   
   51.1% Once before
   18.7% 2 times
   20.3% 3-5 times
   4.8% 6-10 times
   5.1% 10 or more times

   What year was your first visit? 19___

   The following frequencies are the breakdown of the 34% who reported visiting Crater Lake previously.

   1.8%       2.2%       6.5%       9.8%        27.7%        17.3%        16.1%        18.6%

2. Have you ever been up to the rim to see Crater Lake itself?
   
   57% Yes
   43% No

3. Have you taken the boat tour on Crater Lake? (check ✓ one)

   11.3% Yes
   88.7% No

4. Do you plan to take the boat tour on Crater Lake? (check ✓ one)

   22.7% Yes
   49.7% No
   27.6% Unsure

5. Have you attended an interpretive presentation (other than the video) at Crater Lake? (check ✓ one)

   22.4% Yes
   77.6% No

6. Do you plan to attend such an interpretive presentation on your visit to Crater Lake? (check ✓ one)

   40.5% Yes
   24.5% No
   35% Unsure
7. The lake level of Crater Lake fluctuates naturally. It is also possible that human activities in and surrounding the park could affect Crater Lake water levels.

Please state whether you think lowering the lake level is or is not appropriate for each of the following activities.

Circle the number that reflects your level of disagreement or agreement with each statement. If you haven't thought about it much, circle Don't Know (DK).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is appropriate to lower the lake level in Crater Lake for human purposes</td>
<td>51%</td>
<td>26.9%</td>
<td>7.6%</td>
<td>6.1%</td>
<td>1.4%</td>
<td>7.1%</td>
</tr>
<tr>
<td>It is not appropriate to lower the lake level in Crater Lake for Park visitor use</td>
<td>3.7%</td>
<td>7.3%</td>
<td>6.5%</td>
<td>29.7%</td>
<td>46.9%</td>
<td>5.9%</td>
</tr>
<tr>
<td>It is appropriate to lower the lake level in Crater Lake to increase municipal water supplies</td>
<td>45.8%</td>
<td>26.3%</td>
<td>8.8%</td>
<td>9.5%</td>
<td>1.7%</td>
<td>7.8%</td>
</tr>
<tr>
<td>It is not appropriate to lower the lake level in Crater Lake for agricultural use</td>
<td>4.9%</td>
<td>8.8%</td>
<td>8.3%</td>
<td>26.9%</td>
<td>44.5%</td>
<td>6.6%</td>
</tr>
<tr>
<td>It is appropriate to lower the lake level in Crater Lake to make use of geothermal resources</td>
<td>37.9%</td>
<td>24.7%</td>
<td>12.8%</td>
<td>10.4%</td>
<td>2.2%</td>
<td>12%</td>
</tr>
<tr>
<td>It is appropriate to lower the lake level in Crater Lake to increase domestic water supplies</td>
<td>40.5%</td>
<td>29.9%</td>
<td>9.2%</td>
<td>9.7%</td>
<td>4.1%</td>
<td>6.6%</td>
</tr>
<tr>
<td>It is not appropriate to lower the lake level in Crater Lake to develop hydropower resources</td>
<td>5.6%</td>
<td>6.5%</td>
<td>8%</td>
<td>22.6%</td>
<td>49.8%</td>
<td>7.6%</td>
</tr>
<tr>
<td>It is appropriate to lower the lake level in Crater Lake for industrial use</td>
<td>67.6%</td>
<td>19.3%</td>
<td>2.7%</td>
<td>2.4%</td>
<td>4.2%</td>
<td>3.8%</td>
</tr>
<tr>
<td>It is not appropriate to lower the lake level in Crater Lake for commercial use</td>
<td>8.2%</td>
<td>3.9%</td>
<td>2.3%</td>
<td>20.6%</td>
<td>61.7%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>
While answering the following questions, please remember that your responses are confidential.

