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Interpretive Signs Designed to Trigger Naturalist Intelligence at Two American Zoos

Martha Bryant
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Interpretive signs designed to trigger naturalist intelligence

at two American zoos

Dissertation

Presented in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

Lynn University

by

Martha Bryant

10 August 2005
Interpretive signs designed to trigger naturalist intelligence

at two American zoos

Bryant, Martha, Ph.D.

Lynn University, 2005-05-15

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Acknowledgments

A dissertation, no matter the fact it is largely written in a state that approaches solitary confinement, is never the work of a single individual. Many influences converged in the development of the work presented here.

This document would not have been conceived without a childhood filled with animals and books. My parents, Jackie and George Bryant, shared their joy of both. Mary Francis Craig helped direct a love of reading to a love of writing. If any mastery of words is evident, it stems from the many ideas she shared about her craft.

My early work in zoos was influenced by Craig Pugh, Deborah Cullen, and Dr. George B. Rabb. My thanks to Craig for hiring me at Brookfield Zoo and introducing me to a world and a work that I will always love, to Deb for her sense of fun and her very wise perspective about zoo careers, and to George Rabb for pushing me to view conservation and the potential for an individual to contribute to conservation in a new light.

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Abstract

An investigation of interpretive graphics was conducted in 2005 at two mid-sized AZA-accredited zoos, Lowry Park Zoo, Tampa, Florida and Knoxville Zoo, Knoxville, Tennessee. The Lowry Park Zoo study investigated signs at a red-tailed hawk and sandhill crane exhibit. Combination signs and wordless signs were more effective helping visitors see animals, increasing holding time, and number of engagements than treatments of no signs, or signs with words only. A second study, at Knoxville Zoo, tested combination and wordless signs in a children's zoo, investigating 31 signs at a 3.5-acre exhibit. Comparisons of visitors seeing the animals/using interactive exhibit elements, holding time, and engagement activities, showed wordless signs were more effective than combination signs.

Differences in gender ratio, age, group size, and other demographics were not significant. Visit motivation differed between zoos, with visitors from Lowry Park Zoo more often articulating reason for a visit as wanting to see animals. Visitors at Knoxville Zoo most often said they wanted to spend time with family and friends. Differences in potential for naturalist intelligence were probably related to local practices rather than to innate differences in naturalist intelligence. The number of communities in Florida that regulate pet ownership and provide lawn service could account for the lower number of people who have pets and plants.

At both institutions, behaviors supported educational theories. The importance of signs as advanced organizers was shown where signs were removed at the bird exhibit at Lowry Park Zoo, with fewer visitors seeing the animals. Social interaction was noted at both zoos, with intra- and inter-group conversations observed. If naturalist intelligence is necessary to see animals, visitors run a continuum. Some are unable to see animals with signs and assistance from other visitors; others see animals with little difficulty. The
importance of honing naturalist intelligence was best stated by a Lowry Park Zoo visitor who commented, "No one has ever shown me how to see animals." The potential for honing naturalist intelligence is the key finding of the study and should be considered as zoos work to connect their visitors with the creatures in their collections.
### Contents

List of Tables............................................................................................ x

List of Figures ............................................................................................ xi

**Chapter One—Introduction**

Introduction .............................................................................................. 1
Lowry Park Zoo .......................................................................................... 5
Knoxville Zoo .............................................................................................. 8
Hypothesis .................................................................................................... 17
Research methods and design .................................................................... 18
Data collection, organization, and analysis ................................................ 21
Expected results .......................................................................................... 23
Importance of study ..................................................................................... 24
  Impact at Lowry Park Zoo ........................................................................ 25
  Impact at Knoxville Zoo ........................................................................... 26
  Personal statement .................................................................................... 26
Assumptions .................................................................................................. 27
Scope ............................................................................................................... 32
Dissertation design ....................................................................................... 34

**Chapter Two—Literature Review**

Introduction .............................................................................................. 35
Background .................................................................................................... 35
  The evolution of zoos and their changing focus through time. ............... 37
  Zoos: Potential for education .................................................................... 42
  The state of zoo education ....................................................................... 44
Frame of reference: The theory behind the practice .................................... 50
The state of zoo and museum signage ........................................................ 55
  Techniques and standards ....................................................................... 56
  Sign use..................................................................................................... 57
  Signs and seaming .................................................................................... 61
  Signs in children’s zoos .......................................................................... 64
  New directions in signs .......................................................................... 65
Research methods and design ...................................................................... 67
Summary ....................................................................................................... 71

**Chapter Three—Research Design**

Introduction .............................................................................................. 72
Hypothesis ..................................................................................................... 74
Research design ............................................................................................ 75
Population and sample ................................................................................ 76
Data collection .............................................................................................. 77
Data analysis .................................................................................................. 80
Ethics .............................................................................................................. 81
Chapter Four—Results  
Introduction ............................................................................................................................. 83  
The scope of the study ............................................................................................................. 84  
Do zoo visitors see animals? .................................................................................................... 90  
   Seeing animals at Lowry Park Zoo .................................................................................... 90  
   Seeing animals at Knoxville Zoo ..................................................................................... 92  
Holding time: Do zoo visitors stay longer? ............................................................................. 93  
Engagement activities: Do zoo visitors do more? ...................................................................... 96  
Visit motivation ...................................................................................................................... 107  
A propensity for naturalist intelligence? ................................................................................. 109  
Significance of observations .................................................................................................. 112  
Qualitative findings ................................................................................................................ 112  
Explanation and discussion of results .................................................................................... 120  

Chapter Five—Findings, conclusions, and implications  
Introduction ................................................................................................................................ 128  
Summary of the study ............................................................................................................. 128  
Conclusions .............................................................................................................................. 132  
   Conclusions based on visitor use by sign types .................................................................... 132  
   Visit motivation .................................................................................................................. 134  
   Signs as advanced organizers ............................................................................................. 138  
   Social interaction and learning .......................................................................................... 139  
   Naturalist intelligence ......................................................................................................... 139  
Recommendations for further research ................................................................................... 141  
Implications .............................................................................................................................. 144  
Final summary .......................................................................................................................... 145  

Appendices  
Appendix A—IMIGUZ ................................................................................................................. 148  
Appendix B—How are you smart? (adapted from Rose & Nicholl, 1998) ............................... 150  
Appendix C—Signs tested at zoos ............................................................................................. 154  

Literature Cited ........................................................................................................................ 186  

Bibliography ............................................................................................................................. 205
List of Tables

Table 4-1. Days, dates, and sign treatments at Lowry Park zoo were used by visitors, of which 36.25% held an annual pass to the zoo. .......................... 85

Table 4-2. Days, dates, and sign treatments at Knoxville Zoo were used by visitors, of which 27.08% were zoo members. ........................................ 88

Table 4-3. Visit motivation is much debated at zoos. The responses from Lowry Park Zoo and Knoxville Zoo visitors to the question, “Why did you come to the zoo today?” are presented here. .......................... 108

Table 4-4. The propensity for visitors to Lowry Park Zoo and Knoxville Zoo to exhibit indications of naturalist intelligence is based on questions to a survey given to systematically selected visitor groups at both zoos. ......... 110
List of Figures

Figure 1-1. View of the red-tailed hawk/sandhill crane exhibit at Lowry Park Zoo. The animals are marked in the picture. The hawk sits above sight lines and the cranes below normal visitor sight lines. ............................. 7

Figure 1-2. Kids Cove at Knoxville Zoo includes many exhibit elements. In the first photograph, various areas are as follows:
1. Pig exhibit
2. Cow interactive area
3. Contact yard
4. Playground
5. Aviary
6. Water feature
7. Food (KC's Canteen)
8. Gifts (KC's General Store) ............................................................ 9

Figure 1-3. Existing signs at the start of Lowry Park Zoo study included the information above. The existing signs were replaced with new signs that matched other study signs, having black letters on a white background. ........................................................................ 31

Figure 1-4. Wordless signs throughout the study were black-and-white drawings of the gross motor skills that might assist visitors hoping to see animals. Visitors were portrayed pointing, squatting, and in other ways engaging with animals or exhibit elements. ..................................................... 32

Figure 1-5. Combination signs used throughout the study combined words with black-and-white drawings of the gross motor skills that might assist visitors hoping to see animals. Visitors were portrayed pointing, squatting, and in other ways engaging with animals or exhibit elements. ..................................................... 33

Figure 4-1. More Lowry Park Zoo visitors saw animals when combination and wordless signs were in place than when no signs or signs with words only were present (n=2235). ..................................................... 92

Figure 4-2. More Knoxville Zoo visitors saw animals when wordless signs were in place than when combination signs were present (n=1804). ........... 93

Figure 4-3. Lowry Park Zoo visitors stayed at the exhibit longer when combination and wordless signs were in place than when no signs or signs with words only were present (n=2235). ..................................................... 95

Figure 4-4. With the exception of holding time at the milking cow interactive, Knoxville Zoo visitors stayed at exhibit areas longer when wordless signs were in place than combination signs were present (n=1804). This anomaly at the milking cow interactive is related to a day when
the exhibit was not working correctly. More information on this is
given in Figure 4-11. ................................................................. 97

Figure 4-5. Lowry Park Zoo visitors exhibited more engagement activities
when combination and wordless signs were in place than when
no signs or signs with words only were present (n=2235). ............... 98

Figure 4-6. Knoxville Zoo visitors exhibited more engagement activities
when wordless signs were in place than when combination signs
were present (n=1804). ......................................................................... 99

Figure 4-7. In most exhibit areas, Knoxville Zoo visitors exhibited more
engagement activities when wordless signs were in place than
when combination signs were present (n=1804). Of note, is that
there was no engagement with the costumes or the buckboard when
combination signs were in place................................................................. 101

Figure 4-8. Knoxville Zoo visitor engagement at the aviary was higher
when wordless signs were in place than when combination signs
were present (n=1804). .............................................................................. 103

Figure 4-9. Knoxville Zoo visitor engagement around the water feature was
higher when wordless signs were in place than when combination
signs were present (n=1804). ................................................................. 104

Figure 4-10. With the exception of holding time at the milking cow interactive,
Knoxville Zoo visitors stayed at exhibit areas longer when wordless
signs were in place than combination signs were present (n=1804) ....... 105

Figure 4-11. A comparison of visitor engagement is shown here, when the
milking cow interactive was not working and later, after it was
repaired. ................................................................................................. 106

Figure 4-12. Intended to give visitors permission to use exhibit features, as
well as to trigger the imagination of families who might not be
accustomed to role playing, this sign in the Kids Cove aviary............. 118

Figure 4-13. The first entry sign at the Kids Cove Aviary, intended to “warn”
visitors who might be afraid of birds that they would encounter
free-flying birds ....................................................................................... 121

Figure 4-14. The second entry sign at the Kids Cove Aviary, intended both
to “warn” visitors who might be afraid of birds that they would
encounter free-flying birds, and to remind visitors that shoes
were needed to enter the aviary............................................................... 122
The combination entry sign at the Kids Cove Aviary, intended both to “warn” visitors who might be afraid of birds that they would encounter free-flying birds, and to remind visitors that shoes were needed to enter the aviary. ................................. 123

Sandhill cranes are the largest birds in the exhibit studied at Lowry Park Zoo. ................................................................. 155

The red-tailed hawk sits in the tree above visitors at Lowry Park Zoo. .................................................................................. 156

Guinea hogs are the first exhibit visitors encounter in Kids Cove, Knoxville Zoo. ................................................................. 157

The milking cow interactive is a few steps beyond the exhibit housing the Guinea hogs. The cow sits at the entrance to interactives shown in Figures C5 through C7. ......................................................... 158

Behind the milking cow interactive, an open window allows a view of the interior of the barn. Goats and sheep rotate in and out of the barn throughout the day. ............................................................... 159

A line of clothes, boots, and mirrors are placed along the barn wall to encourage role playing as both farmer and zookeeper. .............. 160

A buckboard is attached to the barn wall. The wheels turn and saddles on saw horses stand in front of the buckboard. .................... 161

The entrance to the contact yard, where visitors interact with goats and sheep, has hair brushes that visitors can take with them into the contact yard. ........................................................................ 162

Behind the contact yard is a “goat wall” with small ledges where the goats can get above the crowd. A line painted on the floor of the contact yard allows children to practice their balancing skills. .......... 163

Beyond the contact yard, two handwashing stations are available for visitors ........................................................................ 164

Benches located around Kids Cove provide a resting area for parents and grandparents. .......................................................... 165

Since climbing on exhibit rocks is prohibited in most of the zoo, staff felt a sign was needed to “give permission” to children who wanted to try the climbing wall installed horizontally above a rubber padded surface. ................................................................ 166
Figure C13. The entrance to the aviary was difficult to sign. Some visitors are afraid of birds and choose not to enter. This sign was tested to see if potentially frightened visitors understood they would encounter free-flight birds.................................167

Figure C14. After the opening of Kids Cove, staff discovered children entering the aviary without shoes—having discarded them near the sandbox or the water feature. A potential safety issue results, so this sign replaced the original aviary sign .........................................................168

Figure C15. A periscope in the aviary provides viewers with a bird’s-eye-view of the aviary.................................................................169

Figure C16. The bowl nest, a common shape used by robins and many other songbirds, invites photo opportunities and role playing. One creative dad brought “gummy worms” to feed his daughter..............170

Figure C17. Giant egg shells, painted robin’s egg blue, invite additional role playing. Numerous little boys immediately identified the eggs as “dinosaur eggs” rather than bird eggs................................................171

Figure C18. Casts and molds were used to create this interactive where children match animal feet with footprints pressed into the flat surface.............................................................172

Figure C19. This cavity nest was seldom identified as a nest until animals were added to the illustration. Two enterprising young boys identified the interactive as a volcano, rather than the stump of a tree.................................173

Figure C20. The rear wall of the aviary has two push button interactives. This one has photographs of birds with push buttons that provide verbal identification and a recording of the bird calls.................................174

Figure C21. The objective of this push button interactive is to match illustrations of a bird’s feet (bottom row), with an illustration of the beak (middle row). Holding down two correct buttons light up the picture of the bird on the top row................................................175

Figure C22. Underwater viewing of beavers and the occasional duck engage many visitors..............................................................176

Figure C23. A small room adjacent to the open air underwater viewing of beavers looks in on the lodge where the beavers sleep. Because they are nocturnal, one or more are often napping a few inches from the window................................................177
Figure C24. The terrestrial view of beavers includes vegetation for them to chew and drag through an opening into their pond.................................178

Figure C25. A waterfall runs down the rocks between the beaver lodge and the terrestrial viewing area. It is a favorite with toddlers and parents, providing an opportunity to get wet, without soaking clothes and shoes.................................................................179

Figure C26. Three giant frog interactives spit water across the streambed water feature. Children wading in the stream are sprinkled lightly.........................180

Figure C27. Lily pads sit above the water of the streambed. Children have a choice of staying dry, although few do that unless the weather is inclement...........................................................................181

Figure C28. This sign sits between the rabbit exhibit and the area with stump seating where zookeepers bring bunnies, beavers, and other animals for an up-close—but carefully supervised—encounter with visitors..................182

Figure C29. Nest boxes, hay, wooden eggs, and baskets are used by children who seldom appreciate this was daily work for their grandparents..........183

Figure C30. In addition to the nest boxes and eggs shown in Figure 49, this area is used for storytelling, a respite from the sun or rain, and a place for a stern parental discussion with a misbehaving child.................................184

Figure C31. A garden with heritage species of plants has been started behind the chicken coop. Perhaps because the garden is four steps below the coop, few visitors go to visit the plants.................................................185
Chapter One

Introduction

Zoos, aquariums, nature centers, and drive-through safari experiences are all part of 21st Century entertainment, a phenomenon that popular culture studies suggest both shapes us and is shaped by us (Hancocks, 2001; Hanson, 2004; Hoage, 1989; Mullan & Marvin, 1999; Norton et al., 1995). These venues provide experiences that enrich our lives. In this manner, these institutions transcend the stigma of frivolous entertainment (Hyson, 1999) and function as cultural institutions, providing unique educational experiences (Falk & Dierking, 2002a, 2002b) that feature animals who are touchstones of a human relationship with nature (Hancocks, 2001; Hanson 2004).

The efficacy and power of animals as educators is well known and zoological gardens and zoological parks are effective educational institutions (Carr, 2003; Falk & Dierking, 2000, 2002; Puchner et al, 2001; Roberts, 1997). Many zoos provide profound educational experiences to children and adults (Anderson & Piscitelli, 2002; Screven, 1993a). The intensity of this experience may influence visitors long after the time at the zoo, with Holzer and Scott (1997) reporting on the positive relationship between childhood experiences and adult behavior patterns and leisure activities.

In their study at Cleveland Metroparks Zoo, Holzer and Scott (1977) explored the memorable impact of childhood zoo visits, finding that adults who visited zoos as children
with their families were more likely to visit more zoos, to understand the educational benefits of zoos, and to be more committed to the conservation ethic of zoos. Other studies (Anderson and Piscitelli, 2002) report similar findings in Australia. Tanner (1980), Chipeniuk (1995), and Yoesting and Burkhead (1973) link childhood experiences to preferences for environmentally oriented careers.

In 1993, the International Union of Directors of Zoological Gardens (IUDZG) defined zoos as establishments that exhibit wild or domestic animals to the public. At that time, they estimated that at least 600 million people visited the world's 10,000 zoos—approximately 10% of the world's population (IUDZG/CBSG, 1993). These estimations are a broad overview of the global impact of zoos. More is known, however, about American zoos and the 134 million people who visit accredited American zoos each year (AZA, 2003a, 2003b). This total, 134 million, represents more people than attend NFL, NBA, and Major League Baseball events combined. This popularity gives zoos the opportunity to reach millions with their mission of developing an environmentally aware and informed populace, capable of weighing decisions that affect the future of life on this planet (AZA, 2003a, 2003b, 2003c, 2003d).

The American Association of Zoos and Aquariums (AZA, 2003b) reported that more than 30 million zoo visitors attended classes and lectures, took guided zoo tours, participated in docent (volunteer educator) programs, and met with zookeepers to learn about the animals and their wild habitats. The people who do not participate in education programming at a zoo (approximately 100 million visitors) have an opportunity for learning, however, through interpretive signs placed at nearly all exhibits in American zoos (AZA, 2003b). Like the familiar labels in a museum, signs in the zoo are intended to provide a bridge of understanding between the visitors and the collection (Burcaw, 1997).
With interpretive signs providing educational content (Becker, 1988; Bitgood 1987, 2000; Falk & Dierking, 1992, 2000, 2002; Lattis 1983, 1986; Millar 2000; Roe, 1992; Serrell, 1989), do the people who do not participate in education programming use these educational tools? It is generally assumed that the majority of zoo and museum visitors—as many as 90%—do not read signs (Serrell, 1988a, 1988b; Zaremba et al., 1992). In 1931, Robinson at the Buffalo Museum of Science, in what may have been the first empirical studies to investigate signage use, noted that signs were read by one-tenth of the visitors (Belcher, 1991; Robinson, 1931). Borun and Miller (1980) found 18% of the visitors to Philadelphia-area museums read signs, but where they stopped for an exhibit, as many as 68% were observed to read. Results are not that positive in other studies and Kropf (1991) found only 6% of adult visitors read signs at the New York Hall of Science.

Through the years, research has attempted to determine the reasons visitors chose to read, or to ignore, signs. Chambers (reported in Zaremba & Toedter, 1993; Zaremba et al., 1992) found readership was greater for new signs (71%) than old signs (27%) at the Philadelphia Zoo. In other studies at the Philadelphia Zoo, Zaremba et al. (1992) found that more visitors glanced at small signs than large (26.5% small, 21.8% large).