1. How far do you live* from Crater Lake National Park?
   Range: 10 - 3000 miles
   Average: 1105 miles
   *foreign visitors were not included in this measure
2. Is Crater Lake the primary destination of your trip? (check ✓ one)
   35% Yes
   65% No
3. What is your gender? (check ✓ one)
   54% Female
   46% Male
4. What is your age? _____ years.
   Average: 49.5 years
   Range: 18 - 89 years
5. What is the highest level of education you have completed?
   (check ✓ one)
   1%   Less than 9th grade
   3%   9th to 12th grade, no diploma
   8.8% High school graduate (or equivalent)
   22.3% Some college
   6.8% Associate degree
   21.5% Bachelor's degree
   11.1% Some graduate school, no degree
   25.5% Completed graduate or professional degree
6. Into what group does your total household income fall? (before taxes)
   (check ✓ one)
   5.7% Less than $15,000
   7.4% $15,000 to $24,999
   4.8% $25,000 to $29,999
   8.8% $30,000 to $34,999
   21.7% $35,000 to $49,999
   25.4% $50,000 to $74,999
   11.7% $75,000 to $99,999
   14.6% $100,000 or more
7. In what size of community did you grow up? (check one)
   13.2% farm or rural area
   4.4% semi-rural
   12.6% small town (under 5,000 people)
   24.5% small city (5,000-50,000 people)
   .9% suburb of large city
   17.8% city (more than 50,000 but less than 1 million)
   12.6% large city (over 1 million people)

8. What size of community do you live in presently? (check one)
   7.3% farm or rural area
   5.9% semi-rural
   8.7% small town (under 5,000 people)
   25.6% small city (5,000-50,000 people)
   20.7% suburb of large city
   22.5% city (more than 50,000 but less than 1 million)
   9.3% large city (over 1 million people)

9. At the end of the summer, we will be continuing this study with a brief mail survey. Please provide us with your address in the spaces provided. Your address will only be used for this important mail follow-up.

89% of the survey participants complied with this request for their addresses
   • 95.9% of participants reported addresses in the United States
   • 4.1% reported living outside the U.S.

Your name ________________________
Street ________________________
City ________________________ State ____ Zip Code

If not in the U.S., what is your home country?

ADDITIONAL COMMENTS:

THANK YOU FOR YOUR TIME WITH OUR SURVEY!
Dr. Rebecca Johnson
David Rolloff
Forest Resources Department
OREGON STATE UNIVERSITY
Appendix B: RIM VILLAGE SAMPLE SURVEY

N = 210
1. Have you visited Crater Lake National Park before this visit?
   40% Yes  60% No

2. Have you been to the Visitor Center (at Park Headquarters) or do you plan on going as part of your visit?
   65.8% Yes  13.8% No  20.4% Unsure

3. How far do you live* from Crater Lake National Park?
   Range: 60 - 3000 miles
   Average: 836 miles
   *foreign visitors were not included in this measure

4. Is Crater Lake the primary destination of your trip? (check  one)
   39.6% Yes  60.4% No

5. What is your gender? (check  one)
   52% Female  48% Male

6. What is your age? _____ years
   Average: 46 years
   Range: 18 - 82 years

7. What is the highest level of education you have completed? (check  one)
   0.5% Less than 9th grade
   4.3% 9th to 12th grade, no diploma
   17.1% High school graduate (or equivalent)
   20.4% Some college
   5.7% Associate degree
   17.5% Bachelor's degree
   9% Some graduate school, no degree
   25.6% Completed graduate or professional degree
8. Into what group does your total household income fall? (before taxes)
   Mode: $50,000 to $74,999
   6.3% Less than $15,000  23.4% $35,000 to $49,999
   7.8% $15,000 to $24,999  26% $50,000 to $74,999
   2.6% $25,000 to $29,999 16.7% $75,000 to $99,999
   6.3% $30,000 to $34,999 10.9% $100,000 or more

9. Please provide the following information about where you live.
   - 91.8% of participants reported addresses in the United States
   - 8.2% reported living outside the U.S.

City______________________ State __ __ Zip Code __ __ __ __ __

*If not in the U.S., what is your home country? ____________________

THANK YOU FOR YOUR TIME WITH OUR SURVEY!

Dr. Rebecca Johnson  David Rolloff
OREGON STATE UNIVERSITY
Appendix C: VISITOR SURVEY INSTRUCTIONS
The following is the text used by the research assistant during the scenic preference survey conducted at the Visitor Center. Bold type indicates what was read to visitors.

Introduction:

Good morning/afternoon. My name is David Rolloff and I'm a grad student at Oregon State University. OSU and the National Park Service are working together this summer to gather information from Crater Lake visitors like yourselves. Information gained from visitors is important to the future management of the park resource, and we appreciate your taking time with this survey. The survey consists of two parts and takes a total of about 15-20 minutes.

It's important to us that you know all information you provide in the survey is strictly confidential, all your answers are voluntary, and will only be used for the purposes of this study. There are a few other important things to remember when completing our survey:

First, there are no right or wrong answers. This is not a test. I just want your opinions, regardless of what anyone else thinks.

Second, please answer all of the questions. If you want to make any comments, do so in the margins or on the last page of the survey. Your comments are important to me and I do pay attention to them.

Okay, lets begin with Part One--the slides.

All of the slides you're going to be shown are of Crater Lake. I want to find out what aspects of scenic beauty people prefer the most when they come to see Crater Lake. **

Treatment 2: Some of these slides are depictions of varying changes in the levels of the lake. Some of the changes reflect larger drops in the level of Crater Lake than others.

Treatment 3: Some of these slides are depictions of what the lake might look like with natural variations in the level of Crater Lake. Some of the changes reflect larger drops in the lake level than others.

Treatment 4: Some of these slides are depictions of what the lake might look like if humans used the water in Crater Lake. Some of the changes reflect larger drops in the lake levels than others.
For each pair of slides, I need you to do two things: First tell me if you see a difference between the two views. Then continue by telling me if you prefer one view over the other—whether you strongly prefer the left, prefer the left, have no preference, prefer the right, or strongly prefer the right. When deciding which slide you prefer, please be sure to pay attention to the view depicted in the slide, not the quality of the slide itself.

There are 24 pairs of slides in this survey, and each set will be shown for Preferences 20 seconds. So that you don’t have to worry about keeping track of which slide, I will announce the number of each one when they change.

When slides are finished:
That’s it for the slides. Now I have one follow-up question, which is at the top of page 2. For those of you who did not have a preference for the last set, check the last item in Part Two just above the beginning of “Section 3.”

For those of you who did have a preference, I’d like to know how strong your preference is. For example, these views may occur in different seasons. Crater Lake National Park may also charge different fees in different seasons. If it cost you ___ dollars per person in addition to the park entrance fee to experience your preferred view than to experience the other one, would you be willing to pay this amount? After you have indicated yes or no, briefly explain your reason for that response.

Conclusion:

Then continue with the rest of the questions on the survey. Remember the information you give is completely confidential. When you’re finished, hand your survey and clipboard to me. On your way out, remember to take a book home with you.

Thanks again for your time and I hope you enjoy your visit to Crater Lake.
Appendix D: SLIDE IMAGES
Figure D.1. View 1 Level 1. Rim Village, average level.

Figure D.2. View 1 Level 2. Rim Village, -25 feet.
Figure D.3. View 1 Level 3. Rim Village, -75 feet.

Figure D.4. View 1 Level 4. Rim Village, -125 feet.
Figure D.5. View 2 Level 1. Discovery Point, average level.

Figure D.6. View 2 Level 2. Discovery Point, -25 feet.
Figure D.7. View 2 Level 3. Discovery Point, -75 feet.

Figure D.8. View 2 Level 4. Discovery Point, -125 feet.
Figure D.9. View 3 Level 1. Merriam Point, average level.

Figure D.10. View 3 Level 2. Merriam Point, -25 feet.
Figure D.11. View 3 Level 3. Merriam Point, -75 feet.

Figure D.12. View 3 Level 4. Merriam Point, -125 feet.
Figure D.13. Information Treatments 3 and 4. Example of label for average lake level.

Figure D.14. Information Treatment 3. Example of natural variation label.
Figure D.15. Information Treatment 4. example of human uses label.
APPENDIX E: GROUP INTERVIEW INSTRUCTIONS
GROUP INTERVIEW GUIDE

Text in bold indicates what is read to visitors participating in the study. Questions asked of participants are denoted by bullets, and are in boldface, also.