Empirical research and experimentation have led to improved sign reading. Serrell (1982b) increased sign reading at a Brookfield Zoo bat exhibit from 5% to 14% by relocating an existing sign. With a new sign in the improved location that featured an engaging title, active voice, and an easy-to-read format, she was able to increase readership yet again, attracting 56% of the visitors who stopped to view the bats.

Such reports by Serrell (1982b) are encouraging, but despite improvements in signs throughout the 20th Century, the traditional combination of words and pictures designed to connect the zoo visitor with the animals fall short of their stated goal of education for a
significant portion of zoo visitors (Alexander, 1995; Burcaw, 1997; Dierking et al., 2002a, 2002b; Goode, 1895; Tunnicliffe, 2003).

This research project, conducted at Lowry Park Zoo, Tampa, Florida, and Knoxville Zoo, Knoxville, Tennessee, investigates the premise that zoos, using traditional signs that include either words or a combination of words and images about the animals exhibited, were not incorporating significant 20th Century education and learning theories that might improve visitor educational experience. The researcher approached this investigation questioning whether the tradition of signs containing words or words and illustrations constitutes an educational paradigm is no longer valid for contemporary zoo visitors, many of whom seek recreational rather than educational experiences.

Visit motivation, a phenomenon being studied at a number of AZA-accredited institutions (Andereck & Cladwell, 1994; Csikszentmihalyi & Hermanson, 1995; Dierking, et al., 2002a, 2002b), may impact sign use. According to Mills (Kevin Mills, personal communication, September 23, 2004), more than half (52%) of zoo visitors come to have a good time with family and friends. If this is the case, it may, in part, explain low readership of interpretive signs in zoos.

The two zoos selected for the study, Lowry Park Zoo, Tampa, Florida, and Knoxville Zoo, Knoxville, Tennessee, have many similarities. Both are mid-sized zoos accredited by AZA, both are active in international conservation programs including Species Survival Plans and other efforts, both participate in a variety of research that focuses on the creatures in their collections and on their visitors, and both attract an audience that includes tourists and local residents.
Lowry Park Zoo, Tampa, Florida

Tampa's first zoo was founded in the 1930s, along the Hillsborough River. In 1957, the zoo's collection of indigenous animals and exotic birds was moved to Lowry Park. In 1982, in response to the needs of a growing and diverse collection, the Lowry Park Zoo Association was formed to fund significant improvements to the zoo. In 1984, this partnership hired architects to develop a 24-acre master plan for the zoo and began a $20 million capital campaign. In 1988, the rejuvenated zoo, named Lowry Park Zoo, opened as the public-private partnership that exists today: the land is owned by the City of Tampa and zoo operations are managed by the Lowry Park Zoological Society, an outgrowth of the original association. Today, the region's only dedicated zoological garden, Lowry Park Zoo enhances the quality of life in the Tampa Bay area and serves as a center for conservation and preservation of endangered wildlife (Lowry Park Zoo, 2005).

Lowry Park Zoo is a professionally run, AZA-accredited institution on 56 acres, with a collection of more than 1,600 animals. The zoo is active in international breeding and management programs for conservation of 27 endangered species through Species Survival Plans, international efforts that address management and breeding of captive endangered species (Craig Pugh, personal communication, February 11, 2005). The premier conservation activity at Lowry Park Zoo is the manatee rescue operation to which the zoo dedicates nearly 10% of its operating budget. Lowry Park Zoo is the only non-profit facility in the world that cares for West Indian manatees, a conservation project that costs the zoo approximately $1 million per year, making Lowry Park Zoo a leader in the zoo industry in percentage of annual operating budget committed to in situ conservation (Lowry Park Zoo, 2005).

In 2004, Lowry Park Zoo was named the “No. 1 Family Friendly Zoo in
America” by Child magazine (Lowry Park Zoo, 2005). The zoo welcomes 880,000 visitors from Greater Tampa Bay and from around the world, including more than 86,497 children who have used the zoo’s Florida Environmental Education Center (Zoo School) for classes, programs, meetings, rentals, sleepovers, birthday parties and workshops.

The zoo’s expanding commitment to education is reflected in its service to the community as the largest provider of informal science education in the area. The zoo is second only to the area public school systems as a provider of environmental education (Craig Pugh, personal communication, February 11, 2005).

The exhibit investigated at Lowry Park Zoo holds two species of birds: a single red-tailed hawk (Buteo jamaicensis) who spends most of her exhibit time at about 12 feet above ground level, in a large live oak tree (Quercus sp.). Beneath the tree are two sandhill cranes (Grus canadensis pratensis), who have worn a pathway through the vegetation, mostly bracken fern (Pteridium sp.). The exhibit was selected for a number of reasons:

1. The animals are physically large and should be easy to see.
2. The animals spend their time above visitor line of sight (the hawk) or below it (the cranes).
3. Preliminary observations left the researcher with the impression that many visitors did not see the animals in this exhibit.

The cranes are often visible despite a 43” high barrier that separates the animals from the visitors (see Figure 1-1). During the study, the red-tailed hawk spent virtually all of her time on the branch of the tree where she is seen perching in Figure 1-1.
Figure 1-1. View of the red-tailed hawk/sandhill crane exhibit at Lowry Park Zoo. The animals are marked in the picture. The hawk sits above and the cranes below eye level for most visitors.
Knoxville Zoo, Knoxville, Tennessee

Knoxville Zoo, the second study setting, was founded in 1947 in a city park on the east side of Knoxville. Today, still based in Chilhowee Park, the zoo is a professionally run, AZA-accredited institution on 53 acres, with a collection of more than 800 animals. It is active in international breeding and management programs for the conservation of 26 endangered species through Species Survival Plans (Bryant, 1998). The zoo’s animal husbandry programs for Burmese pythons and red panda have been recognized by the prestigious Bean award from AZA (Bryant, 1998). In addition, the zoo is the most popular year-round attraction in Knoxville, providing recreational opportunities to nearly 400,000 visitors from the southern Appalachian region and from around the world (tourists make up 47% of zoo visitors) (Bryant, 1998). The zoo is the largest provider of informal science education in the area and second only to local school systems as a provider of environmental education (Jim Vlna, personal communication, April 18, 2004). More than 160,000 children visit the zoo each year with family and friends or in school groups that come from Tennessee, and schools from surrounding states of Kentucky, Virginia, Georgia, Alabama, West Virginia, North Carolina, and South Carolina (Micah A. Herren, personal communication, April 18, 2004).

The exhibit investigated is a new Appalachian-themed children’s zoo called Kids Cove. The study covers 3.5 acres of exhibits, walkways, and visitor amenities (Figure 1-2), and includes an Appalachian farm intended to recreate the experience of an historic regional family farm featuring heritage species of domesticated animals including pigs (Guinea hogs—*Sus scrofa*), sheep (Tunis—*Ovis aries*), and goats (Nigerian dwarf—*Capra hircus* and Oberhasli—*Capra aegagrus*). Other exhibits in Kids Cove display regional songbirds. At any one time, visitors may see American goldfinch—*Carduelis tristis*, American robin—*Turdus*
Figure 1-2. Kids Cove at Knoxville Zoo includes many exhibit elements. In this photograph, taken from the top of Reptile hill show various areas are as follows:
1. Pig exhibit, cow interactive area, contact yard
2. Playground
3. Aviary
4. Water feature
5. Food (KC’s Canteen), gifts (KC’s General Store)

Close-ups of the exhibits follow:
1. Pig exhibit, milking cow interactive area, contact yard, and the hand-washing station.
2. Playground slides, spider web, climbing wall, sandbox, and window from playground into contact yard.
3. Aviary including cavity nest, birds-eye-view periscope, bowl nest, and egg shells.
4. Water feature including lily pads and spitting frogs.
5. Food (KC’s Canteen) and gifts (KC’s General Store).
migratorius, cattle egret—Bubulcus ibis, song sparrow—Melospiza melodia, white-throated sparrow—Zonotrichia albicollis, northern cardinal—Cardinalis cardinalis, mourning dove—Zenaida macroura, yellow-rumped warbler—Dendroica coronata, wood duck—Aix sponsa, Eastern bluebird—Sialia sialis, wood thrush—Hylocichla mustelina, Eastern towhee—Pipilo erythrophthalmus, and Carolina wren—Thryothorus ludovicianus. Within the aviary, beavers (Castor canadensis) make their homes in the pools. Outside the aviary, beyond the beaver exhibits, a rabbit hutch (Oryotolagus cuniculus) and a chicken coop (Gallus domesticus) provide reminders of the other animals that would have been found on an early Appalachian farm.

In addition to the animals, numerous hands-on interactive exhibit elements are designed to add experiential learning and play for children. Interactives near the barn and contact yard include a mechanical cow that children may wish to milk, a buckboard, two saddles on sawhorses, and costumes for role playing as zoo keepers and farmers. At the contact yard, there are hairbrushes to brush the sheep and goats. Within the aviary, child-sized nests and eggs encourage visitors to enter a bird's world, a periscope provides a bird's-eye-view of the area, a footprint puzzle, and two push-button interactive boards play birdcalls and light up when beaks and feet are combined to match the birds pictured at the top of the board. A nearby water feature includes large artificial “spitting” frogs and lily pads to recreate the streams and ponds found throughout the Appalachian region. A room adjacent to the chicken exhibit includes nest boxes, straw, and wooden eggs where children may experience the task of collecting eggs.

Meandering walkways provide visitors with choices to determine their route through Kids Cove. The playground, designed by Teri Hendy (Executive Board Member, National Playground Safety Institute, Ashburn, Virginia; also President, Site Masters, Inc., Cincinnati, Ohio), provides opportunities for learning and play for children of varying physical abilities.
A rock-climbing wall, plastic-tube slides, a rope spider web, a large sandbox, and a wheelchair accessible sandbox are highlights of the experience. Visitor services including concessions and gifts are located in the heart of Kids Cove. A portable restroom facility and a wild animal carousel are just outside the entrance to Kids Cove (Jim Vlma, personal communication, April 18, 2004).

Hypothesis

The hypothesis for this research was that zoo visitors exposed to wordless signs were more likely to see animals in zoo exhibits, spend longer holding time at an exhibit, and participate in more extensive engagement activities than those zoo visitors exposed to no signs, signs with words only, and combination signs, which are those that combine words with the images from the wordless signs. This full hypothesis was tested at Lowry Park Zoo, Tampa, Florida, and further study at Knoxville Zoo, Knoxville, Tennessee, tested combination signs and wordless signs, the two sign treatments that were shown to be most effective for visitors to Lowry Park Zoo, Tampa, Florida.


1. Is seeing animals in a zoo exhibit, holding time, engagement, or naturalist intelligence related to variables that include age, gender, group size, and if the visitor is a tourist or local?

2. Are zoo membership, attendance at other animal attractions, pet ownership, gardening, belief that conservation is an important issue, and active support of
conservation indications of naturalist intelligence as evidenced by the ability to see animals in exhibits?

Research methods and design

Zoos and museums often do not employ rigorous research design or methods when investigating education and visitor studies (Serrell, 1996). When zoo and museum projects are approached by experienced educational researchers, Screven (1993b) relates that these researchers often discover that the theories and methods grounded in formal education fall short in:

... identifying presentation modes and teaching strategies that stimulate and sustain visitor interest. Sooner or later, they place less reliance on educational theory and more on watching what visitors do during visits, how they move through spaces, how much time they spend reading, viewing displays, and even which exhibition halls they chose. (Screven, 1993b, p. 4)


Many studies on zoo signs have been influenced by Serrell (1982b), who suggests that if the purpose of evaluation is to improve an exhibit, a small sample size, a focus group, or other limited means of investigation may provide the information necessary for change (Becker, 1988; Falk, 1997, 1999; Lynn & Gagnard, 1984; MacPhee & Melien, 2000). Screven
(1992), however, warns, "misconceptions, pseudo-controversies, contradictory methodologies, and over-simplifications of evaluation abound in the museum field." (p. 4).

Since Screven's work, Diamond (1999) has addressed research design and methods in her Practical Evaluation Guide: Tools for Museums and Other Informal Educational Settings, which serves as a handbook for many institutions interested in evaluating their exhibits and programs. She begins by reminding readers that quantitative methods classify diverse behaviors into categories by looking at numerical patterns in data that summarize the reactions of subjects (a subset of total visitors) to a set of predefined variables and that these quantitative methods can be generalized to predict responses by total visitor population (Diamond, 1999). She defines qualitative methods as those that emphasize a depth of understanding rather than producing information that can be generalized to the larger population. It is important to note, however, that Best and Kahn (2003) question the wisdom of making generalizations from evaluation-based studies. Despite that caution, evaluation remains the most common research method in zoos and museums (Hefferman, 1998; Shettl, 1976; Screven, 1995).

Evaluation determines what happens at a given institution at a particular time: it is a "snapshot" of events. Evaluations are specifically performed to see if a program, sign, or exhibit is meeting the goals assigned. Evaluation provides what Best and Kahn (2003) describe as a value judgment. Zoos and museums frequently use evaluation outcomes to revise the program, sign, or exhibit under investigation and to enhance its efficacy.

Many evaluations have been undertaken to study visitor use of signs and attribute the frequency and duration of that use to such things as location within the exhibit, placement of the sign defined by proximity to a main exhibit feature, text length, letter size and typeface, color, size, density of visual stimuli, lighting and glare, visitor interest, visitor involvement,
clear language, cueing (the use of questions, often in the title of the sign), content, and organization (Becker, 1988; Birney, 1989; Jocham & Radcliffe, 1991; Landry, 1985; Litwak, 1990; Litwak & Kaestle, 1987; Mosca, 1982; Rand, 1986; Samson, 1995; Serrell, 1989, 1996; Veverka, 1990). These and other studies have led to a significantly improved understanding of sign use by visitors and have been used to develop standards that guide sign design and placement (Metropolitan Museum of Art, 1995). Serrell (2002) and others (Bitgood, 1989; Millar, 2000; Moorcroft et al., 2000; Moses, 1994; Nolinske, 1999; Zaremba et al., 1992) have investigated sign success based on a number of variables. Those variables that seem most applicable to this study include:

- Holding time (how long the visitors stay at the exhibit).
- Engagement (what do they do at the exhibit)

Holding time is the duration a visitor spends at a particular exhibit, reading signs, looking at exhibit elements, using interactive exhibit elements, or engaging in some way with the exhibit or with other visitors. Serrell (1996) found a positive correlation between amount of time visitors spent at an exhibit and the number of activities they performed while there.

Engagement takes numerous forms at a sign or exhibit, include in-group discussion, inter-group discussion, and acting out or role-playing. Visitors may point at the animal or take a photograph. Kropf (1991) investigated engagements including family discussion and interaction with exhibit elements.

Learning in a zoo or museum is often assumed to be related to time spent at an exhibit (Serrell, 1997, 1998; refuted by Tunnicliffe, 2003), much like a classroom teacher might relate learning to time-on-task. In this, Serrell (1997) suggests that holding time and engagement in zoos and museums appear to be parallel concepts with allocated time and
engaged time in a classroom. Research on these classroom phenomenon has found optimal learning takes place during not during allocated time (holding time), but during engaged time, when students are physically, emotionally, and overtly participating in classroom lessons (Richard Cohen, personal communication, 23 February 2004). Despite Diamond’s (1999) cautions about drawing research methods and techniques directly from classroom studies, the apparent tie between engagement at an exhibit and engaged learning in a classroom is worthy of additional exploration in zoos and museums.

Measurements of learning have been performed by Hayward and Hart (1997) and Dierking et al. (2002a, 2002b), who did immediate and delayed surveys of zoo and museum visitors, contacting people two to nine months after an exhibit visit. Dierking et al. (2002a, 2002b) found that 35% of the visitors stated exhibits influenced their attitudes, interest, and in the delayed survey, visitors reported that their visit had been responsible for behavioral changes or reinforced interest.

Data collection, organization, and analysis

The quasi-experimental, evaluation-based investigation was designed to determine if, at Lowry Park Zoo, Tampa, Florida, four signs treatments (no signs, existing signs, combination signs that combine words with an illustration of what a visitor must do to see animals in the exhibit, and wordless signs), were correlated with observable differences in exhibit use. To address potential bias in the study, a research design that systematically selected zoo visitors for study, based on order of entry to exhibit pathway, was employed (Best & Kahn, 2003).

Three measurements of exhibit use, did the visitor see the animals, holding time, and engagement, were collected by unobtrusive observation, a standard method employed by zoos and museums for visitor research (Bitgood, 2002; Diamond, 1999; Serafina, 2001;
Smell, 1996; Taylor, 1991). Although prior to the study there was concern as to whether it would be possible to observe if visitors saw the animals, the preponderance of visitors either visibly tilted their heads up and/or down to see the birds or pointed at the birds. In addition, the observations were able to provide the information as to whether the visitors use the techniques described on the combination and wordless signs (by words or by pictures) to locate the animals in the exhibit.

After observations were complete and visitors were leaving the area, the third individual or group that was unobtrusively tracked was approached and asked to provide demographic information as well as to respond to questions that seek to confirm if the visitor saw the animals and if they used the signs to help them do so. Additional questions were designed to elicit information about naturalist intelligence.

Data were collected using a clipboard, stopwatch, and IMIGUZ (Inventory of Multiple Intelligence Graphics Use in Zoos, see Appendix A). Using this instrument, the researcher observed visitors, marking animal sightings, holding time, and checking a list of engagement activities. Survey questions were included on IMIGUZ and every third group was invited to participate in an interview to provide information on demographics and a propensity for naturalist intelligence. The data sheets were organized and checked at the end of each day to ensure they were accurately dated and completely coded. Data were entered on an Excel spreadsheet, then imported into SPSS (Statistical Package for the Social Sciences) for analysis.

The literature was searched for information on data analysis of zoo and museum studies (Birney, 1994). With numerous approaches to data analysis mentioned in the literature, quantitative data was reviewed using:
1. Descriptive statistics to look at frequencies, numbers, means, range, and standard deviation of observational and survey data collected on variables including whether or not visitors saw animals, holding time, number of engagement activities, gender, group size, local/tourist, member/non-member, and a series of questions to determine propensity for naturalist intelligence.

2. ANOVA, Analysis of Variance, was chosen to determine if the between-treatment variance was sufficiently greater than the within-treatment variance to determine if the differences in means are valid or a function of sampling error (Best & Kahn, 2003).

3. Non-parametric tests were used to confirm results of the ANOVA.

Qualitative data from both observations and interviews are interpreted using thick description (Geertz, 1973).

*Expected results*

The expectation was that visitors who visited the exhibit when no signs were present, would be less likely to see animals than those exposed to any sign type. Further, it was anticipated that visitors exposed to the wordless signs would be more successful at seeing animals in exhibits and show a greater indication of higher naturalist intelligence. Holding time and engagement were anticipated to increase with visitors becoming engaged in more ways and for longer periods of time at the exhibit. Visitors with stronger indications of naturalist intelligence were anticipated to see the animals more easily when exposed to all sign types than those visitors who do not have an affinity for or an intuitive understanding of the natural world.
Too little research has been done on the use of signs for people who do not read. Preliterate children, who make up a large percentage of zoo visitors, are presumed to learn at zoos based on interactions with the adults who take them to the zoo. It is known that some adult visitors read signs (Witteborg, 1981; Yerke, 1984), either aloud or silently, and subsequently interpret the information to children; in other instances, parents may read signs with children, drawing a finger under each word as it is read (Borun & Miller, 1980; Falk & Dierking, 2000; Lattis, 1983, 1986; Serrell, 1982b, 1996). There is little research on the use of signs for the three to ten age group that is the target audience at the children’s zoo at Knoxville Zoo. Chronologically almost half of this group are preliterate (Borun & Miller, 1980; Falk & Dierking, 2000; Lattis, 1983, 1986; Serrell, 1982b, 1996).