I. STUDY INTRODUCTION: A brief explanation of the research project.

Good morning/afternoon. My name is David Rolloff and I'm a grad student in Forest Resources at Oregon State University. I'm working on a research project this season to gather information from Crater Lake visitors like yourselves. Information gained from park visitors is part of the work I'm doing for my doctoral dissertation, which concerns scenic resources in Crater Lake National Park. I appreciate your taking time with this survey and your help with my research. This group interview consists of two parts and takes a total of about 20-30 minutes.

It's important that you know all information you provide in the survey is strictly anonymous, confidential, and that all your comments are voluntary. The information gained in this study will be used for my research, and for park managers.

Please remember that there are no right or wrong answers to what we're talking about. This is not a test, it is a discussion, so anything you feel like saying is valuable! I just want your opinions, regardless of what anyone else thinks. Let me know what comes to mind while we're talking and don't hesitate to ask questions.

This study will consist of two parts: First, I'm going to show you some slides of Crater Lake, and we'll visit about your impressions of the views in the slides. Second, I'm going to ask you questions relating to the use of resources here in Crater Lake National Park.

II. PARTICIPANT INTRODUCTIONS:
Each visitor will introduce themselves individually & tell a bit about themselves:

- What is your first name?
- Where are you from?
- Have you been to Crater Lake before?
- What are some of the main reasons you came to Crater Lake National Park?
III. SCENIC PERCEPTION: The Slide Portion

Now I'm going to show you some slide views of Crater Lake. I want to find out what aspects of scenic beauty people prefer the most when they come to see the lake. For each pair of slides, I would like you to write down three things about what you're seeing.

Point to flip chart with the three questions:
First, do the views look the same? If you think they're different, what is the difference? And last, indicate if you prefer one view over the other.

There are 20 pairs of slides in this survey, and each set will be shown for 20 seconds.

When slides are finished:
That's it for the slides. Now I have some questions about what you saw.

Explore the following areas allowing for any responses to surface in the group before proceeding to the next questions:
- Tell me about what you saw in the slides.
- Could you tell any differences between the two views? If so, what did you see?
- What lake level do you think I was trying to show you in these slides?
- I used slides from three viewpoints. Did you prefer one of the three viewpoints shown in the slides more than another?
  If so, why?
- Do you think my directions could have guided you in any way toward looking at a specific part of the slide views?
- Were there any other elements which may have influenced your impressions of the slides—e.g. slide quality, seating position in the room, perceived differences in slide color?

Once responses have subsided:
The only thing that varied in the views you were shown was the level of the lake. I created these different levels on a computer—the lake level varies around 4 feet a year, not as much as in these images. Don't feel bad if you think you saw other differences! People "see" many different things in these images, and that's partly what these group sessions are for—to discover more of what people see in these views of the lake.
Some of the images you were shown depicted a “normal” lake while others were computer manipulated to depict drops of 25, 75, and 125 feet.

- Did you notice those changes?
- Would you have estimated, based on these numbers, that this was the magnitude of the change in feet?
- Now that you know about what was happening in the slides, do you have any comments about the views? Have your impressions changed with this knowledge?
- What do you think might cause such a drop in the levels of the lake?
- If you were told that the reason the lake level was dropping in these levels was because of “natural variation” what would your reactions be?
- Now if you were told that the reason the lake level was dropping was because of human use of the lake water, what would your reactions be?

Key Question: Let’s say that you need to make a decision of whether or not it would be appropriate to lower the lake levels starting in 1998. What would your decision be?

Probe for reasons why, why not appropriate.

IV. POTENTIAL HUMAN USES OF CRATER LAKE WATER.
Exploration of natural and human-caused situations which could contribute to a lowering of the lake level in Crater Lake. Note differences in reasoning between natural variation and human variation.

The lake level of Crater Lake fluctuates naturally. Theoretically, it is also possible that human activities in and surrounding the park could affect Crater Lake water levels. Do you think lowering the level of Crater Lake for human purposes would be appropriate? Why or why not?