Several zoos, including Miami MetroZoo, address growing groups of international visitor with multilingual handouts and include iconographic information on some interpretive signs. However, most zoo educators speculate that speakers of other languages are probably part of the majority of zoo visitors who, for a multitude of reasons, do not read signs (Becker, 1988; Birney, 1989; Litwak, 1990; Mosca, 1982; Rand, 1986; Samson, 1995; Serrell, 1989, 1996).

If the capacity to see an animal in a zoo exhibit, holding time, and engagement increase at significant levels for visitors exposed to wordless signs when compared to other sign treatments, this study will potentially influence development and interpretation of zoos and museums, especially children’s zoos and children’s museums. Since no empirical study of wordless signs in zoos has been described in the literature published by AZA or elsewhere in the past 20 years, the research extends existing knowledge.
In addition to the impact on visitor learning and experience, most zoos depend in varying degrees to earned income. They are therefore interested in having visitors extend visit time and increase the likelihood that visitors will purchase additional food, drinks, and souvenirs during a longer visit (Marie Vlma, personal communication, May 5, 2004). If total time spent at each exhibit increases with the wordless signs, with a similar increase in total visit duration, an increase in per capita income could be of substantial benefit to zoos.

The impact on the audience, especially the empowerment of a young child, is already noted by a number of authors (Anderson, 2001; Anderson et al., 2000, 2002; Brandt, 1993; Falk & Dierking, 2000; Piscitelli, 2001; Piscitelli & Anderson, 2001, 2002), and is beyond the scope of this project. The researcher posits, however, the premise that providing the support (wordless signs) so a young child can “do the exhibit” without parental assistance will engage children to a greater degree. Is it possible that these empowered children who understand an exhibit on their own may be the very ones inspired to follow environmental careers? It would be of interest for future studies to seek to develop an understanding of what sparks the imagination of children in zoos, and inspires them throughout their lives.

Impact at Lowry Park Zoo. Lowry Park Zoo keeps information on many aspects of its operation. Attendance numbers, age categories (children 0-2, 3-12, adult, senior, school group) are kept because of their relationship to income. Zip code surveys are conducted for several weeks each year to measure the impact of the zoo on local tourism. Marketing surveys have sought to determine visitor motivation, whether the visit was spontaneous or planned, suggested by parent or child.

The data collected in this study better define the zoo’s audience as well as provide definitive information about visitor use of the zoo. To ensure that this research project fit
the needs of the zoo, the author has worked closely with Craig Pugh, Simon Hackshaw, Jennifer Hackshaw, and Trish Rothman at Lowry Park Zoo.

Impact at Knoxville Zoo. Knoxville Zoo also collects and maintains significant information on its operation. Attendance numbers, age categories (children 0-2, 3-12, adult, senior, school group) are kept because of their relationship to income. Zip code surveys are conducted for several weeks each year to measure the impact of the zoo on local tourism. A staff member, as part of a Master’s degree program at the University of Tennessee, Knoxville (Glass, 1999) investigated the impact of the presence of a human interpreter at exhibits on cognitive retention by visitors.

The data collected in this study better define the zoo’s audience as well as provide definitive information about visitor use of the zoo. Knoxville Zoo staff, including Jim Vlna, Marie Vlna, Lisa New, Tim Adams, Micah Herren, Keith Montgomery, and Jon Whitehead have asked thought-provoking questions and provided data and advice throughout.

Douglas Kimball, a nationally known wildlife artist who lives in Knoxville, brought the idea of wordless signs to life with his drawings for the entire study. Doug’s advice as both artist and consulting parent improved numerous aspects of the study. Don Clark (principal, Design:Clark) designed the frames at Knoxville Zoo that held the signs and his wealth of knowledge on attraction, sign appeal, and the placement of environmental graphics contributed significantly to the entire project.

Personal statement. The interest that prompts this research arises from the author’s writing of zoo signs that began in 1985 at Chicago’s Brookfield Zoo. Through graduate studies in museology at the University of Kansas, work at Knoxville Zoo, and as a consultant for zoos and museums, the author has been conscious that despite their diversity and presumed importance, signs fall short of their educational potential. The idea for
wordless graphics came in the company of Marie and Jim Vlna during one of many discussions on how zoos can better reach their visitors and fulfill their mission.

**Assumptions**

The assumptions of this study are:

1. The primary assumption was that visitors to Lowry Park Zoo and Knoxville Zoo would understand and use wordless signs in a manner similar to the way they use traditional interpretive signs, but that wordless signs would be used by a greater number of visitors than other sign types.

2. The techniques developed to study the efficacy and use of traditional signs in zoos and museums are assumed to function in a similar manner to measure the efficacy and use of wordless signs in this study.

3. The zoo visitors continue the tradition of cooperation and research assistance that they have historically shown for other projects.

The terms that may ensure a shared understanding of the project include:

**Children’s zoos:** Children’s zoos are often called “a zoo within the zoo” (Brookfield Zoo, 2003; Kriegel et al., 2001) or “farm in the zoo” (Lincoln Park Zoo, 2003). The first children’s zoo in America opened at the Philadelphia Zoo in 1936 (Philadelphia Zoo, 2003) and was shortly followed by the creation of a children’s zoo at the Bronx Zoo in 1941 (Bronx Zoo, 2003). Lattis (1983) says these early efforts provided children with the opportunity to touch animals and gain a better appreciation for living things.

Today, many children’s zoos are designed for children ages 3 through 10 and their families (Bradshaw, 2000; Kriegel et al., 2001). While there is great variety in children’s zoos from institution to institution, most include a
contact yard (sometimes called a “petting zoo” by visitors) where children can interact with goats, sheep, and other domesticated animals (Schneider, 1982). Many have a farm-based theme, although it is a farm modeled on the 18th and 19th Century family farm rather than the production-intensive, single species farms more common today (Grisham, 1982). Milking demonstrations, incubators for hatching chickens, and other farm-based activities are common sights. Household activities from earlier times—churning butter, carding and spinning wool, weaving, whittling, and other rural activities—are often demonstrated at regular intervals for visitors (Kriegel et al., 2001).

Where wild animals are included in the children’s zoo, they often represent those found in the region where the zoo is located (Lattis, 1983; Schneider, 1982). It is not uncommon to see raccoon, deer, raven, skunk, beaver, and other small mammals, reptiles, amphibians, and invertebrates in a children’s zoo.

Existing signs at Lowry Park Zoo: Currently signs at the red-tailed hawk/sandhill crane exhibit are engraved (white letters on a blue background) and contain only words. Those were replaced for the study with signs that contained identical information (common name, scientific name, and continent) on signs that had black letters on a white background (Figure 1-3).
Sandhill Crane  
*Grus canadensis pratensis*  
North America  

Red-tailed Hawk  
*Buteo jamaicensis*  
North America  

Figure 1-3. Existing signs at the start of Lowry Park Zoo study included the information above. The existing signs were replaced with new signs that matched other study signs, having black letters on a white background.

**Wordless signs:** Those signs that incorporate only an image that illustrates what visitors need to do to participate in the exhibit activity—from seeing the animals to manipulating the interactive elements. One of the wordless signs used at Lowry Park Zoo is shown in Figure 1-4.

**Combination signs:** These signs combine the illustration from the wordless sign with prose intended to trigger visitor action to assist in seeing the exhibit animals or using interactive elements of the exhibit. An example of a combination sign used at Lowry Park Zoo is provided in Figure 1-5.
Wordless signs were black-and-white drawings of the gross motor skills that might assist visitors hoping to see animals. Visitors were portrayed pointing, squatting, and in other ways engaging with animals or exhibit elements.

**Holding time:** The total time spent at an exhibit. It is measured by using a stopwatch to time the first person in a visitor group (family or friends) to cross an arbitrary line, until that group of visitor leaves the exhibit. Serrell (1996) found a positive correlation between amount of time visitors spent at an exhibit and the number of activities they perform while there.

**Engagement:** These are the activities that the visitor performs while using or viewing an exhibit. Literature includes such activities as conversation within the group, conversation between two groups, pointing, using exhibit elements, etc. A checklist was included in IMIGUZ (Appendix A), but was expanded as visitors performed additional engagement activities.
Look Down!
Sandhill cranes fly, but they feed on the ground, eating seeds, leaves, and insects.

Formal education: Historically, formal education refers to school-based education, most often denoting an established, compulsory school system. Formal education has often been used to distinguish school-based education from educational experiences provided in other arenas, including museums and zoos. (See also definitions for informal education and free-choice learning.)

Free-choice learning: A newer term than “informal education,” free-choice learning does more than suggest a different location for the educational process. Free-choice learning describes what occurs outside of classrooms as “free-choice, nonsequential, self-paced, voluntary, [and] . . . driven by the unique intrinsic needs and interests of the learner” (Falk, 2001, p. 6-7). (See also definitions for formal and informal education.)
Informal education: Since the 1970s, the phrase informal education has often been used to refer to museum education and environmental education as a way of defining and distinguishing these activities from school-based education. (See also definitions for formal education and free-choice learning.)

Naturalist intelligence: Naturalist intelligence is that which allows an individual to see and intuitively understand aspects of the natural world. According to Gardner (2004), this means that individuals can “make consequential discriminations in the natural world: between one plant and another, between one animal and another, among varieties of clouds, rock formations, tidal configurations, and the like” (Gardner, 2004, p. 36-37).

Scope

The scope of this project focused initial efforts studying the effect of four sign types on visitor behavior and exhibit use at the red-tailed hawk/sandhill crane exhibit at Lowry Park Zoo, Tampa, Florida. It expanded evaluation of combination and wordless signs at Kids Cove, Knoxville Zoo, Knoxville, Tennessee.

The Lowry Park Zoo exhibit was selected because it contained large, readily visible animals whose use of the exhibit falls above (the hawk) or below (the cranes) common visitor eye level. This selection presumes that individuals with strong naturalist intelligence will know to look for animals above and below eye level, while those visitors who lack significant naturalist intelligence will not readily see the animals. Preliminary observations made when the exhibit was selected, suggested that many visitors left the manatee underwater viewing area and did not look for animals at the bird exhibit, rather they moved immediately to Stingray Bay, where they could see a crowd of people gathered to feed the stingrays. This study went beyond the simple investigation of sign use and sought to
determine the relationship of four sign options (no signs, existing signs, combination signs, and wordless signs) to visit activities, and indications of naturalist intelligence that may shape visitor experience.

The longer duration testing of combination signs and wordless signs at Knoxville Zoo to provide additional meaning to data collected at Lowry Park Zoo, with an emphasis on appeal to children made possible by the sign locations (36" top of sign) at Knoxville Zoo.

Like all zoo-based studies, the testing of wordless signs presented some significant challenges. These included:

1. At Lowry Park Zoo, visitor use of the exhibit studied was confounded by some unknown degree by the location of the red-tailed hawk/sandhill crane exhibit between two of the zoo’s most popular exhibits (manatees and stingrays).

   At Knoxville Zoo, the measurement of attraction was confounded by the height at which signs were placed. Although the signs were mounted at a 15 degree angle for adult viewing, their atypical placement designed specifically for children may potentially have reduced adult attraction.

2. There was no standard found in the literature for measuring use of signs that did not involve reading. It appeared that a brief glance could potentially communicate a complete message to the visitor. The existing link between extended time spent in front of a text-based sign and reading speed was not of assistance in evaluating data from visitors exposed to the wordless treatment.

Study limitations were that the research design included multiple participant groups rather than testing the designs with the same group. There is precedence in the literature (Birney, 1994; Routmann, 2004) for such a quasi-experimental design, but the author is aware that while subjects are presumed to have educational, attitudinal, and demographic
similarities, there may be an unanticipated difference between groups observed. This is lessened by collecting data only on individuals or family groups rather than school groups whose dynamics (Tunnicliffe, 1996, 2003) are different.

Delimitations include the use of a sample of convenience associated with testing only visitors to Lowry Park Zoo and Knoxville Zoo, and further, only to those visitors who come to the red-tailed hawk/sandhill crane exhibit and Kids Cove. In addition, evaluation-based studies are a "snap-shot" of a single institution (Best & Kahn, 2003) and conclusions should not be extended beyond the exhibits and institutions where observations were conducted. While the observations at the two zoos complement each other, they are not predictive of visitor response at other institutions.

Dissertation design

A review of the literature, research design, results, and conclusions are included in subsequent chapters of this dissertation. The literature review in Chapter 2 is a comprehensive look at 20 years of literature published by AZA (formerly AAZPA—the American Association of Zoological Parks and Aquariums) for national and regional meetings, as well as applicable references in a variety of fields including cognitive psychology, education, museum studies, and visitor studies. Research methods and design are outlined in Chapter 3. Results of both studies, with explanatory figures and tables precede the presentation of qualitative results and the integration of qualitative and quantitative findings in Chapter 4. Conclusions and implications are explored in Chapter 5. Appendices include include IMIGUZ, the instrument for data collection; a copy of "How are you smart?" (adapted from Rose & Nicholl, 1998) an instrument for determining strengths in multiple intelligences; and samples of all signs tested in both phases of the research. Literature cited and non-cited references complete the dissertation.
Chapter Two

Literature Review

Introduction

This chapter provides a background that presents multiple definitions of a zoo, including the commonly used definition of a zoo as a museum with a living collection, places zoos in an historical perspective, and positions zoos as educational institutions. With that framework established, interpretive signs are defined and their structure and function explored through appropriate literature. Finally, methodology for the study of signs and their efficacy is presented.

Background

Museums are collections-holding cultural institutions that define their existence through five activities: collection, conservation, exhibition, research, and education (Alexander, 1995; Burcaw, 1997). Some institutions add an additional element, recreation, to their mission (Burcaw, 1997; Hoage & Deiss, 1996). The U.S. government’s Institute for Museum and Library Services defines museums as institutions that are (IMLS, 2003):

- organized as a public or private nonprofit institution that exists on a permanent basis for essentially educational or aesthetic purposes;
• care for and own or use tangible objects, whether animate or inanimate, and exhibit these objects on a regular basis through facilities that it owns or operates;
• have at least one professional staff member or the full-time equivalent, whether paid or unpaid, whose primary responsibility is the acquisition, care, or exhibition to the public of objects owned or used by the museum;
• are open and provide museum services to the general public for at least 120 days a year. (IMLS, 2003, ¶2, 3, 4, 5)

The American Association of Museums (AAM) estimates there are 12,000 museums in the United States (AAM, 2003). These range in size from a local history museum with a small collection that runs on volunteer labor, to the most sophisticated cultural institutions including the many museums under the umbrella of the Smithsonian Institution and major museums found in urban centers (Alexander, 1995; Burcaw, 1997).

By the definitions given here, museums include art, history, natural history and other science museums, libraries and archives that include exhibit areas, as well as museums with living collections: arboretums, botanical gardens, aquariums, and zoos (Alexander, 1995; Burcaw, 1997; Falk & Dierking, 2002). While this definition is based on the concept of a zoo as a cultural institution, in 1993, the International Union of Directors of Zoological Gardens (IUDZG) arrived at a broader definition of zoo, as any establishment that exhibited wild or domestic animals to the public, by definition adding nature centers and drive-through safari parks, to the term zoo. This dissertation, however, follows the definition of a zoo as a museum with a living collection and strives to ensure clarity in this literature review using the phrase “zoos and museums” unless describing research done specifically in a zoo or in a museum that does not have a living collection.
The evolution of zoos and their changing focus through time. Whether one chooses to believe that Noah was the world’s first zookeeper when the animals arrived—two-by-two—at the ark, zoos have long been an important part of human cultural history. The earliest zoos were menageries, built for royalty to view exotic animals from around the world. About 1500 BC, Egypt’s Queen Hatshepsut put together a collection of animals. By 1000 BC, Chinese Emperor Wen Wang founded the Garden of Intelligence, a zoo of 1,500 acres (Baratay & Hardouin-Fugier, 2002).

From these earliest times, the practice of holding menageries spread as rulers from Africa, India, China, and Europe collected animals as a display of power and wealth. The ancient Greeks established public zoos for the study of animal life (Hoage et al., 1996; Hoage & Deiss, 1996). The Tower of London began its history as a zoo in 1235, with a gift of leopards to King Henry III. Edward I built a tower for his collection of lions, animals he may have brought to England in 1274 when he returned from the Crusades (Hahn, 2003; Thomas, 1996).

Vienna’s first organized collection of animals was brought to the city in 1452. The exploration of the New World renewed the European interest in exotic animals and in zoos and by 1570 a game park was built around the palace grounds of Schonbrunn. By 1752, the time of construction of Europe’s first modern zoo, Tiergarten Schonbrunn, animals from the original game park in Vienna were arranged and interpreted according to the Linnaean system of classification (Karkaria & Karkaria, 1998). This zoo opened to the public in 1779 (Vienna Zoo, 2003) and zoos spread throughout Europe.

In 1828, the London Zoo opened, touting itself as the world’s first scientific zoo with a collection of exotic animals studied by eminent scientists of the time. In 1847, the zoo opened to the public (Hoage & Deiss, 1996; Kisling, 1996, 2001; London Zoo, 2003).
These "scientific" zoos provided information for visitors including common name, scientific name, and sometimes included information on comparative anatomy and physiology.

The Philadelphia Zoo claims to be the oldest zoo in the United States. Its charter was signed on March 21, 1859. The Civil War, however, slowed construction and the zoo would not open until July 1, 1874 (Philadelphia Zoo, 2003). America's first impact on zoos was their creation for public enjoyment—paralleling the populist expansion of American museums (Alexander, 1995; Kisling, 1996).

During the early years of the 20th Century, zoos began to see increased competition for visitors from amusement parks and motion pictures, a phenomenon which Hyson (1999) suggests led to a developing perception of zoos as "show business" rather than educational venues and as "low culture" compared to the "high culture" of art museums.

In 1924, the American Association of Zoological Parks and Aquariums (AAZPA) was founded to advance the mission of zoos in the areas of conservation, education, science, and recreation (AZA, 2004). This organization, today known as the American Zoo and Aquarium Association (AZA), is the accrediting body that promotes the 213 member zoos and aquariums in North America working toward a future "where all people respect, value, and conserve animals and nature" (AZA, 2004; ¶1).

Education, a focus within American zoos, led, in 1929, to the world's first formal zoo education program being established at the Bronx Zoo (Bronx Zoo, 2003). Education had long been included in many zoo mission statements, but in many zoos it would not be emphasized until the waning decades of the 20th Century (Carr, 2003; Paris, 1999; Peters, 2000).

The next major change in zoos came with the opening of Brookfield Zoo in suburban Chicago. Begun in the late 1920s, but not opening to the public until 1934,
Brookfield Zoo was the first American zoo with “barless” exhibits (Ross, 1997). It was a trend that would sweep the zoo world. While the tradition of providing information to zoo visitors was growing, the new barless zoos were a non-verbal presentation of the environment in which the animal lived (Karkaria & Karkaria, 1998).

The post-war years, with the expansion of automobile ownership, accelerated the public’s association of zoos with family entertainment (Hyson, 1999). Then the 1957 Sputnik launch led to the creation of National Aeronautics and Space Administration (NASA) (Launius, 1999) and a post-Sputnik interest in science and science education. Amidst this interest in science, Rachel Carson’s *Silent Spring* (1962) made public the long-held fear that modern life was degrading global environmental quality and decreasing planetary biodiversity.