Presently, the water in the lake is only used to view as a scenic resource, but what other uses could be made of the water? List those that people think of on eraserboard.
There could also be more specific uses of the water and I'd like to hear what you think about the appropriateness of using Crater Lake water for these purposes:

Record visitor reaction to the following:

1. Park visitor use
2. Municipal water supplies
3. Agricultural use
4. Geothermal resource development
5. Domestic water supplies
6. Hydropower resource development
7. Industrial use
8. Commercial use

If you are opposed to these uses, is there ever a time you would find such a use appropriate?

If you support any of these uses, is there ever a time you would find such a use inappropriate?

Key Question: If you found out that Crater Lake water was used for purposes such as those above, how do you think this information would affect how you viewed the lake?

VI. CONCLUSION:

That's it for my questions. Thank you participating in my study. Before you go, I would like to explain that there currently are no plans to lower the lake level in Crater Lake for human purposes. Future policy and legal issues regarding the status of the water resource in Crater Lake have raised questions about what people value most about the scenery here in the park. As part of my graduate research, I'm studying park visitors' values to gain an understanding about how visitors feel about potential futures of the lake.

Do you have any remaining questions or comments?

Again, thanks for your time and I hope you have a good visit here at Crater Lake.
APPENDIX F: GROUP INTERVIEW SURVEY FORM
Oregon State University
CRATER LAKE NATIONAL PARK
SCENIC SURVEY

1. _______________________________________
2. _______________________________________
3. _______________________________________
4. _______________________________________
5. _______________________________________
6. _______________________________________
7. _______________________________________
8. _______________________________________
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16. _______________________________________
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18. _______________________________________
19. _______________________________________
20. _______________________________________
APPENDIX G: RESULTS FROM THE PSCORE ANALYSIS
Participants Preferences for Crater Lake Levels

In the visual portion of the study, one objective beyond investigating whether or not participants could detect a difference between the two slides in each slide pair was to elicit participants' preferences for lake views. This appendix explores participants' preferences for views of Crater Lake in terms of their ratings on the preference score, or Pscore, test statistic.

The Agreement Statistics: Results from the preference score. While the first part of each paired slide comparison asked visitors if they saw a difference, the second part asked participants to indicate whether they had a preference for the right or left slide. Exploring participants' preferences for lake views was the focus of the next experimental hypothesis.

Calculation of the summary agreement score for preference, or Pscore involved the same procedure as for the Dscore. Similar to the Dscore, it was necessary to define an expected score for an ideal participant who consistently preferred the higher lake levels (or closer to normal) as opposed to preferences for views depicting lowered lake levels. Because there were only 2 views presented at once, the expected preference score consisted of either 1 or 2, reflecting participants' preference for one view over the other.
The $P_{score}$ was calculated in the following manner:

$$DE_{ij} = \sum (\text{observed } # \text{ in cell} - \text{expected preference } # \text{ in cell})^2 \text{ over all cells}$$

To obtain the participant's relative departure from expected preferences follows as

$$RDE = DE / 284$$

and then the RDE is converted to the agreement statistic indicating the participant's preferences for lake levels

$$P_{score_{ij}} = 1 - RDE$$

In order to investigate whether a participant's preference score is dependent on the information they received about the slide views, effects of the 5 information treatments were explored using analysis of variance (ANOVA) for nested factorial designs for the hypothesis. Results have been included in Tables G.1 and G.2.

From the analysis of variance, it was determined that a nesting effect resulted from the fact that the variation between individuals within a session was different than variation between sessions within a treatment. Therefore, in testing the above hypothesis, it was necessary to specify the error term associated with $session$ within $treatment$ in the model to avoid potential false positives associated with using the mean squares from the error line of the analysis of variance table below.
Table G.1. Analysis of Variance Table for Preference Scores.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>30</td>
<td>0.46</td>
<td>0.114</td>
<td>13.16***</td>
</tr>
<tr>
<td>Session(treatment)</td>
<td>4</td>
<td>0.78</td>
<td>0.026</td>
<td>2.99***</td>
</tr>
<tr>
<td>Error</td>
<td>1135</td>
<td>9.88</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1169</td>
<td>11.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** ***p < .0001

Results of the analysis of variance suggest evidence of a treatment effect on participants' preferences for slide views (F = 13.16, p = .0001). Similar to differences between treatment groups for the difference statistic, this implies that the means of at least two of the five groups in the informational treatments are not equal for the preference part of the experiment. Mean agreement scores for the Pscore, their standard errors, as well as the 95% confidence intervals have been included in Table G.2. Least squares means for the Pscores close to 1 for each treatment imply that participants tended to prefer the slide views with higher water levels. Once again, even the Pscores associated with the no information treatment group (Treatment 1) tended to score in agreement with what would be expected if participants always preferred the higher levels of water.

Table G.2. Mean Preference Scores for the 5 Treatment Groups.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pscore LSMean</th>
<th>Std Err LSMean</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.818</td>
<td>0.0059</td>
<td>0.806, 0.830</td>
</tr>
<tr>
<td>2</td>
<td>0.845</td>
<td>0.0065</td>
<td>0.832, 0.858</td>
</tr>
<tr>
<td>3</td>
<td>0.864</td>
<td>0.0080</td>
<td>0.848, 0.880</td>
</tr>
<tr>
<td>4</td>
<td>0.884</td>
<td>0.0087</td>
<td>0.867, 0.910</td>
</tr>
<tr>
<td>5</td>
<td>0.864</td>
<td>0.0072</td>
<td>0.850, 0.878</td>
</tr>
</tbody>
</table>
Further Exploration of Information Effects on the Pscore. Specific sources of variation between the five treatment groups were explored using combinations between the different treatment groups. Table G.3 contains results from the analysis of variance for group comparisons as they corresponded to treatment groups. Recall that the a reference table for the treatment groups was provided in Table 3.3.

When participants’ preferences for slide views are the focus of analysis, statistically significant differences are more prevalent between treatment groups. In the analysis of the difference scores, the explanation for the mean differences between group was primarily found in the effect of treatment group 5 when compared to other treatments.

**Table G.3. Contrast Table for Treatment Comparisons Relating to the Pscore**

<table>
<thead>
<tr>
<th>Comparison</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 vs. T2</td>
<td>1</td>
<td>0.082</td>
<td>9.45**</td>
<td>.002</td>
</tr>
<tr>
<td>T1 vs. T3</td>
<td>1</td>
<td>0.187</td>
<td>21.44***</td>
<td>.0001</td>
</tr>
<tr>
<td>T1 vs. T4</td>
<td>1</td>
<td>0.351</td>
<td>40.20***</td>
<td>.0001</td>
</tr>
<tr>
<td>T1 vs. T5</td>
<td>1</td>
<td>0.213</td>
<td>24.50***</td>
<td>.0001</td>
</tr>
<tr>
<td>T2 vs. T3 and T4</td>
<td>1</td>
<td>0.096</td>
<td>11.04**</td>
<td>.0009</td>
</tr>
<tr>
<td>T3 vs. T4</td>
<td>1</td>
<td>0.027</td>
<td>3.10</td>
<td>.079</td>
</tr>
<tr>
<td>T1 vs. T3 and T4</td>
<td>1</td>
<td>0.396</td>
<td>45.50***</td>
<td>.0001</td>
</tr>
<tr>
<td>T4 vs. T5</td>
<td>1</td>
<td>0.029</td>
<td>3.36</td>
<td>.067</td>
</tr>
<tr>
<td>T5 vs. all others</td>
<td>1</td>
<td>0.016</td>
<td>1.89</td>
<td>.169</td>
</tr>
<tr>
<td>T2 vs. T5</td>
<td>1</td>
<td>0.033</td>
<td>3.81*</td>
<td>.05</td>
</tr>
<tr>
<td>T1 vs. all others</td>
<td>1</td>
<td>0.379</td>
<td>43.54***</td>
<td>.0001</td>
</tr>
</tbody>
</table>