In 1968, Baba Dioum, Senegalese conservationist and poet, addressed the general assembly of the IUCN—the International Union for the Conservation of Nature and Natural Resources—capturing the growing concern of conservationists, including those in American zoos, with a phrase that would shape zoo education for more than a decade:

In the end, we will conserve only what we love.
We love only what we understand.
We will understand only what we are taught.
—Baba Dioum (1968)

Shortly after Dioum’s speech, an expanding conservation movement in the United States brought about passage of the Endangered Species Act (1973). By 1975, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (known as CITES) with its 161 member nations became the foundation for international protection of animals and plants (CITES, 2003). CITES, headquartered in Geneva, Switzerland, maintains the international database that lists endangered, threatened, and rare species of plants and animals from around the globe. Participant countries are voluntarily bound by
CITES guidelines, but must create domestic legislation to protect the species listed by the international database (CITES, 2003).

By 1977, the Tbilisi Declaration (UNESCO, 1978) defined the role, objectives, and characteristics of environmental education at a UNESCO conference in Georgia, then part of the USSR. The interest in the environment and the Tbilisi Declaration (UNESCO, 1978) led to formal discussions of environmental education (Hudson, 2001; Jordan, 2001; Kool, 1987), which came to be defined as:

a process in which individuals gain awareness of their environment and acquire knowledge, skills, values, experiences, and also the determination, which will enable participants to act individually and collectively, to solve present and future environmental problems” (Srinivas, 1998, ¶ 2).

With these guidelines, zoo education in the 1970s and 1980s was a reflection of the international conservation community’s urgency to convey the seriousness of the environmental crisis to the public (Hancocks, 2001). With the oil crisis of 1973, a new environmental awareness was introduced through the popular press and the vocabulary of the environmental crisis moved into the public domain. At this time, many zoo education programs were filled with the gloom and doom of conservationists who feared that education in zoos, and elsewhere, was too little and too late to address environmental problems (Hoage and Deiss, 1996).

In 1993, the International Union of Directors of Zoological Gardens (IUDZG) developed a World Zoo Conservation Strategy (IUDZG/CBSG, 1993). IUDZG defined zoos as establishments that exhibit wild or domestic animals to the public. Triggered on the IUDZG estimate that at least 600 million people visited the world’s 10,000 zoos—approximately 10% of the world’s population at that time, the group focused international conservation planning through education for zoo visitors (IUDZG/CBSG, 1993).

The capacity to reach large audiences, and the shared focus of zoos on nature, provided a potential for conservation—or at least environmental education—on a global scale (Mullan and Marvin, 1999). The World Conservation Strategy went on to suggest that zoos “form a network of public institutions which—in numerous countries, cities, and urban areas of the world—focus on living organisms and nature from all parts of our planet” (IUDZG/CBSG, 1993, p. 2). In describing zoos in this manner, IUDZG (1993) included both accredited and non-accredited institutions, as well as those operated for profit and non-profit. In short, in their impact as potential providers for environmental education, IUDZG suggests that institutions that exhibit animals to the public are more alike than different (IUDZG/CBSG, 1993).

With this global audience, David Sobel (1995, 1999) began to write that rather than enhancing and expanding the connection with a disappearing natural world, children, especially, were hearing of environmental problems and developing what Sobel called “ecophobia” (Sobel, 1995). His concern about the content of environmental education for children echoes the sentiments Carson (1956) raised in *The Sense of Wonder*:

> It is not half so important to know as to feel. If facts are the seeds that later produce knowledge and wisdom, the emotions and the impressions of the senses are the fertile soil in which the seeds must grow (Carson, 1956).
Sobel’s work has changed the focus for many educators, who choose to present their environmental education with affective beginnings that involve development of a personal relationship with animals and nature.

*Zoos: Potential for education.* Serrell (1982a), in the classic text on zoo management developed by the AZA, outlines standards of zoo practice, saying,

> Education is an essential function of zoos and aquariums. It is inherent in the exhibits themselves, is augmented by many services and programs, and exists to enhance the visitor’s experience. Communications with the public about the animals on display can promote more favorable attitudes toward wildlife, the environment, other people, and the facility itself. (Serrell, 1982a, p. 13)

Zoos and museums have significant potential for communicating information, correcting misconceptions, improving attitudes, and improving cognitive skills (Sanders, 1987; Screven, 1993a). Zoo and museum education is voluntary and self-directed, prompted by curiosity, discovery, and exploration (Diamond, 1999).

One of the strengths of zoo and museum education is its capacity to bring people together in a community of learners (James Rollings, personal communication, January 20, 2001). Turner (1982) calls this *communitas*—an ephemeral or permanent community brought together by shared experiences or interests. It manifests itself as one visitor turns to another—either a visitor within the social or family group, or to a stranger—to comment on what is being seen at an exhibit. According to Turner (1982), this sense of community makes the mind a fertile seedbed for learning. Bashaw and Maple (2001) call this between-visitor learning a “ripple effect” and report it to be more effective than signage in helping visitors locate tigers in a naturalistic exhibit at Zoo Atlanta—a common problem in zoos with naturalistic exhibits, especially in exhibits where animals are camouflaged or whose natural habits involve minimal movement during zoo visiting hours.
Elsewhere, this learning community has been shown to enhance cognitive processes (Glass, 1999). Screven (1993b) says it is a function of leisure-oriented visitors with zoo and museum exhibits. This phenomenon of social interaction is a distinctive feature of the unguided learning that occurs in zoos and museums (Churchman, 1985; Falk & Dierking, 2000, 2002; Walter, 2002; Yerke, 1984). These learning opportunities (and the social interaction that makes them possible) result from the multisensory experiences at an exhibit that typify free-choice learning by having multiple entry and exit points for learning, and accepting multiple outcomes (Falk & Dierking, 2000). Open learning opportunities encourage oral expression to such a degree that Decrosse and Natali (1995) suggest that the oral text created by visitor response is a “singular form of written text in an exhibition” (p. 165).

There is increasingly strong evidence, based on research being done in Australia (Anderson, 2001; Anderson & Piscitelli, 2002; Anderson et al., 2002; Kelly, 2002; Piscitelli, 2001; Piscitelli & Anderson, 2001, 2002), that exhibits in children’s museums and children’s zoos, designed specifically for children, have significant influence on learning. The value of learning in zoos and museums is that it is overt, emotional, physical, experiential, and long lasting, both in the retention of materials and the capacity of the exhibits to initiate the self-directed learning common in zoo and museum visitors (Piscitelli & Anderson, 2001, 2002; Piscitelli, 2001; Weier & Piscitelli, 2002).

Kelly (2002), at the Australian Museum Audience Research Centre, has compiled an overall picture of visitor learning at the Australian Museum. She has found that museum learning is a social activity, a sensory experience, facilitated by “real stuff” and living exhibits. It is an active process, which by connecting prior knowledge with new information can change the visitor’s point of view. She also found that museum learning is long-term, individual, entertaining and fun, and is able to make a difference to visitors (Kelly, 2002).
Falk and Dierking (2000) write extensively on learning in American zoos and museums, focusing on how the visitor constructs meaning from the “free-choice learning” experiences in museums. Falk and Dierking (2002) describe learning in zoos and museums as a “panoramic, lifetime event” of leisure and learning through which individuals construct the core of personal knowledge that guides them through life (Diamond, 2000; Dierking et al., 2003; Roggenbuck, 1990).

Frank Oppenheimer, founder of San Francisco’s Exploratorium, describes the free-choice learning in museums as, “no one flunks museum” (Gardner, 1983, 1999). Learning under these potentially low-stress and rewarding informal conditions is described by Gardner (Brandt, 1993) as:

[Museums] are places where kids can find things that interest them and explore these things at their own pace and in their own way.

A good museum is a child-friendly place to learn. And many people, including me, have been fascinated as we’ve escorted kids whom we thought we knew to children’s museums and discovered unexpected strengths or unexpected areas of confusion. Or discovered that kids we thought of as being unable to learn were terrific learners, but in a very different type of environment. It broadens your notion of what kids are like, what they can do (Brandt, 1993, ¶ 23).

Falk and Dierking (2000) note that children’s museums are more than just child-friendly places to learn: they are environments that empower children. Not only are the exhibits designed for children, many times they are designed for children to take charge of their adult companions (Gopnik et al., 2001; Piscitelli, 2001; Piscitelli & Anderson, 2001, 2002). Falk and Dierking (2000) describe the impact of this, saying, “Imagine being five years old and for this brief moment being in charge of your parents. It is a truly memorable and thrilling experience” (p. 187).

The state of zoo education. The acknowledged potential for learning in zoos and museums, combined with their popularity, makes them an attractive venue for conservation and environmental education. IUDZG (1993) report that 10% of the world’s population—
then 600 million individuals—visit a zoo each year. Kevin Mills (personal communication, September 23, 2004), reported that 90% of all Americans have visited a zoo or aquarium and that 58% have visited on in the past two years.

Most institutions that hold and exhibit wild and domestic animals for the public—the minimal definition of a zoo—include an educational component. The general figures provided by IUDZG (1993), note the potential for education is considerable. Attendance and educational efforts for non-accredited zoos and other animal exhibitions in the U.S. is not known. Their presence in communities across the country, however, suggests these institutions, like accredited zoos, attract people who are interested in spending time in the company of creatures (Hancocks, 2001; Hanson, 2002; Mullan & Marvin, 1999; Pimm, 2001).

With this acknowledged potential for learning in zoos and museums, all AZA-accredited zoos—those that meet legislated standards of animal care as well as voluntary standards for excellence—include education in their mission and the commitment to education is significant. Using their facilities as living classrooms, zoos teach more than 12 million people who attend subscription programming with explicit educational content. These subscription programs are typically taught partially in a classroom and partially among the zoo exhibits, sometimes taking visitors to view behind-the-scenes and make an intimate connection with animals (AZA, 2003b, Sausman, 1982).

Zoos dedicate $52 million annually to education programs. Each year more than 9 million public and private school students visit zoos with their teachers. The commitment to zoo education allows 3.5 million of these students to visit the zoos free of charge. Each year more than 85,000 teachers take workshops and receive teaching materials to improve science education in public and private schools (AZA, 2003b).
More than 9 million people participate in onsite programs for children, families, and adults, including seniors (AZA, 2003b). These are often called “keeper chats,” shows, encounters, or animal demonstrations that are interactions between zoo staff and visitors.

Most zoo function on the belief they have the capacity to provide profound educational experiences to children and adults (Anderson & Piscitelli, 2002; Screven, 1993a). Holzer and Scott (1997) report a significant body of literature covers the positive relationship between childhood experiences and adult behavior patterns and leisure activities. Other studies (Chipeniuk, 1995; Tanner, 1980; Yoesting & Burkhead, 1973) link childhood experiences to preferences for environmentally oriented careers. This belief in the potential for life-changing impact of a zoo visit has led to an increasing commitment to zoo education explicitly intended to evoke affective learning and result in having visitors leave zoos with a deeper understanding of the natural world.

While the programmatic educational effort of zoos reaches more than 30 million visitors each year, it pales when compared to the number of people who visit zoos each year. According to AZA (2003b), AZA-accredited zoos and aquariums attract more than 134 million visitors each year. That number is a significant motivation for institutions who believe they have a responsibility to develop an environmentally aware and informed population, capable of weighing decisions that affect the future of life on the planet (AZA, 2004). This is reinforced by an opinion poll (Roper Starch Worldwide, 1995), where 92% of Americans agreed that zoos, aquariums, and other venues that exhibit animals teach people about creatures they might otherwise never discover, and 87% agreed that most children would not have the opportunity to see a variety of wild animals without zoos and aquariums.

AZA figures (AZA, 2003b) suggest that people who do not participate in programming at the zoo, are not using the interpretive signs present at almost every exhibit in
every accredited zoo as an opportunity for learning. Interpretive signs appear to lag behind other educational strategies and techniques in their efficacy (Schonk, 1994; Schiele, 1995; Screven, 1986).

Alexander (1995) and Burcaw (1997) define interpretation as the bridge between visitors and the collection. Interpretive signs, then, are those that identify the collection in some meaningful way to connect the exhibit to the visitor (Serrell, 1996).

Veverka (1990) says interpretation will:

- Provoke attention, curiosity, and interest of the visitor.
- Relate to the everyday life and experiences of the visitor.
- Reveal the story through unusual viewpoints or presentation styles.
- Address the whole . . . tell the visitor how one element of the story relates to the big picture.
- Strive for unity. Use the right colors, words, graphics, etc., to support the theme or story.

He borrows heavily from Tilden (1957), whose principles of interpretation were developed while working as a National Park ranger. From Tilden (1957):

- Interpretation must relate to what is being displayed or described to something within the personality or experience of the visitor.
- Interpretation is revelation of the exhibit story and a connection between exhibit and visitor based on information.
- Interpretation is an art whether the exhibit deals with scientific, historical, or architectural elements.
- The aim of interpretation is provocation.
• Interpretation should present the whole story rather than a part of the story.

• Interpretation addressed to children (say up to the age of 12) should follow a fundamentally different approach than that for adults.

Interpretation has changed since Tilden’s (1957) groundbreaking work. Today, Beck and Cable (1998) have expanded Tilden’s work to better meet the needs and the increasing sophistication of modern audiences. Of note, they add:

• High technology can reveal the world in exciting new ways. However, incorporating this technology into the interpretive program must be done with foresight and care.

• Interpreters must concern themselves with the quantity and quality (selection and accuracy) of information presented. Focused, well-researched interpretation will be more powerful than a longer discourse.

• Interpretive writing should address what readers would like to know, with the authority of wisdom and the humility and care that comes with it.

• Interpretation should instill in people the ability and the desire, to sense the beauty in their surroundings—to provide spiritual uplift and to encourage resource preservation.

• Passion is the essential ingredient for powerful and effective interpretation—passion for the resource and for those people who come to be inspired by the same. (Beck & Cable, 1998, p. 10-11).

Although interpretation is better understood now than in the past and is evolving to better meet the interests and learning styles of a modern audience (Heimlich & Norland, 2002; Kotulak, 1996; McLean, 1998; Morgan, 2000; Ramberg et al., 2002; Russell, 1999; Silver et al., 2000), the stasis of interpretive signs is built on a tradition of more than a century and may be related to a number of factors (Falk & Dierking, 2000; Serrell, 1996):

• Many signs in zoos and museums are written by curators, whose expertise lies in content, rather than in an understanding of the learning styles and needs of visitors (Falk & Dierking, 2000; Plaisance, 1984).

• The emphasis on collection care and public safety, both legislated and that recommended by AZA, limit the resources that zoos are able to expend on
education research and innovation needed to improve interpretive signs
(Winsten, 1993).

- Because the installation of interpretive signs comes only as new exhibit
  construction is completed, the budget for signs is often limited by cost overruns
  in earlier portions of the project (Jim Vlpa, personal communication, 18 April
  2004).

As Michael Spock, notable exhibit designer who has worked at such prestigious
museums as the Boston Children’s Museum and Chicago’s Field Museum of Natural History
and is now with the Chapin Hall Center for Children at the University of Chicago, describes
the state of professionalism in museum education, especially in the design and consideration
of exhibits and programs (Falk & Dierking, 2000):

There seems to be a stubborn streak running through our profession that treats
museum exhibitry and programming as a mysterious art, entirely dependent on the
instincts and skills of the exhibitor and programmer, rather than being built on a
growing common body of knowledge. For there is abundant evidence that few of
us seem to be paying attention to what we already collectively know. In . . .
flawed exhibitions and programs, you can see where their creator is, inadvertently
or deliberately, ignoring generally acknowledged rules of thumb or more
sophisticated analytical systems. . . . [Signs and] Labels are too long, copy is not
broken down into manageable paragraphs with helpful subheads, type is too small
and low to be ready by a person with bifocals, terms are obscure to a person new
to the subject

There are perfectly straightforward ways of dealing with each of these issues,
abundantly supported by theoretical frameworks and accessible research findings . . .
Yet a discouragingly large number of us seem not to be paying attention. Especially
disturbing are our colleagues who would not think of presenting information in
exhibitions and programs that was not thoroughly grounded in the current research
literature of their fields but who remain the most stubbornly inoculated from the
influences of the learning theory and visitor studies literature. They just don’t—or
won’t—get it. (Falk & Dierking, 2000, p. ix)
Frame of reference: The theory behind the practice


As significant as his influence on content, Sobel (1995) also proposed that environmental education be tied to the developmental stages of children, suggesting that environmental education programs would be improved if educators would depart from earlier practices that invoke knowledge and responsibility for the environment before children are allowed to develop flourishing personal relationships with the natural world. The innovations of Sobel's ecophobia (Vernon, 2000; Kristen Christensen, personal communication, March 12, 2001) have significantly changed the message of environmental education (Hungerford, 2002a, 2002b, 2002c), but not the medium of delivery.

Spock (Falk & Dierking, 2000) suggests that, especially in the development of signs and labels, the research in zoos and museums, along with basic education theory, is too often ignored when exhibits are designed. These theories, however, can form the basis for understanding the learning processes that take place in zoos (Basile, 2000; Borun et al., 1997; Kellert & Dunlap, 1989).

The theories that form the basis for understanding the potential learning processes that take place in zoos come from several 20th Century educators. Although some of the
literature suggests Piaget’s constructivism (Piaget, 1971) is key to learning in museums (Bailey et al., 1998; Hein, 1991, 1998, 2001; Hein & Alexander, 1998), the zoo and museum research that has explored the learning potential of signs (Falk & Dierking, 2000; Serrell, 1996) more often cites the theories of Vygotsky, who saw cognitive development as a complex triad of culture, thought and language, and social interaction that “scaffold” to build the intellectual development of every individual (Vygotsky, 1962, 1978). According to Vygotsky:

- Culture, the socially constructed phenomenon that shapes what an individual needs to learn and the skills necessary for survival and success, provides the symbols and tools of shared understanding.

- Social interaction creates a “zone of proximal development.” This zone is the difference between a person’s individual developmental level as determined by independent problem solving and the level of potential as determined through problem solving under guidance of teacher (or adult in the case of children) or in collaboration with more capable peers.

While Vygotsky (1962, 1978) is better known for his theories in speech development, it is the zone of proximal development that is most applicable to learning in zoos. Through the non-intrusive intervention of a volunteer, docent, zookeeper, or by more capable peers, scaffolding is often seen in interactions between parents and children, with the parent providing questions that lead to the child’s discovery of new information. In short, learning occurs in the zone of proximal development, that is, in the zone between what the individuals knows and what can be learned by the individual with assistance of a better-informed person through social interaction (Riddle, 1999).
The non-intrusive nature of the intervention that takes place in zoos is very similar to implementation of Vygotsky's theories (1978) in the classroom, which places the teacher and students in collaborative roles that allow the children to create meaning in their own ways and learning becomes a reciprocal experience. A shortcoming of Vygotsky’s theory suggested by Speaker (2003) is that Vygotsky “hints at the possibility of other sensory processes which are not languaged, but he goes no where with these ideas because he is so thoroughly tied into the word as the unit of thought.” (¶11)

While Speaker (2003) does not suggest it, the inclusion of Gardner’s multiple intelligences (1983, 1999) with the learning model in Vygotsky’s zone of proximal development may additionally serve to explain the efficacy of zoos as educational institutions. The receptivity for learning not just through language and words, but through the eight intelligences that Gardner describes may provide the profound educational experiences that Holzer and Scott (1997), Tanner (1980), Chipeniuk (1995), and Yoesting and Burkhead (1973) attribute to zoos.

Gardner’s (1983, 1999) multiple intelligences (linguistic, logical-mathematical, bodily-kinesthetic, spatial, musical, interpersonal, intrapersonal, and naturalist) form a child’s intuitive understanding of the world by age five or six (Gardner, 1991). Gardner (2004) outlines these intuitive understandings, separating intuitive theories of matter, life, mind, and human relations. Of interest here are what Gardner describes as intuitive theories of life:

- If it is moving, it is alive. If it is still, it is dead. If it is on a computer screen, you can’t tell for sure.
- All species, including human beings, were created essentially at one moment and they have not changed materially since.
- If something important happens to an organism, that experience will be passed on to his or her offspring (Gardner, 2004, p. 55).
These make up the predominant preconceptions that children and many adults bring to a zoo visit. Gardner describes this as a paradox: “Theories are difficult to change, and early theories prove especially difficult to alter” (Gardner 2004, p. 57). In other words, unless an individual develops a deep understanding of life (such as training as a biologist), when confronted with a question they are not properly prepared to answer, they revert to the intuitive understandings developed in childhood.

Despite having been conceived in part by Gardner’s observations at Boston’s children’s museum (Brandt, 1993), the concepts of multiple intelligences are infrequently used in zoos and museums. The potential to engage multiple intelligences and create effective educational experiences has been shown in classrooms (Armstrong, 1999; Bolanos, 1996). This research study proposes to bring Gardner’s theory of multiple intelligences to the creation of zoo signs, with the intention of enhancing or triggering naturalist intelligence, an intuitive understanding of the natural world.

At a zoo, this lack of naturalist intelligence (Gardner, 1991; Gardner et al. 2001) may explain, in part, the number of visitors who fail to see animals in naturalistic exhibits (Bashaw & Maple, 2001). In a nine-month period at Knoxville Zoo in 2001, 32% of written visitor complaints came because visitors were unable to see animals that were known to be on exhibit (Jim Vlna, personal communication, February 12, 2002). This discovery lends support to the statement of Gardner et al. (2001) that American culture has so focused on verbal and arithmetic skills emphasized in the classroom that those skills have come to have greater adaptive value than other previously valued intelligences and characteristics. Gardner et al. (2001) go on to suggest that, deprived of meaningful stimulation, Americans are losing the capacity to see and to have any intuitive understanding of the natural world or, as the
findings at Zoo Atlanta and Knoxville Zoo suggest, even in the pseudo-naturalistic environment of a zoo exhibit.

In a strictly biological sense, the urban disconnect with the natural world mentioned by Gardner et al. (2001) has not been a part of life for sufficient time to be evolutionarily "adaptive," but researchers interested in the changing capacity of naturalist intelligence should note that Gardner et al. (2001) say that the use individuals make of information and the intellectual approach is handed down both through biology and culture. It is the cultural element that has transferred the value from naturalist, bodily-kinesthetic, spatial, and interpersonal intelligences that would have been a part of hunter-gatherer life (Binford, 2001), to the current value on "academic" intelligences: linguistic and logical-mathematical.

The study is also based in part on the concept that removing input from specific of the multiple intelligences (Lazear, 1991), may trigger other intelligences to fill the lack. This premise, applied to zoo signs, suggests there may be a way to enhance naturalist intelligence in zoo visitors while continuing the goal of signs that are intended to promote learning in zoos and museums by directing a visitor's attention to what is important.

The educational process in zoos where visitors are expected to learn from signs is incomplete without additional educational theory. Ausubel's (1960, 1963) theory of advanced organizers explains the findings of Blais (1995a) who discovered that even unread, signs are an important indicator to visitors that there is something to see. From this theoretical perspective, signs function as a "subsuming bridge" (Ausubel, 1963) helping visitors link visually rich experiences at a zoo to existing knowledge. Signs, like the advanced organizers Ausubel (1960) recommends for classrooms, may help promote learning in zoos and museums by linking explicit concepts to the visitor's existing knowledge by directing attention to what is important.
Ausubel’s theory of advanced organizers as key to exhibit use confirms that the presence of signs are a necessary part of the zoo exhibit for many visitors. However, with limited readership reported in so many studies (Bashaw & Maple, 2001; Bramley, 1986a; Litwak, 1990, 1996; Screven, 1992; Serrell, 1982b, 1993, 1996; Winsten, 1993; Zaremba et al., 1992; Zaremba & Toedter, 1993), it is not clear that sign content influences the experience of more than a small subset of zoo visitors.

The state of zoo and museum signage

Just as many practitioners use zoo and museum interchangeably to describe a collection-holding cultural institution, these institutions use other terms interchangeably. Signage, label, graphic, and panel are all synonyms for sign, including words, pictures, and diagrams intended to help visitors interpret the collection. For the purpose of this paper, sign and signage, the more common terms in zoos, will be used.

Zoos and museums have a variety of signs (Fisher, 1990; Screven, 1986, 1992, 1995; Serrell, 1996). Signs include panels that recognize major and sometimes minor donors for funds necessary to create an exhibit; credit panels which recognize the contributions and efforts of everyone who worked on an exhibit; wayfinding, orientation, or directional signs that point visitors toward other exhibits, amenities, and exits; and prohibitive signs that warn visitors of dangers to public health or tell visitors of the activities needed to protect the collection (e.g., do not feed the bears).

In the past century, there have been a series of innovations in signage: materials, typefaces, colors, number of words, and content. During the 20th Century, signs began to reflect an increased understanding of reading level, readability, and placement. Although the signs themselves have changed significantly, most zoo and museum exhibits include a sign, usually to the right of the main viewing area, at prescribed heights and distances from the
visitor, that use words and images to describe what the exhibit curator or zoo educator believes to be important for the visitor to learn (Serrell, 1996).

In zoos, many signs feature range maps, scientific name, common name, habitat, diet, and a selection of “fun facts” about an animal. Newer practices, developed since the concept of story and theme was introduced through World’s Fairs of 1933 and 1939 (Samson, 1995), use signage to tell part of the continuous story that is woven through a modern exhibit, sometimes through an entire institution. Falk and Dierking (2000) include signs as an integral part of the free-choice learning available in zoos and museums.

Techniques and standards. Signs in all types of museums are designed to help organize the information in an exhibit and build a bridge of understanding between the exhibited objects and the visitor (Burcaw, 1997; Serrell, 1996). Most authors agree that interpretive signs should be created for the visitor. They should be written and designed according to research-based information about signs, much of which was codified in an early work by Serrell (1982b), and included comprehensive recommendations for content, writing, design, placement, and other elements that can help create signs that engage visitors.

Serrell suggests (1982b, 1996) something supported by significant research since that time (Falk & Dierking, 2000, 2002): while the average visitor may not be very knowledgeable about the subject matter of an exhibit, they are motivated to learn (Serrell, 1982b). Falk and Dierking (2000) confirm zoo and museum visitors have high to moderate interest in the exhibits they view, and low to moderate knowledge. In short, visitors are not usually subject-matter experts, and do not visit a zoo or museum with the expectation of becoming an expert.

Interpretive signs are thought to play a key role in communication and education. Belcher (1991) says that signs help form the link between the visitor and the collection.
Peart (1984) states that signs are essential to an exhibit, regardless of its content. Screven (1995) notes that signs personalize topics, helping to connect the unfamiliar with the familiar. Signs also interpret sensory impressions, meanings, and causal relationships. Finally, signs orient the visitor, perhaps serving as a cue, whether the sign is read or not, that the visitor should look for something (Ausubel, 1960, 1963; Blais, 1995b; Jacobi & Poli, 1995).

**Sign use.** With all of these techniques and the goals that accompany preparation of signs, are they read? It is generally assumed that the majority of zoo and museum visitors—as many as 90%—do not read signs (Serrell, 1988a, 1988b; Zaremba et al., 1992). Robinson, in studies at the Buffalo Museum of Science, noted that the signs were read by one-tenth of the visitors (Belcher, 1991; Robinson, 1931).

In other studies there, more visitors glanced at small signs than large (26.5% small, 21.8% large) (Zaremba et al., 1992). This finding is supported by Belcher (1991) who noted that large illustrations were more effective in gaining initial interest, but only 88% as effective (as small signs) in retaining interest.

At the National Museum of Natural History, part of the Smithsonian Institution, Wolf and Tymitz (1978, 1979) found that 51% of the visitors read 1 to 5 signs, 23% read 6 to 15 signs, and 26% read more than 15 signs.

Serrell (1982b) did a series of observations on sign reading at Chicago’s Brookfield Zoo. At a glass-fronted fruit bat exhibit in a darkened building, only 5% of the visitors who stopped at the exhibit to watch the bats, read the sign. Relocating the sign increased readership to 14%. Serrell was further able to improve readership at the bat exhibit by redoing the signs according to the standards described above. With a new sign, title, active verbs, and an easy-to-read format, she was able to increase readership yet again, attracting
56% of the visitors who stopped to view the bats. Note, however, that figure does not address the total number of zoo visitors, but only those who had sufficient interest to enter the Small Mammal exhibit building and to stop at the fruit bat exhibit.

Serrell conducted a similar study with an interpretive sign at the open-air enclosure that housed Olga, Brookfield Zoo’s walrus, then the most popular animal at the zoo. When Serrell began, the walrus sign contained 218 words. Visitors were observed to read the sign for an average of 23 seconds. Serrell projected average reading speed of 250 to 300 words per minute to determine that visitors read only 53% of sign. A new sign was produced (using her suggestions on readability) with 179 words. Reading time increased to 31 seconds, allowing the visitor to read 87% of the sign, an increase in total number of words read from 116 to 156 (Serrell, 1982b, 1996).

Falk and Dierking (2000) confirm Serrell’s (1982b) finding that visitors are more likely to read three 50-word signs than a single 150-word sign with the same text. The size of the letters on the signs and their location relative to objects also influenced sign reading. The more visitors read signs, the more likely they were to stop and look at the exhibits associated with them (Falk & Dierking, 2000).

Litwak (1990) in a study at Oglebay’s Good Children’s Zoo in Wheeling, West Virginia, tested, through unobtrusive observation, three experimental conditions, with introductory signage that labeled a red wolf exhibit as “endangered species,” “new exhibit,” or provided no introductory signs. She found that there was not sufficient evidence to conclude that introductory signs had any effect on time spent at the exhibit by visitors or on interpretive sign reading behaviors.

The difference between these findings and those of Birney (1994) are striking. Birney’s study allowed visitors to self-report on sign reading in a zoo exhibit. Only 33 of 203
visitors reported that they did not read signs (16%), a figure that no observation-based study reports. In fact, Kropf (1991) observed that only 6% of adult visitors read signs at the New York Hall of Science.

Screven (1995) says that visitors can be encouraged to read by visual cues (diagrams and photos), by asking them to interact with the sign (touch, smell, manipulate, predict), or challenging them to pursue a goal. Blais (1995a) suggests that four components affect whether or not visitors read signs: content, structure (graphic design), presentation format (interactive, sound, graphics, video), and context (physical and environmental aspects including noise, lighting, sight lines, competing exhibits, entrances/exits).

Many authors address a variety of reasons that zoo and museum visitors may read signs at exhibits.

- Adults scan signs to answer questions their children are asking (Falk & Dierking, 2000).
- More visitors read short signs than long signs (Serrell, 1996).
- If a visitor does not understand a sign or exhibit, they will skip the exhibit (Serrell, 1996).
- Visitors of all ages are attracted to signs about concrete rather than abstract ideas (Serrell, 1996).
- Other visitors (but not too many) are stopping to look at an exhibit. “Popular” exhibits seem to work for many types of people (Serrell, 1996; also Rorimer, 1998, who reports interest in exhibit elements at the Art Institute of Chicago was improved when the artist “hired” visitors to look at works).

Other literature addresses the reasons why visitors do not read signs:
- Parents looking after small children have little time to read anything (Kriegel et al., 2001).

- Families talk about topics described in signs, they do not read/pay attention to the entire text if doing so interferes with the group’s ability to enjoy and maintain social relationships (Falk & Dierking, 2000). (Falk & Dierking, 1992, report that families spend as much as 15 to 20% of their time talking.)

- Chambers (reported in Zaremba et al., 1992) reported that only 6% of the visitors at the Philadelphia Zoo visit the zoo for educational purposes and used that figure to explain limited sign readership.

- Zaremba et al. (1992) suggest that repeat visitors to the same institution may not read signs because they already know the content.

- Kramer (1990) reports from the Bronx Zoo that “museum fatigue” occurs when people are tired or overwhelmed by sign length. Falk and Dierking (1992) also report museum fatigue and relate that visitors read more signs early in a visit (usually within the first 20 to 30 minutes) than later in the day and that they read less as they approach the exit to an exhibit.

- Exhibit is too crowded (Litwak, 1990).

- Animals are not visible (Bashaw & Maple, 2001; Litwak, 1990).

- No uniformed zoo personnel were present (Glass, 1999; Litwak, 1990).

- Visitors do not want to spend much time or effort reading while at the zoo or museum (Serrell, 1988b).

- They are children and children are more likely to touch and manipulate rather than read (Serrell, 1996).
Serrell (1996) concludes that visitors are looking for signs that are in some way memorable, sensory (involving multiple senses), guided (but not coerced), investigatory, and personal (Serrell, 1996).

Signs and learning. There have long been questions as to whether or not learning takes places in zoos and museums. Tunnicliffe (2003) suggests that observations of visitors reading signs only measure physical and verbal actions, not necessarily long-term learning. Birney (1994) found, however, using a survey of close-ended questions about exhibit content plus demographic and lifestyle questions, that visitor understanding of concepts improved after going through a bird exhibit at the Bronx Zoo.

Falk and Dierking (2000) were among the first researchers to assess sign reading as it relates to learning. They report that two exhibit clusters were investigated with and without explicit labeling. The first treatment used the common museum practice of placing conceptually related exhibits near each other, as the exhibition was originally designed and currently installed at a museum. Other than an introductory exhibit title placed at the front of the exhibition, the exhibits had no explicit signage informing visitors that the exhibit elements contained conceptually related content, nor was there any signage defining the concept the exhibit was designed to communicate.

In the second treatment, temporary signs were attached to each exhibit element. Each sign contained a headline and a sub headline. The headline summarized the main message of the exhibit; an identical headline was included with each of the cluster elements. The sub headline provided a brief description of the main message of the individual element and was different for each element in the cluster. Falk and Dierking (2000) were testing the assumption that headline signs would enable visitors to more readily identify the individual exhibit elements as part of a single related cluster. They discovered that the second
treatment, with both introductory and element signage resulted in significantly more learning.

Dierking et al. (2002a, 2002b) outline the latest AZA studies on visitor learning in zoos and aquariums from a multi-institutional research program. They report that visitors suggest (2002b):

- Increasing educational activities such as developing more detailed panels, selling information pamphlets, sponsoring educational lectures or films, offering classes and workshops about aquatic ecology, and including more hands-on components in exhibitions. (Dierking et al., 2002b, p. 3)

While visitors say they are interested in reading signs, research in zoos suggests otherwise. Swanagan (2000) recommends improving visitor learning at zoos by “emphasizing affection and quasi-formal programs for organized groups, and live animal shows for the general visitor, rather than knowledge-based techniques (text panels, slide shows only)” (p. 8). Heinrich and Birney (1992) had similar findings on the effects of live animal demonstrations and information retention by visitors. Glass (1999) discovered the presence of an interpreter at a zoo exhibit improved retention, whether or not the visitor interacted with the interpreter. Screven (1993b) says that considerable knowledge is needed to understand how visitors behave and learn in leisure-oriented informal education settings (Roggenbeck et al., 1990). In the same vein, Serrell (1996) reports that visitors who stay at a zoo or museum longer, continue to spend time in cursory investigation, not looking in-depth at a few exhibits.

A significant study in Philadelphia-area museums has led to an improved understanding of the dynamics of learning in zoos and museums. Borun et al. (1996, 1997, also Borun, 1998; Wagner, 1999) identify seven characteristics of “family-friendly exhibits.”

- Multisided to allow a family or other visitor group can cluster around.
Multi-user so that several individuals can interact comfortably.

Accessible for both children and adults.

Multi-outcome to meet the interests of a variety of groups and to foster group discussion.

Be based on multiple levels of knowledge.

Readable in terms of text arrangement.

Relevant to link to prior knowledge of most visitors.

This understanding of exhibit design and the impact on learning are codified by Falk and Dierking (2002) in five principles:

- Experiences at zoo and museum exhibits should be designed so that more than one person can participate at a time. It means that there needs to be opportunities for two, three, or even five people to all be able to see, touch, and as appropriate, feel the experience simultaneously.

- Since so many free-choice learning experiences involve different-aged learners, it is also important to design experiences so that people of varying ages can participate. In other words, both adults and children need to be able to engage in the experience and be able to understand what is going on.

- It is also important that free-choice learning experiences be designed so that all participants, regardless of age or prior experience, are able to derive satisfaction from participating in the experience. This means that there should be multiple outcomes possible, and that the experience itself is rich enough, varied, and complex enough to foster group discussion.

- The experience should support different learning styles and levels of knowledge. Not everyone learns in the same way, so it is important to create experiences that allow different learners to intellectually access an experience in different ways.

- Finally, and this is true of any learning experience but particularly important for designing educational experiences that facilitate group learning in zoos and museums, the experience should provide links to the learners’ prior knowledge and experience. This implies knowing something about the group who will actually be using the experience. At the end of the day, designing educational experiences with the end users clearly in mind is the key to any successful educational effort. (Falk & Dierking, 2002, p. 156)

Amid the myriad of learning opportunities and their potential efficacy and accessibility, learning does take place in a museum. Falk and Dierking (2000) note that
museums have been specializing in free-choice learning for more than a century. As the public's interest in learning has grown, museums have developed better methods for delivering information and experiences. Their studies have found "the majority of visitors showed persistence of knowledge and interest and a tendency to follow up experiences with learning from other settings, particularly television, other museum visits, and books" (p. 131). They believe that something "profound and different is happening as the 21st Century begins: learning has taken on greater importance and greater urgency than ever before" (Falk & Dierking, 2000, p. 213). But even with this emphasis on learning, they remind exhibit designers and zoo and museum educators,

"Experienced visitors can look at a display and, quite literally, in a given amount of time, see more and remember more than inexperienced visitors. This has nothing to do with intelligence and everything to do with experience and training" (Falk & Dierking, 2000, p. 119).

Their discoveries are strong reminders that for visitors, "knowledge construction is personal and inextricably connected to prior knowledge and understandings that they brought to these experiences" (Falk & Dierking, 2000, p. 82).

Signs in children's zoos. Of particular interest for the second phase of research in Kids Cove at Knoxville Zoo, is the use of interpretive signs in children's zoos (Barker, 2004; Brookfield Zoo, 2003; Bradshaw, 2000; Schneider, 1982). As early as 1982, Serrell (1982b) wrote:

Children's museums and children's zoos do not lend themselves to interpretive labeling, yet interpretation will very likely occur in these settings by other means, perhaps through parent-child interactions, participatory exhibits, demonstrations, or docent help. Where clear alternatives are provided, labels may be superfluous. Successful interpretation by other means may make labels unnecessary. Then, too, a few exhibits "say it all" without words. No verbal means of interpretation—either spoken or written—is needed when the message is purely visual, as it would be, for example, in a display intended to communicate an undiluted feeling of beauty, mystery, inspiration, or even tragedy. (Purely visual messages are sometimes enhanced with music.) It is a good idea, however, to evaluate non-verbal exhibits to ascertain that the message is being communicated effectively without words. You
may need to add a label as an afterthought if viewers are missing or are misinterpreting an important point. (Serrell, 1982b, p. 22).