*p < .05 **p < .01 ***p < .0001
In the analysis of the preference scores, the no information treatment (group 1) seems to be the most influential treatment in the ANOVA. When Treatment 1 is contrasted with 2, there is highly suggestive evidence of a difference ($F = 9.45, p = .002$). Additional comparisons of 1 with Treatment 3 ($F = 21.44, p = .0001$), Treatment 4 ($F = 40.20, p = .0001$) and Treatment 5 ($F = 24.50, p = .0001$) all show significant differences. When Treatment 1 is contrasted with 3 and 4 together, there is further evidence of a significant difference ($F = 45.5, p = .0001$). As well, when treatment 1 is compared with all others there is more evidence of a treatment effect ($F = 43.54, p = .0001$).

Other contrasts between treatment groups showed evidence of significant differences. When the verbal information treatment (group 2) was contrasted with slide text information treatments (groups 3 and 4), there was evidence of a difference in group means ($F = 11.04, p = .0009$). There was also evidence of a difference between group 2 and group 5 ($F = 3.81, p = .05$).

Modeling Participants’ Visual Preferences. Table G.4 contains the results from the ANOVA on the Pscore. There is evidence of an informational treatment effect ($F = 9.53, p = 0.0001$) but there is also evidence of an effect for treatment nested within session ($F = 8.27, p = 0.0001$). Additionally, there was a statistically significant indication of an association between the participant’s Pscore with their trip
characteristics and a number of attitudes toward use of the lake water. There was no indication of an association between the Pscore and any of the demographic variables.

Regarding the significant effect of the nested variables of session and treatment, the significance of the difference in variation between the treatment and the variation between sessions implies that the relative contribution among individual sessions does not vary consistently for each treatment in the study. An explanation for this inconsistency is difficult to pinpoint, given that the same researcher presented the study in the same location using a script for presentation. The technical presentation of the slides (set-up of projectors) or even the seating arrangements of participants may be possible explanations. Nonetheless, the factorial design of this model makes it possible to identify several sources of variability in this study.

### Table G.4. Final Model on the Pscore.

<table>
<thead>
<tr>
<th>Variable</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>17</td>
<td>0.908</td>
<td>0.533</td>
<td>5.60</td>
<td>.0001</td>
</tr>
<tr>
<td>Error</td>
<td>541</td>
<td>5.161</td>
<td>0.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>558</td>
<td>6.069</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>3</td>
<td>0.273</td>
<td>0.910</td>
<td>9.53</td>
<td>.0001</td>
</tr>
<tr>
<td>Session(treatment)</td>
<td>4</td>
<td>0.316</td>
<td>0.079</td>
<td>8.27</td>
<td>.0001</td>
</tr>
<tr>
<td>Destination</td>
<td>6</td>
<td>0.124</td>
<td>0.021</td>
<td>2.17</td>
<td>.0449</td>
</tr>
<tr>
<td>Human Use</td>
<td>1</td>
<td>0.104</td>
<td>0.104</td>
<td>10.86</td>
<td>.0010</td>
</tr>
<tr>
<td>Agricultural Use</td>
<td>1</td>
<td>0.039</td>
<td>0.039</td>
<td>4.13</td>
<td>.0427</td>
</tr>
<tr>
<td>Industrial Use</td>
<td>1</td>
<td>0.046</td>
<td>0.046</td>
<td>4.79</td>
<td>.0291</td>
</tr>
</tbody>
</table>

*p < .05  **p < .001  ***p < .0001
After accounting for differences due to information exposure, the nested nature of the variable session(treatment), and visitors' final destination, there is an association between participants' Pscore and whether or not Crater Lake was the destination of participants' trip ($F = 2.17, p = .05$). Evidence also suggests an association between their attitudes toward potential uses of Crater Lake water. The relationship between participants' preference for higher lake levels and their attitudes toward lowering lake levels for human use is statistically significant ($F = 10.86, p = 0.001$). Similarly, there is also evidence of an association between the Pscore and participants' attitudes toward agricultural use ($F = 4.13, p = 0.04$) and industrial use of Crater Lake water ($F = 4.79, p = 0.03$).