By 1996, she was saying (Serrell, 1996):

Labels for children's exhibitions should be crafted for their developmental levels, not a watered-down childish version of an adult label. They should stick to vocabulary words that are familiar to children, especially avoiding geographical proper nouns and words related to geologic time. Children exist in the here-and-now and have a poor sense of extended time (past and future) and of world space (far away is down the block). If children's museums want to fully realize their goals for their primary target audience, they should not attempt to write for adults. Children will read labels written for children. Adults also will often choose to read labels directed at children, because they know the labels will be easier to read and understand than most other museum labels (Serrell, 1996, p. 96).

Lattis (1983, 1986) at the Bronx Zoo’s Children’s Zoo found that their dual signage, one level for adults, another level for children, was not effective. Borun and Miller (1980) found that signs are best written for adults and designed for children to learn from interactions with adults. Serrell (1988b), however, advocates writing for children when they are the target audience. In later work, she advocates that children’s museums must appeal to preverbal children and address their information to the developmental level of visitors (Serrell, 1996).

New directions in signs. Zoos and museums have used text-based signs for more than a century (Karkaria & Karkaria, 1998). In the midst of the debate over the techniques and efficacy of zoo signs, Veltre (1996) at the Bronx Zoo suggests that print-based texts have turned zoos into encyclopedias illustrated with live animals, saying:

Zoo professionals continue to use the print medium in guiding both the design of zoos and the use to which they were put. With the development of long, erudite, museumlike graphics, zoogoing was considered more than ever to be a literacy-based experience.

Zoo-going has traditionally been a visual experience a fact that was often in conflict with the print-based approach of the nineteenth- and early twentieth-Century menagerie. (One goes to see a zoo, not read it.) With the decline of literacy, as some have suggested, and the advent of “secondary orality,” the zoo may be experiencing a revival as iconography. The general director of the New York Zoological Society uses iconlike metaphors in referring to the Bronx Zoo’s Elephant House as “a palace in praise of elephants and rhinos” and its Jungle World as “a cathedral of the diversity of the tropical rainforest.” Like the medieval stained glass window, even
icons in this electronic era are intended not so much to make one think as they are to make one feel. It is this almost religious feeling of awe and respect for wildlife and natural systems which is the goal of modern zoological exhibits. (Veltre, 1996, p. 27 to 29)

While most people do not appear to feel as strongly about print-based information in zoos as Veltre, Fisher (1990) suggested zoos might look at an international standard for signage, saying that consistent signage that is similar at all institutions would “go a long way toward promoting a comfort level for visitors.” (p. 282). Serrell (1982b) stated, “If the purpose of the display is to invite every visitor to find personal meaning in the objects, then do not use labels” (p. 97), cautioning that without interpretation, fewer visitors will relate the exhibit to their own experience.

Decrosse and Natali (1995), who found open learning opportunities encourage oral expression and social interaction, suggest that the oral text created by visitor response is a “singular form of written text in an exhibition” (Decrosse & Natali, 1995, p. 165). Blais (1995a, 1995b) discusses an exhibit where signs were eliminated. In CitieCines, which opened in Paris and later moved to Toronto, no signs were used. Such experiments have led to the suggestion that signs, even when they are not read by visitors, are of fundamental importance to exhibit use. Jacobi and Poli (1995) say that signs cue visitors that there is something to see. By its presence, a sign, acting as an advanced organizer (Ausubel, 1960, 1963), alerts visitors that there is something to look for in the exhibit.

But while there is some thinking that signs may not be a necessity, Schiele (1995) is not at all uncertain about the importance of words on signs. He says that if an exhibit excludes language, there is a risk that visitors will not understand the most important messages of the exhibit. Jacobi and Poli (1995) add, “text makes the exhibit intelligible and communicable” (p. 51). Bitgood (2002) adds, “without interpretation at the critical location
where it will be used, visitors are likely to get the wrong message, a trivial message, or none at all.” (p. 15).

**Research methods and design**

Museums and zoos use various types of formative evaluation to investigate the efficacy of programs and exhibits with their visitors (Bitgood, 2002; Diamond, 1999; Taylor, 1991). Evaluative studies determine what happens at an institution at a particular time. Evaluations are most useful in determining performance of a program, sign, or exhibit. Best and Kahn (2003) say that evaluation brings “value judgment” to the investigation since zoos and museums are conducting the evaluation to determine:

- Are the intended results of the program, sign, or exhibit achieved?
- Are there unintended results of the program?
- Are these unintended results positive or negative?
- Are the results of the program sufficient to warrant continuation? (Best & Kahn, 2003, p. 125)
- Do the results suggest that the sign, exhibit, or program must be changed in some way to better meet institutional goals?

These evaluative approaches to visitor research vary in their reliability and rigor; however, most museum- and zoo-based studies look at sign efficacy based on multiple elements.

- Holding time (how long the visitors stay at the exhibit).
- Engagement (what do they do at the exhibit)

Since the 1930s, empirical studies have discovered that in general, visitors to zoos and museums tend to turn to their right when they enter an exhibit, that visitors tend to
follow the wall to their right as they explore an exhibit, and that they spend less time at individual exhibit elements as they approach the exit (Diamond, 1999; Melton, 1933, 1935; Melton et al., 1936; Robinson, 1931).

Many studies have evaluated signs and attribute sign use to such things as location within the zoo or museum exhibit, placement of the sign defined by proximity to main exhibit feature, length, letter size and typeface, density of visual stimuli, lighting and glare, visitor interest, visitor involvement, clear language, cueing (the use of questions), content, and organization (Becker, 1988; Birney, 1989; Litwak, 1990; Serrell, 1989, 1996).

Falk (personal communication, 19 April 2004) commented that sign content can be absorbed more quickly than suggested by Serrell (1982b), especially when the content is graphic rather than word-based. Falk (personal communication, 19 April 2004) noted that a picture may be seen and understood in a fraction of a second, suggesting that visitors may not need to pause at a sign to benefit from its content.

Holding time is the duration a visitor spends at a particular exhibit, both reading signs and looking at exhibit elements, is of considerable interest as more than a measurement of exhibit efficacy. Serrell (1996) found a positive correlation between amount of time visitors spent at an exhibit and the number of activities they performed while there. Falk and Dierking (1992) found that holding time was longest during the first 20 to 30 minutes of a visit and declined as “museum fatigue” set in. Increased holding time can promote an increased visit duration, which is frequently correlated with increased visitor spending (Marie Vlma, personal communication, May 5, 2004), an element of interest to zoos whose funding depends on earned income through food and gift concessions.

Engagement takes numerous forms at a sign or exhibit, include in-group discussion, inter-group discussion, and acting out or role-playing. Changing sign copy from third
person to second person was effective in increasing visible engagement (Gibbon exhibit, Knoxville Zoo, unpublished observations by this researcher), where visitors reached above their heads in imitation of the brachiation (the movement of these lesser apes swinging by their arms from tree limb to tree limb) of the gibbons.

Dierking et al. (2002), Litwak (1990), Serrell (2002), Vernon (2000), and others have looked at the efficacy of exhibits against a wide range of visitor characteristics in zoos and museums. These studies suggest that researchers may want to consider any or all of the following:

- Age
- Gender
- Group size
- Group make up (family versus friends)
- Generational group makeup (one, two, or three generations, and all combinations of those)
- Tourist vs. local
- Member vs. non-member
- Pets or no pets
- Use of interactives for playing or intended use (pushing buttons or lifting flaps without noting content)
- Time of day
- Direction from which visitors enter exhibit

A variety of data collection methods are used in zoos and museums. Pre- and post-testing, unobtrusive tracking and observation, and exit surveys are all used to provide insight
into visitor experience and exhibit efficacy. Quasi-experimental studies are performed to
gauge visitor response to exhibit elements, treating visitors exposed to exhibit elements as
control and treatment groups.

When pre-testing is used (Routmann, 2004), it is used only to determine a baseline
against which to measure exhibit experiences. Because pre-testing impacts exhibit use and
behavior, pre-tested individuals are not included as subjects for observation or exit
interviews. More commonly, the pre-testing function is part of front-end analysis, which is
often used to measures knowledge and attitudes prior to exhibit development. Unobtrusive,
non-participatory observation (Bitgood, 2002) followed by a brief interview at the consent of
systematically chosen visitors is more common in mixed-method studies (Best & Kahn,
2003).

Given the range of research techniques, a mixed-method, quasi-experimental
approach to zoo and museum research appears to provide the most comprehensive
understanding of visitor experience and exhibit efficacy (Birney, 1994; Bitgood, 2002). This
is of particular importance when seeking insight into the use and function of signs and their
impact on exhibit use and visitor experience (Serrell, 1996).

Like all zoo and museum-based studies, the testing of any exhibit or exhibit element
must address the potential for bias. Care must be taken to ensure that people who
participate in the study are not made to feel self-conscious if they do not see animals in an
exhibit and that their risk of participating in the study is only temporary discomfort and the
time they donate to answering questions. For this study, data will be collected through
unobtrusive, non-participatory observation (Bitgood, 2002) followed by a brief interview at
the consent of the visitors. Visitors will be systematically selected based on entry to the
exhibit (Best & Kahn, 2003).
Both zoos where studies will be conducted, collect limited demographic data at the zoo entry that provides information on age category (child under 3, child 3-12, adult, or senior; membership status). Both zoos take sporadic zip code surveys to determine institutional impact on community tourism. Neither zoo has information on percentage of visitors who come to see the entire zoo or just a few exhibits.

Summary

Empirical studies have investigated a significant range of questions about the use and efficacy of signs in zoos and museums from Robinson's early studies (1931) to more recent work (Bashaw & Maple, 2001; Bitgood, 2002; Kramer, 1990; Litwak, 1990; Routmann, 2004; Serrell, 1996; Zaremba et al., 1992; Zaremba & Toedter, 1993). These have led to improved understanding of the impact of placement, design, and content have on visitor use of signs in institutions across the country (Serrell, 1996). Several studies have confirmed that learning takes places as the result of signs (Birney, 1994; Dierking et al., 2002a, 2002b; Falk & Dierking, 2001). In a thorough investigation of a complete collection of all literature published by AZA from 1980 to the present and held in the Knoxville Zoo library, the researcher was unable to find that zoos have experimented with "wordless" signs.

By allowing this study to be conducted, Lowry Park Zoo and Knoxville Zoo take a step forward in the search to provide an empowering educational experiences to visitors who, for a variety of reasons, may chose not to read signs. Wordless signs are a gesture of inclusion for children (the pre-literate), for parents who are too busy managing multiple children to read signs, for international visitors, for other visitors whose reading facility is limited, and for those visitors who, for myriad reasons, may choose not to read.
Chapter Three

Research Design

Introduction

Research in the past few decades has been directed at discovering the learning mechanisms at work in zoos and museums (Anderson, 2001; Anderson et al., 2002; Falk & Dierking, 2000, 2002; Litwak, 1990, 1996; Piscitelli & Anderson, 2001, 2002; Serrell, 1993, 1996; Winsten, 1993; Zaremba et al., 1992; Zaremba & Toedter, 1993). There is no doubt of the efficacy of zoos and museums as educational institutions and of their ability to inspire children (Chipeniuk, 1995; Holzer & Scott, 1997; Tanner, 1980). Falk and Dierking (2000) and Serrell (1989, 1996) conclude that there is a significant match between the education experiences that zoos and museums provide and what their visitors are seeking.

One element of the education experience provided by zoos and museums, the interpretive sign, appears to be less successful than programs, tours, and many staff and visitor interactions provided at zoos (Belcher, 1991; Borun & Miller, 1980; Kropf, 1991; Zaremba et al., 1992). Institutions strive to create signs that are at once attractive and educational, able to create a link between visitor and collection (Alexander, 1995; Burcaw, 1997). Too often, however, visitors do not read signs (Borun and Miller, 1980; Bryant,
2005a; Kropf, 1991; Robinson, 1931; Serrell, 1988a, 1988b; Zaremba et al., 1992) and the educational opportunity is missed.

Michael Spock suggests that part of the problem is related to the frequency with which zoos and museums ignore the theoretical base of visitor understanding that has been built in the past few decades (Falk & Dierking, 2000). Going further, the current research was based on the premise that zoos and museums are not just overlooking the body of zoo and museum research that would direct them toward improved signs, but they are ignoring advances in understanding learning described by educational theorists including Vygotsky (1962, 1978), Ausubel (1960, 1963), and Gardner (1983, 1999).

Gardner’s (1983, 1999) theory of multiple intelligences, despite having been conceived in part by his observations at Boston’s children’s museum (Brandt, 1993), receives virtually no mention in the literature from zoos and museums reviewed for this project. The potential to engage these intelligences and to create effective educational experiences has been shown in classrooms (Bolanos, 1996). The current study brought Gardner’s (1983, 1999) multiple intelligences to the creation of interpretive signs and tested the efficacy of these signs at two accredited zoos using a quasi-experimental, mixed-method, evaluation-based research design that included unobtrusive observations of systematically selected groups of visitors past various sign treatments and asked systematically selected visitors to respond to questions in a brief interview.

Assumptions underlying the study are that as academic intelligences (linguistic and logical-mathematical) are culturally linked (Gardner et al., 2001), so too are the multiple intelligences anticipated to be triggered by this study: spatial, bodily-kinesthetic, interpersonal, and naturalist (Bryant, 2005b). This is based on the Gardner et al. (2001) statement of perceived adaptive plasticity in the intelligences. It is further based on this
researcher's assumptions, drawn from Binford (2001), that hunter-gathering societies would have needed to clump the four spatial, bodily-kinesthetic, interpersonal, and naturalist intelligences in a way similar to how modern culture has come to link linguistic and logical-mathematical intelligences.

**Hypothesis**

The hypothesis for this research was that zoo visitors exposed to wordless signs were more likely to see animals in zoo exhibits, spend longer holding time at an exhibit, and participate in more extensive engagement activities than those zoo visitors exposed to no signs, signs with words only, and combination signs, which are those that combine words with the images from the wordless signs. This hypothesis was tested fully at Lowry Park Zoo, Tampa, Florida, and the wordless signs and combination signs were tested at Knoxville Zoo, Knoxville, Tennessee.

Related questions include:

1. Is seeing animals in a zoo exhibit, holding time, engagement, or naturalist intelligence related to variables that include age, gender, group size, and if the visitor is a tourist or local?

2. Are zoo membership, attendance at other animal attractions, pet ownership, gardening, belief that conservation is an important issue, and active support of conservation indications of naturalist intelligence as evidenced by the ability to see animals in exhibits?
Research design

Based on Birney (1988, 1994), Routman (2004), and evaluation studies in the literature (Bitgood, 2002; Diamond, 1999; Taylor, 1991), a quasi-experimental, mixed-method, evaluation-based design was chosen for this research project. To ensure that the results were not biased by the use of a sample of convenience (zoo visitors), sign treatments were tested at two AZA-accredited zoos: Lowry Park Zoo, Tampa, Florida, and Knoxville Zoo, Knoxville, Tennessee. By switching between “wordless” and other sign treatments, the researcher could determine differences in visitor behavior were attributable to sign treatment and not to other elements of exhibit design.

The first study, at Lowry Park Zoo, Tampa, Florida, exposed zoo visitors to four sign treatments (no signs, existing signs, wordless signs, and combination signs that paired the wordless illustration with text that described what a visitor must do to see exhibit animals); the second study, at Knoxville Zoo, Knoxville, Tennessee, investigated zoo visitors exposed to two sign treatments (wordless signs and combination signs). Other study variables were identical at the two sites:

- Three dependent variables (holding time, engagement, and naturalist intelligence);
- A number of categorical independent variables (male/female; member/non-member; local resident/tourist; group constellation—generations represented as child/parent/grandchild; do/do not visit nature attractions);
- A continuous independent variable (group size);
- Extraneous independent variables, those that cannot be controlled, include weather and crowding conditions. Information on these conditions is collected daily by zoo staff and provided to the researcher.
The four sign treatments at Lowry Park Zoo were tested on one weekday and one weekend day to ensure a broader look at visitor behavior across all family and individual visitor groupings. The two sign treatments at Knoxville Zoo were tested for two weeks each. The change of signs is designed to uncover any daily variations in visitor demographics that might influence study findings, was made to strengthen research design despite Serrell (1998), who says she has found that while there are demographic differences in visitors through time (often seasonally), they do not appear to affect exhibit use.

Extraneous variables of weather and crowding potentially influence the study. Weather is a significant predictor of zoo attendance, but has not been studied to discover the precise impact of weather on those visitors who come to the zoo despite inclement weather. Weather throughout the February study at Lowry Park Zoo was clear. At Knoxville Zoo, there were days in April and May that had sufficient rain to depress visitation. Observations were taken during the first two rainy days, however, data was discarded and data collection on rainy days was discontinued when exhibit use was obviously skewed to areas sheltered from the rain. It was not apparent that crowding conditions limited the study in any way.

Instruments were designed for data collection in this study. Built on examples of other instruments (Birney, 1994; Bitgood, 2002; Setrell, 1996), IMIGUZ—Inventory of Multiple Intelligence Graphics Use in Zoos (Appendix A) was created using measurement protocols that were appropriate and have been used in a variety of zoo and museum studies (Birney 1994). Because the scope of the two projects differed significantly, data sheets were modified to fit exhibit parameters peculiar to each institution. The validity and reliability of unobtrusive tracking observations and immediate post-visit interview, both chosen for this study, have been established by many researchers (Bitgood, 2002; Birney, 1994; Routmann, 2004).
Population and sample

Zoo visitors represent a sample of convenience. To offset this potential bias, treatments were studied over days that intentionally included both weekends and weekdays, at all hours of zoo operation from open to close, and study participants were systematically selected. While the use of a sample of convenience limits the capacity to generalize results, it is the standard for visitor studies in zoos and museums.

At least 150 unobtrusive observations were made of visitors for each sign treatment and at least 50 interviews were conducted for each treatment. Observations were made on systematically selected visitors who entered the exhibit area. The third group of visitors observed was asked to participate in an interview at Lowry Park Zoo. The dynamics of a new exhibit at Knoxville Zoo found that conducting interviews over three days to better meet the needs of the visitors. The quantitative sample size was projected to be more than adequate to allow testing of variables and provide appropriate confidence levels.

Because the study used unobtrusive observation and did not require additional contact with participants, response rates, retention, and attrition are not considered. Evaluation studies in zoos and museums are limited by the fact that they provide a snapshot of visitor behavior and by their use of a sample of convenience. They provide only information about zoo visitors, and cannot be used to extrapolate actions or attitudes about non-zoo visitors. The strength of these studies, however, is that they are widely accepted as valid measurements of exhibit efficacy. Because this is the standard investigative technique for visitor studies in zoos and museums, however, its external validity will be accepted. The systematic sampling provides an adequate basis for the statistical procedures.
Data collection

The visitors who came to the red-tailed hawk/sandhill crane exhibit at Lowry Park Zoo constituted the sample of convenience for the first part of the study; visitors at Knoxville Zoo’s Kids Cove constitute a similar sample for the concluding elements of the study.

The data, collected on the IMIGUZ form, includes:

- Date
- Time of day
- Entry point
- Which sign treatment is in place (no signs, existing signs, wordless signs, and signs that combine the wordless illustration with text that describes what a visitor must do to see the exhibit animals)
- Group size
- Gender makeup

Similar data was collected through unobtrusive observation of Knoxville Zoo visitors, however, in some exhibit elements, only one entry point was available.

The data collected while unobtrusively observing visitors (or visitor groups) includes whether or not the visitor group appeared to see the animal, the length of holding time at the exhibit, and engagement activities performed at the exhibit. As selected visitor groups prepared to leave the area, one individual in the systematically selected groups was approached and asked if they would answer a few questions for the study. If they agreed, the visitor was asked a number of questions that covered demographics:

1. Why did you come to the zoo today?
2. Who is in your group?
3. Are you local/out of town?
Other questions addressed the propensity for naturalist intelligence:

1. Did you see the animals in the exhibit?

2. Are you an annual pass holder/member? Y/N

3. Do you go to other zoos/aquariums/Busch Gardens (LPZ)/Dollywood (KZG)?

4. Do you have pets?

5. Do you garden or have houseplants?

6. Do you think conservation is an important issue?

7. Do you recycle or do other activities that support conservation?

And finally, to provide information for the organizations where the research was conducted:

1. Is there anything you would like me to tell the zoo administration?

Oral survey and oral consent was chosen to accommodate visitors who might have limited reading ability because of language differences or limited literacy.

These questions and the technique that combines unobtrusive observation with an exit interview are appropriate to answer the research questions. The limitations of such a data collection strategy include:

- Visitors are not always truthful. Bashaw and Maple (2001) found a lack of honesty from visitors who were asked if they saw animals on exhibit.

- Visitors who know the most about animals and nature, are often also the most aware of the need for conservation. They may downplay their conservation activities knowing this need, while someone who knows little, but just recycled a can or bottle at the zoo may say they do a great deal for the environment (Hanson, 2004).

The strength of the research design and the willingness of visitors to participate in data collection come from local community support of both institutions. Visitors are
interested in both zoos, pleased to see the changes that have been made through the years, and feel invested in the improvements. Most community residents believe zoo administration listens to their opinions and responds in a manner that meets the needs of the animals and the visitors. This community support of the zoo is reflected in the recent media award in which Lowry Park Zoo was named the “No. 1 Family Friendly Zoo in America” by Child magazine (Lowry Park Zoo, 2005). Community support at Knoxville Zoo is shown through local media naming the zoo as the community’s number one place to take children every year since 2002.

Data analysis

The data analysis begins with a focus on Lowry Park Zoo, using the smaller study to provide a baseline for further investigation. Analysis includes a look at frequencies of cranes seen, hawks seen, birds seen, holding time, number of engagements observed, why visitors have come to the zoo, who is in the group (family, friends, out of town guests, and others), gender, whether the visitors hold an annual pass (Lowry Park Zoo), whether they are local or tourists, whether they visit other animal attractions have pets, garden or care for house plants, whether they believe conservation is an important issue, and whether they support conservation in any way. Descriptive statistics, including means and range were used to investigate the contribution of variables to outcomes observed (Best & Kahn, 2003).

Data findings for Lowry Park Zoo were checked using post-hoc tests to ensure that the descriptive statistics were not providing an unrealistic view of the data. Non-parametric tests were also run. Thick description (Geertz, 1973) was used to find meaning and present qualitative data.
The limitation to this study was the unknown element of the wordless signs. It was anticipated that one standard measure of sign efficacy, attraction (average number of words read per minute), would not be applicable for this study. It was shortly discovered, as had been predicted by the researcher and confirmed by Falk (personal communication, 19 April 2004), that the time it takes to “read” and interpret wordless signs varies for visitors, but is often too short to be measured using observations and a stopwatch. In a more controlled study, perhaps in a museum, video might capture eye movement and provide insight to this element of sign use.

**Ethics**

The research goal of better understanding and perhaps giving insight to free-choice learning in a zoo is a significant step toward the AZA goal of creating an educated and caring public, who are able to make informed decisions about the environment (AZA, 2003b). Further, if there is a long-term solution to current environmental problems, this researcher believes that solution will be found by a child inspired in a zoo or museum.

The benefits and risks to zoo visitors who participate in this study are within the accepted standards of zoos and museums. Care was taken to ensure that the visitors were aware that the study was “testing” the efficacy of exhibits rather than seeking to test the visitors themselves. Visitors entering the exhibit areas were observed unobtrusively, and provided consent only to answering questions as visitors exit the area. This use of unobtrusive observation is a common practice in zoos and museums (Birney, 1994; Routmann, 2004), and is a necessary part of a study designed to investigate visitor behavior patterns that can be anticipated to extend beyond the research efforts.
The confidentiality of the participants was ensured by the use of oral consent with visitors never identified by other than demographic categories. The raw data will be retained for a minimum of five years by the researcher, in secure storage at the researcher's residence.

Sharing data with Lowry Park Zoo and Knoxville Zoo is an integral part of the study. The researcher presented an early look at the data (Bryant, 2005a, 2005b) at a regional AZA conference in Knoxville, Tennessee, April 13, 2005. Study participants will eventually be able to go to the zoo's website to discover research findings. If deemed appropriate by zoo administration, the research will be disseminated through the zoo magazines.
Chapter Four

Results

Introduction

The hypothesis for this research was that zoo visitors exposed to wordless signs were more likely to see animals in zoo exhibits, spend longer holding time at an exhibit, and participate in more extensive engagement activities than those zoo visitors exposed to no signs, signs with words only, and combination signs, those that combine words with the images from the wordless signs.

The full hypothesis was tested at Lowry Park Zoo, Tampa, Florida, and further study at Knoxville Zoo, Knoxville, Tennessee, tested combination signs and wordless signs, the two sign treatments that were most effective at helping visitors at Lowry Park Zoo, Tampa, Florida, see animals on exhibit.

Related research questions include:

1. Is seeing animals in a zoo exhibit, holding time, engagement, or naturalist intelligence related to variables that include age, gender, group size, and if the visitor is a tourist or local?

2. Are zoo membership, attendance at other animal attractions, pet ownership, gardening, belief that conservation is an important issue, and active support of
conservation indications of naturalist intelligence as evidenced by the ability to see animals in exhibits?

The Scope of the study

The study was conducted at two AZA-accredited zoos with many similarities. Both Lowry Park Zoo, Tampa, Florida, and Knoxville Zoo, Knoxville, Tennessee, are medium-sized zoos that have been upgrading exhibits as the result of capital campaigns. In addition, both are committed to improving visitor experience and were willing to host research efforts that investigated the use of interpretive signs designed to trigger natural intelligence and enrich visitor experience.

The scope of the two research projects differed significantly. At Lowry Park Zoo, Tampa, Florida, four different treatments of two interpretive signs were tested at one exhibit. The visitor experience at the Lowry Park Zoo exhibit studied did not include any interactive exhibit elements, simply three animals and two signs. At Knoxville Zoo, two different treatments of 31 unique interpretive signs placed in 38 locations (seven signs were duplicated and used at either end of an exhibit area, see Appendix C for copies of all signs) were tested at a 3.5-acre children’s zoo, Kids Cove, with multiple exhibits. Most of the Kids Cove exhibit areas included extensive interactive materials.

Each of the four treatments at Lowry Park Zoo was in place for two days: one weekday and one weekend day. The zoo visitors represent a sample of convenience that were systematically chosen for inclusion in the study. Every third visitor group entering the area was unobtrusively observed, and every third group observed was asked to participate in a short survey at the end of the observation.

In February 2005, 50,100 visitors came to Lowry Park Zoo, of which 17,306 (34.5%) had purchased an annual pass (equivalent to membership at Knoxville Zoo). Attendance
during the study was 14,983, of which 5,400 (36.3%) had annual passes at the zoo. Table 4-1
provides details.

Table 4-1. Days, dates, and sign treatments at Lowry Park zoo were used by visitors, of
which 36.25% held an annual pass to the zoo.

<table>
<thead>
<tr>
<th>Day/Date</th>
<th>Treatment</th>
<th># Visitors</th>
<th># Visitors with annual pass</th>
<th>% Visitors with annual pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturday, February 5</td>
<td>No signs</td>
<td>2,658</td>
<td>1,113</td>
<td>41.87</td>
</tr>
<tr>
<td>Sunday, February 6</td>
<td>Words only</td>
<td>2,487</td>
<td>1,144</td>
<td>46.00</td>
</tr>
<tr>
<td>Monday, February 7</td>
<td>Combination</td>
<td>910</td>
<td>282</td>
<td>30.99</td>
</tr>
<tr>
<td>Tuesday, February 8</td>
<td>Wordless</td>
<td>898</td>
<td>338</td>
<td>37.64</td>
</tr>
<tr>
<td>Thursday, February 10</td>
<td>Words only</td>
<td>824</td>
<td>262</td>
<td>31.80</td>
</tr>
<tr>
<td>Friday, February 11</td>
<td>No sign</td>
<td>2,402</td>
<td>534</td>
<td>22.23</td>
</tr>
<tr>
<td>Saturday, February 12</td>
<td>Combination</td>
<td>2,221</td>
<td>862</td>
<td>38.81</td>
</tr>
<tr>
<td>Sunday, February 13</td>
<td>Wordless</td>
<td>2,493</td>
<td>865</td>
<td>34.70</td>
</tr>
</tbody>
</table>

Data were collected using a stopwatch and the instrument, IMIGUZ (Investigation of
Multiple Intelligences Graphics Use in Zoos, see Appendix A). Data from the observations
included group size and makeup (gender and age determined as child or adult), whether or
not visitors saw cranes, hawks, or both bird species, holding time, and number of
engagements that took place at the exhibits. Interviews sought information as to why
visitors were at the zoo, whether they were local or tourists, whether or not the visitors held
an annual pass at Lowry Park Zoo, visited other animal attractions including zoos and
aquariums, had pets, gardened or had house plants, believed conservation to be an important
issue, or did anything to support conservation.
Observations were made at Lowry Park Zoo on 664 groups (n=2235 visitors) and surveys were conducted with 200 of these groups (n=720 visitors). Of these, 975 visitors were male (43.63% male), 1269 were female (56.37% were female). Groups ranged in size from 1 to 14, with a mean of 3.40. Children were a part of 463 groups, and the remaining 201 groups were made up adults only.

At Knoxville Zoo, where two sign treatments were tested, each treatment was in place for 12 days. The initial research plan to follow visitors through the entire exhibit was not feasible because of the size of the exhibit and the length of time that many visitors stayed in the exhibit. On the opening weekend, one family was observed to spend more than six hours in Kids Cove with most of the time spent with parents sitting on benches near the playground while the children went in and out of the playground. The family moved to the center area of Kids Cove for lunch and then returned to the playground. To ensure adequate sample size and to allow comparison with the Lowry Park Zoo study, four separate areas of the exhibit were investigated:

1. Pigs through the handwashing station: The children’s zoo exhibits begins with a pig (Guinea hog) exhibit, the cow interactive area (see #2), a contact yard with sheep and goats, and beyond the contact yard is a handwashing station. There are eight signs in this area.

2. Cow interactive: Between the pig exhibit and the contact yard, a mechanical milking cow and associated interactive area includes a buckboard, saddles on saw horses, costumes for role playing as farmers and/or zookeepers, and an open window into the barn. There are four signs in this area.

3. Playground: The playground’s most obvious feature is Clayton’s Play Cabin containing climbing structures and slides. In the playground, an open slide near the
cabin has been put in place for younger visitors, a large sandbox, a climbing wall, a rope spider web, and a suspension bridge are also part of the area. Observations were made at both the playground entrance and at the sandbox, where it appeared that younger children and parents were spending considerable time. There is one sign in this area, at the end of the climbing wall intended to give children tacit permission to climb on the rocks—an activity prohibited elsewhere in the zoo.

4. Aviary: The netted exhibit area contains two large pools separated by a beaver dam that are home for the beavers and ducks. Wading birds stand on exhibit areas at the water’s edge. There are perching sites and trees throughout the area for free-flight songbirds. Extensive interactive elements in the aviary are placed along the visitor pathway. These interactive elements include a periscope to provide a “bird’s eye view” of the aviary, a footprint matching puzzle, human-sized nests and broken egg shells, a songbird push-button sound board, and a push-button matching interactive that encouraged visitors to match feet and beaks. There are eight signs in this area.

5. Water feature: Exhibit area provides underwater viewing for beavers and birds, a look into the beaver lodge and night holding area, and a glass-fronted view into the terrestrial beaver exhibit. There are also exhibits for rabbits and chickens and a heritage garden. The chicken exhibit includes an animal exhibit as well as an interactive area with nest boxes where children can collect wooden eggs and place them in baskets. The water feature includes three giant plastic frogs that spit water across a shallow creek and has lily pads where children who do not choose to wade in the creek may walk above the water surface. An arched wooden bridge, where feet can make a drumming sound, crosses the creek. There are ten signs in this area.
Observations were made on the days shown below in different areas of Kids Cove. Attendance for those days, as well as the percent of visitors who are zoo members is provided. In April and early May 2005, on study days, 44,243 visitors came to Knoxville Zoo, of which 11,982 (27.08%) were members (See Table 4-2 for details).

Zoo visitors again represent a sample of convenience that were systematically chosen for inclusion in the study. Rather than interview every third observed group, three days of the study were devoted to interviews, selecting the third group entering an exhibit area. This was done to allow the families to explore the new exhibit at will rather than holding them in an area for even a brief interview.

In the 24 days of the study, 538 groups (n=1804 visitors) were unobtrusively observed and 128 groups (n=424 visitors) were surveyed. Of these, 38% were male, 62% were female. Groups ranged in size from 1 to 12, with a mean of 3.34. Adults made up 48% of visitors, children made up 52% of visitors. Only 9% of the groups (46 groups) were made up of adults only.

Although three times as many days were spent collecting data, the number of groups observed at Knoxville Zoo is smaller than those observed at Lowry Park Zoo (n= 538 at Knoxville Zoo, n=665 at Lowry Park Zoo) and the number surveyed were smaller (n=128 at Knoxville Zoo, n=200 at Lowry Park Zoo). This is related to the size and complexity of the Knoxville Zoo visits and the increase from two to 31 signs.
Table 4-2. Days, dates, and sign treatments at Knoxville Zoo were used by visitors, of which 27.08% were zoo members.

<table>
<thead>
<tr>
<th>Date</th>
<th>Treatment</th>
<th>Area investigated</th>
<th># Visitors</th>
<th>#Members</th>
<th>%Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>02-Apr</td>
<td>Wordless</td>
<td>Pigs through handwashing</td>
<td>423</td>
<td>80</td>
<td>18.91%</td>
</tr>
<tr>
<td>03-Apr</td>
<td>Wordless</td>
<td>Playground</td>
<td>2,432</td>
<td>1,028</td>
<td>42.27%</td>
</tr>
<tr>
<td>04-Apr</td>
<td>Wordless</td>
<td>Pigs through handwashing</td>
<td>1,275</td>
<td>489</td>
<td>38.35%</td>
</tr>
<tr>
<td>05-Apr</td>
<td>Wordless</td>
<td>Aviary</td>
<td>2,024</td>
<td>675</td>
<td>33.35%</td>
</tr>
<tr>
<td>06-Apr</td>
<td>Wordless</td>
<td>Water feature</td>
<td>1,398</td>
<td>542</td>
<td>38.77%</td>
</tr>
<tr>
<td>09-Apr</td>
<td>Wordless</td>
<td>Interview</td>
<td>4,021</td>
<td>1,274</td>
<td>31.68%</td>
</tr>
<tr>
<td>10-Apr</td>
<td>Wordless</td>
<td>Sandbox</td>
<td>3,343</td>
<td>1,193</td>
<td>35.69%</td>
</tr>
<tr>
<td>11-Apr</td>
<td>Wordless</td>
<td>Cow interactive</td>
<td>1,127</td>
<td>515</td>
<td>45.70%</td>
</tr>
<tr>
<td>17-Apr</td>
<td>Wordless</td>
<td>Aviary entrance</td>
<td>3,017</td>
<td>915</td>
<td>30.33%</td>
</tr>
<tr>
<td>18-Apr</td>
<td>Wordless</td>
<td>Aviary</td>
<td>1,768</td>
<td>848</td>
<td>47.96%</td>
</tr>
<tr>
<td>19-Apr</td>
<td>Wordless</td>
<td>Cow interactive</td>
<td>882</td>
<td>290</td>
<td>32.88%</td>
</tr>
<tr>
<td>20-Apr</td>
<td>Wordless</td>
<td>Egg place</td>
<td>1,264</td>
<td>231</td>
<td>18.28%</td>
</tr>
<tr>
<td>25-Apr</td>
<td>Combination</td>
<td>Cow interactive</td>
<td>828</td>
<td>204</td>
<td>24.64%</td>
</tr>
<tr>
<td>26-Apr</td>
<td>Combination</td>
<td>Sandbox</td>
<td>580</td>
<td>113</td>
<td>19.48%</td>
</tr>
<tr>
<td>27-Apr</td>
<td>Combination</td>
<td>Aviary</td>
<td>1,461</td>
<td>211</td>
<td>14.44%</td>
</tr>
<tr>
<td>28-Apr</td>
<td>Combination</td>
<td>Pigs through handwashing</td>
<td>2,109</td>
<td>196</td>
<td>9.29%</td>
</tr>
<tr>
<td>30-Apr</td>
<td>Combination</td>
<td>Interviews</td>
<td>691</td>
<td>134</td>
<td>19.39%</td>
</tr>
<tr>
<td>1-May</td>
<td>Combination</td>
<td>Entry and exit counts for Kids Cove</td>
<td>2,490</td>
<td>874</td>
<td>35.10%</td>
</tr>
<tr>
<td>2-May</td>
<td>Combination</td>
<td>Pigs through handwashing</td>
<td>798</td>
<td>191</td>
<td>23.93%</td>
</tr>
<tr>
<td>3-May</td>
<td>Combination</td>
<td>Egg place</td>
<td>1,984</td>
<td>228</td>
<td>11.49%</td>
</tr>
<tr>
<td>4-May</td>
<td>Combination</td>
<td>Water feature</td>
<td>2,490</td>
<td>265</td>
<td>10.64%</td>
</tr>
<tr>
<td>5-May</td>
<td>Combination</td>
<td>Playground</td>
<td>1,673</td>
<td>39</td>
<td>2.33%</td>
</tr>
<tr>
<td>7-May</td>
<td>Combination</td>
<td>Entry and exit counts for Kids Cove</td>
<td>3,461</td>
<td>743</td>
<td>21.47%</td>
</tr>
<tr>
<td>8-May</td>
<td>Combination</td>
<td>Interview</td>
<td>2,704</td>
<td>704</td>
<td>26.04%</td>
</tr>
</tbody>
</table>
Do zoo visitors see animals?

The question of whether or not visitors see animals has arisen from the researcher’s experience as a zoo employee and from the literature. In a 9-month period at Knoxville Zoo, approximately one-third of the written complaints to zoo administration involved visitors who were unable to see animals that were known to be on exhibit (Jim Vlina, personal communication, February 12, 2002). At Zoo Atlanta, Bashaw and Maple (2001) reported a similar problem at a tiger exhibit and their attempt to correct the situation using interpretive signs. To understand the phenomenon, one need only stand in front of a zoo exhibit that houses a camouflaged animal and listen to visitors who have difficulty locating the animal. This is disquieting in light of the zoo’s education mission, especially with the awareness that if visitors cannot see animals in a zoo exhibit, they may never see animals in the wild.

Why the concern? Most zoo staff would respond that the animals are the most effective educators at the zoo. The literature supports the idea of a profound and life-long influence the experiences can have on zoo visitors (Chipeniuk, 1995; Holzer & Scott, 1997; Tanner, 1980). The potential for such influence, however, is lost if visitors see only exhibits and not animals.

Seeing animals at Lowry Park Zoo. The Lowry Park Zoo exhibit studied for this project, home to a red-tailed hawk and two sandhill cranes, was selected for a number of reasons:

1. The animals are physically large and should be easy to see.
2. The animals spend their time above visitor sight (the hawk) or below it (cranes).
3. Preliminary observations left the researcher with the impression that many visitors did not see the animals in this exhibit.
In February 2005, four sign treatments were tested at the red-tailed hawk and sandhill crane exhibit at Lowry Park Zoo:

1. No signs
2. Words only (common name, scientific name, continent, identical to the existing zoo signs, but provided in black copy on a white background to match the other signs for this study)
3. Combination signs (words and an illustration that showed how to see animals in the exhibit)
4. Wordless signs (an illustration only that showed how to see animals in the exhibit)

Each treatment at Lowry Park Zoo was in place for two days: one weekday and one weekend day. The zoo visitors represent a sample of convenience from which groups of visitors were systematically chosen for inclusion in the study. Every third visitor group entering the area was unobtrusively observed.

The following bar graph (Figure 4-1) clearly shows that treatments with no signs and signs with words only were less effective at helping visitors see the cranes than either the combination signs or wordless signs. A similar result was observed with the hawk, with even fewer visitors seeing a bird in a tree than on the ground. If seeing animals is a goal of a zoo exhibit, this portion of the study conducted at Lowry Park Zoo found that signs are important, and further, that signs designed to show visitors how they may see animals in the exhibit are more effective than simple identification signs containing animal common name, scientific name, and continent of origin.
Figure 4-1. More Lowry Park Zoo visitors saw animals when combination and wordless signs were in place than when no signs or signs with words only were present (n=2235).

Seeing animals at Knoxville Zoo. These results at Lowry Park Zoo led to the Knoxville Zoo study, where 31 combination and wordless signs were placed at 38 locations (seven signs were duplicates placed at opposite ends of a large exhibit) tested at the opening of a new children’s zoo, Kids Cove (Appendix C). The area featured a number of animal exhibits, including Guinea hogs, goats and sheep in a contact yard, beavers, and an aviary with native, East Tennessee songbirds. Although not equally effective at all exhibits, it is readily seen from the data that wordless signs help more visitors see animals than combination signs, with the exception of birds in the free-flight aviary (Figure 4-2).
Figure 4-2. More Knoxville Zoo visitors saw animals when wordless signs were in place than when combination signs were present (n=1804).

**Holding time: Do zoo visitors stay longer?**

Zarembo and Toedter (1993) and Serrell (1996) have used holding time to gauge the efficacy of signs. Holding time is the duration a visitor spends at a particular exhibit, reading signs, looking at exhibit elements, using interactive exhibit elements, or engaging in some way with the exhibit or with other visitors.

Holding time is of interest to zoos for myriad reasons. Some researchers (Serrell, 1996 and others) speculate that holding time is equivalent to “time on task” in a classroom, with longer holding times equating to more learning. While this is refuted by other educators (Tunnicliffe, 2003), who views engagement as a better measure of learning.

Holding time, however, contributes to visit duration. For visitors who come to the zoo for a set visit duration, holding time impacts the number of exhibits and experiences they may have. For visitors whose zoo visit is open ended, holding time can potentially have
substantial impact on visit duration and the earned income. Visitors who stay longer are more inclined to purchase food and drink (Marie Vlna, personal communication, 05 May 2004), contributing to revenue streams that help support zoos.

In studies at the two zoos, holding time was one of the measurements collected by unobtrusive observation of visitors. The third visitor group to cross an imaginary line at either end of the bird exhibit at Lowry Park Zoo was observed. Visitor groups spent a wide range of holding time in the exhibit area, with minimum holding time of 3 seconds to maximum holding time of 744 seconds. The minimum holding time represents the time it takes for a visitor (or visitor group) to walk past the exhibit. Although holding time for visitors who did nothing but walk past the exhibit ranges from 3 seconds to 223 seconds, other visitor groups were able to engage with the exhibit in some way in as little as 5 seconds. The shortest holding times often represent visitors who were headed to a specific destination, including restrooms, a restaurant, or Stingray Bay.

The results for holding time are shown graphically (Figure 4-3), illustrating that the treatment with no signs was responsible for the lowest holding time among all sign treatments and that the combination sign that included words and the illustration showing actions necessary to see animals, was the most successful treatment across all variables.

At Knoxville Zoo, the larger exhibit area made measurement of holding time more complex. The layout of Kids Cove lends itself to segmental observations. Following the visitor pathway and most common visitor line of travel, holding time was observed for pigs through the handwashing station, the playground, the aviary, and the water feature.
Lowry Park Zoo visitors stayed at the exhibit longer when combination and wordless signs were in place than when no signs or signs with words only were present (n=2235). The range of holding time, measured in seconds, was 10 to 1637 seconds for pigs through the handwashing station, with a mean of 272 seconds. The cow interactive, when viewed from within the area, showed a range of holding times from 5 to 326 seconds, with a mean of 78 seconds. When data was collected by researcher positioned outside the area, the range of holding time was 2 to 199 seconds, with a mean of 59 seconds. This difference may be explained by the Hawthorne effect (Mayo, 1945), certainly it is a commonly observed phenomenon in zoos and museums, where visitors are more likely to approach an exhibit and spend time when there are other visitors in the area. This is of sufficient impact that Rorimer (1998) reported hiring visitors to stand in front of an art museum exhibit to attract attention.

Visitors exhibited a holding time range of 12 to 795 seconds in the aviary, with a mean holding time of 164 seconds. Holding times noted at the water feature show a range of 1 to 54 seconds, with a mean of 18 seconds. This is related to inclement weather when
timed observations were made at the water feature. As part of interviews near the end of the study, when repeat visitors were found to be frequent among zoo members, a number of groups reported that they had spent several hours at the water feature so children could play. Certainly as the weather improved and repeat visits were observed, the researcher noted that more and more families were bringing bathing suits and towels for children, and parents brought books and magazines to entertain themselves while children played. It is important to note here that on the last day of the study, 31% of visitors interviewed had been at Kids Cove on at least one other occasion and one family reported that this was their fifteenth visit in 40 days.

The holding time at Knoxville Zoo was compared with sign treatment across the segments of Kids Cove (Figure 4-4). These figures of holding time at Knoxville Zoo show that the wordless signs are more effective than combination signs for increasing holding time at Kids Cove, with the most substantial increase in holding time in the contact yard and at the aviary.

Engagement activities: Do zoo visitors do more?

Engagement takes numerous forms at an exhibit, including in-group discussion, inter-group discussion, and acting out or role-playing. Visitors may point at the animal or take a photograph. Some researchers (Sertell, 1997; Tunnicliffe, 2003) are beginning to suggest that holding time and engagement in zoos and museums appear to be parallel concepts with allocated time and engaged time in a classroom.

Research on these classroom phenomenon has found optimal learning takes place not during allocated time (holding time), but during engaged time, when students are physically, emotionally, and overtly participating in classroom lessons (Richard Cohen, personal communication, 23 February 2004). Despite cautions from Diamond (1999) and
Figure 4-4. With the exception of holding time at the milking cow interactive, Knoxville Zoo visitors stayed at exhibit areas longer when wordless signs were in place than combination signs were present (n=1804). This anomaly at the milking cow interactive is related to a day when the exhibit was not working correctly. More information on this is given in Figure 4-11.
Screven (1993b) about drawing research methods and techniques directly from classroom studies, the apparent tie between engagement at an exhibit and engaged learning in a classroom is worthy of additional exploration in zoos and museums.

The frequency of engagements at Lowry Park Zoo, including pointing, photographing birds, and engaging in intra- and inter-group conversation, occurred at a range from 0 to 14 activities, with 47.4% of the visitors performing one or more engagement activities at exhibit studied. The small discrepancy between the number of visitors who performed engagement activities (47.4%) and the number of visitors who saw a bird (44.7%) can be explained by the number of visitors who looked at the signs and either chose not to look for the birds or were unable to locate the birds within the exhibit.

The frequency of engagement activities indicates that the treatment with no signs was the least effective for triggering engagements and the combination sign the most effective treatment for triggering engagement (Figure 4-5).

![Figure 4-5. Lowry Park Zoo visitors exhibited more engagement activities when combination and wordless signs were in place than when no signs or signs with words only were present (n=2235).](image-url)
The potential for engagement was much greater at Knoxville Zoo than at Lowry Park Zoo, since the exhibit areas were specifically designed to attract children and families and engage them in hands-on activities (Figure 4-6).

Figure 4-6. Knoxville Zoo visitors exhibited more engagement activities when wordless signs were in place than when combination signs were present (n=2235).
In the area with pigs, the cow interactive area, goats, and handwashing, 69% of visitors saw the animals or look at the signs for the pigs. At the cow interactive area, more than 80% of the visitors who walked past the area engaged in some manner. At the contact yard, 56.2% of the visitors entered the area to see the goats. This unexpectedly low use of the contact yard may have been related to March 24, 2005, a week prior to the opening of Kids Cove, news stories about an outbreak of E. coli infections traced to a Central Florida petting zoo that was featured in both the Knoxville News-Sentinel and on national television (MSNBC, 2005).

Although noted above that when viewed from the pathway, 81.2% of the visitors did interact with one or more exhibit elements in the area near the milking cow, it is possible that the Hawthorne effect (Mayo, 1945) seen in number of visitor engagements. When the researcher was seated in the area, the rate of interaction increased to 91.6% of the visitors. In both instances, most visitors (81.25% and 84.4%, respectively) engaged with either the cow or the sign in front of the cow that showed a child milking the cow. Adults not accompanied by children were more likely to point at the sign and comment on it, but not to try milking. Adults accompanied by children were more inclined to demonstrate milking techniques.

At the costume area, 10.9% pointed at the sign or mentioned the costumes, but only 4.7% played with them. This is due, in part, to the number of parents who discouraged children from using this exhibit element. The buckboard and saddles were used by 7.8% and 27.3% of visitors, respectively. Of the 14.1% of the visitors who pointed at the window or at the sign adjacent to the barn window, only 8.6% actually looked in the window to see if animals were inside the barn (Figure 4-7).
Figure 4-7. In most exhibit areas, Knoxville Zoo visitors exhibited more engagement activities when wordless signs were in place than when combination signs were present (n=1804). Of note, is no engagement with the costumes or the buckboard when combination signs were in place.

Observations were made at the playground. The complexity of the area, however, and a repeated entry-and-exit behavior, the presence of only one sign in the play area, and no educational goals set for the playground, resulted in a limited study of this area. Holding time at the playground, including Clayton's play cabin with slides and climbing structures, the sandbox, the climbing wall, and the rope spider web, was noted to range from one minute to 126 minutes, with mean holding time of 26.33 minutes. Some groups left and returned multiple times, either exploring other areas of Kids Cove or leaving Kids Cove to visit other areas of the zoo. Very often, parents or grandparents would sit in the benches across the walkway from the Play Cabin and children would enter and exit to describe what they were doing.
In the aviary, with many elements available for engagement, a similar percent of visitors did not engage with exhibit elements. At the aviary, only 5.2% of visitors did not engage in any observable manner. In the aviary, 58% looked for or saw the beavers, but less than 14% looked for or saw birds. This is difficult to assess, since this may be related to the difficulty in seeing songbirds or a general lack of interest in birds on the part of zoo visitors. It is well known that the exhibits that attract most visitors are most likely to contain mammals, especially mammals with round eyes and round faces (Hoage, 1989). Of even greater potential to attract visitor attention are animals known as CMVs—charismatic mega-vertebrates—the largest animals, very often those from Africa, but including the giant panda from China.

The interactive elements in the aviary were used in varying degrees, with 56.6% of the visitors using the bowl nest but only 31.2% using the cavity nest. More than half, 53.9%, of the visitors interacted in some way with the egg shells. The footprint puzzle and the periscope providing a birds-eye-view of the exhibit were used by 29.2% and 60% of the visitors, respectively, perhaps related to placement of the interactive elements, with the periscope the first element seen by visitors who enter the aviary from the covered bridge.

The pushbutton interactives were problematic for visitors. Slightly more than half, 50.6% of the visitors pushed the sound board buttons at least once. There is an unfortunate lag time in the electronics, so visitors often push buttons four or five times before a response is heard. In addition, the machine has pictures of 16 birds with a button under each picture. The response to pushing a button includes a male voice saying the name of the bird followed by the bird call. For some reason, many visitors are unable to understand the name of the bird and more than one group thought that the bird's name was part of the bird call they had never heard before.
While 44.2% of the visitors attempted to use the feet and beak matching board, only two groups of visitors (n=154) were able to use this exhibit element successfully. Visitors must push, and hold down buttons underneath drawings of bird feet and match bird bills to have a picture of the bird light on the top line of the board. Visitors who are able to match, but do not hold down the buttons believe the exhibit is broken, as do visitors who are unable to match feet and beaks for a duck, a blue heron, and a hawk.

The perception that these exhibit elements were not working correctly served to reduce both number of engagements and holding time in aviary visitors who entered from the rear of the aviary where these were the first interactive exhibit elements encountered. A similar phenomenon was observed at the milking cow interactive and it is described below.

Visitor engagement at the aviary is shown here, with bird and puzzle engagements the only two that are lower with wordless signs than with combination signs (Figure 4-8).

Figure 4-8. Knoxville Zoo visitor engagement at the aviary was higher when wordless signs were in place than when combination signs were present (n=1804).
In the large area that surrounds the water feature, there were opportunities for families to interact with exhibit elements and to purchase food and gifts. Nearly one-third (31.3%) of the visitors purchased some food item at KC's Canteen, but only 19.5% entered KC's General Store, where gifts and souvenirs are available. A waterfall where children can get their hands wet was used by 6.3% of the visitors, but 58.6% either entered the area with the spitting frogs or entered and sat on the frogs. The lily pads, across one portion of the stream, were used by 43.8% of visitors, most frequently children, but if the area was not too crowded, adults often walked on the lily pads. Only 28.9% of the visitors looked at the rabbits and 44.5% looked at the chickens. The area with nest boxes and wooden eggs, however, was used by 59.4% of the visitors and held special attraction to youngest visitors.

A heritage garden, planted behind the chicken coop is several steps below the grade of Kids Cove plaza. While 46.1% of visitors looked at the sign for the garden, only 5.5% went down the few steps to see the garden (Figure 4-9).

Figure 4-9. Knoxville Zoo visitor engagement around the water feature was higher when wordless signs were in place than when combination signs were present (n=1804).
Here the visitor engagements were lower at the waterfall and at the rabbit exhibit with wordless signs than with combination signs. All other opportunities for engagement, at frogs, lily pads, the chicken exhibit, the egg place, the heritage garden and the garden sign, were higher with wordless graphics.

Rather than reflecting a difference in the efficacy of signs, the decrease in engagements at the milking cow interactive shown here reflects a day when the cow had a torn udder and was not working correctly (Figure 4-10).

![Figure 4-10](image)

Figure 4-10. With the exception of holding time at the milking cow interactive, Knoxville Zoo visitors stayed at exhibit areas longer when wordless signs were in place than combination signs were present (n=1804).

Many visitors approached, tried the interactive or watched other visitors try the interactive, and left with the comment that the interactive was broken. The impact of malfunctioning interactive, is shown to affect the visit experience, was quantified as follows, showing the
drop from 73% of visitors engaging with the working interactive and only 27% of visitors engaging with a broken interactive (Figure 4-11).

An overview of Kids Cove found that 29.7% of the visitors interacted with five or more exhibit elements, and only 3.9% did not engage with any exhibit elements. Given these results, it is obvious why so much emphasis is placed on the development of interactive learning opportunities at zoos, especially in areas described as children’s zoos. Lowry Park Zoo, while not having interactive elements at the bird exhibit studied, has extensive interactive opportunities at other locations in the zoo, including Stingray Bay, which in many instances drew visitors past the bird exhibit in anticipation of being able to touch and feed the stingrays.

The charts of engagement presented above nearly replicate the results of holding time, where combination signs were more effective at Lowry Park Zoo and wordless signs were more effective at Knoxville Zoo in triggering engagement activities by visitors.


Visit motivation

Information from surveys was used to gain insight into visit motivation. Survey participants at Lowry Park Zoo were systematically selected as every third group that was observed. The preponderance (90.50%) of those asked were willing to participate. A number of the "no" responses to the request for survey came from visitors whose command of English was limited. The proximity of the research site to a restroom was responsible for some visitors refusing to participate, and as the end of the day approached, fewer visitors were willing to participate in a brief interview. At Knoxville Zoo, only one visitor group declined to be part of the survey, for unknown reasons. The survey participants at Knoxville Zoo were systematically selected as the third group to enter an area of observation.

Why visitors come to zoos is a matter of considerable debate. Differences of opinions are wide, and while there are some cross-institutional studies being done (notably Dierking et al., 2002a, 2002b), their findings differ from those at Lowry Park Zoo. When asked why they were at Lowry Park Zoo, visitors said they had come to the zoo see the animals (38%), not the anticipated "spend time with family and friends" that the Mills (Kevin Mills, personal communication, New Orleans, September 23, 2004) reported at AZA. This data from Lowry Park Zoo differs significantly from that collected at Knoxville Zoo, where most visitors (70%) stated that they came to the zoo to have a good time with family and friends (Table 4-3). The question was identical for both segments of the study. The differences in response could, of course, reflect very different visitor demographics and motivation. Some of those differences are clearly evident in the number of visitors who came to entertain out-of-town guests, a response given by 18% of the Lowry Park visitors and none of the Knoxville Zoo visitors. The preponderance of visitors from Knoxville who came to spend time with family (70%) could reflect either a local emphasis on family
Table 4-3. Visit motivation is much debated at zoos. The responses from Lowry Park Zoo and Knoxville Zoo visitors to the question, “Why did you come to the zoo today?” are presented here.

<table>
<thead>
<tr>
<th>Reason given for visiting zoo</th>
<th>Lowry Park Zoo %</th>
<th>Knoxville Zoo %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Came to see animals</td>
<td>38</td>
<td>1.5</td>
</tr>
<tr>
<td>Entertain out of town guests</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Spend time with family and friends</td>
<td>16.5</td>
<td>70</td>
</tr>
<tr>
<td>Have a good time</td>
<td>5.5</td>
<td>1.5</td>
</tr>
<tr>
<td>The zoo is good for children</td>
<td>5.5</td>
<td>13.5</td>
</tr>
<tr>
<td>Tourists visiting the area</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Photography</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>It is a beautiful day</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td>Exercise</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>On a date</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>An opportunity to spend time outside</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>See nature</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Zoo trips are a family tradition</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Babysitting</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>The zoo is close to my house</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>It is a good place for a day off</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>The zoo is fun</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Getting married at the zoo/attending birthday party</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>No reason</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Education</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
values or the marketing efforts of Knoxville Zoo branding the zoo as a family adventure and Kids Cove in particular as a “new zoo place to play.”

One of the least expected responses, that visitors came to the zoo for education, was surprisingly found only at Knoxville Zoo, in a community that does not always appear to place great value on formal education. Those responses were from parents who home school their children and use the zoo as a frequent support for science and outdoor activities. No groups at Lowry Park Zoo self-identified as home schoolers, so it is not known from this study if this use of the zoo, to supplement home schooling curriculum, is common in the Tampa Bay area.

A propensity for naturalist intelligence?

The propensity for naturalist intelligence is one that is difficult to assess. Survey questions were similar to those in “How are you smart?” (Appendix B, adapted from Rose & Nicholl, 1998), and sought information on:

1. Are you an annual pass holder (Lowry Park Zoo)/member (Knoxville Zoo)?
2. Do you go to other animal attractions (other zoos, aquariums, Busch Gardens, Dollywood, etc)?
3. Do you have pets?
4. Do you garden or have houseplants?
5. Do you think conservation is an important issue?
6. What do you do to support conservation?

Of the groups interviewed at Lowry Park Zoo, 50.5% were zoo pass holders and 49.5% were not (Table 4-4). At Knoxville Zoo, the number of members interviewed was higher, with 84% of those interviewed having memberships at the zoo, and 16% not having a membership.
Table 4-4. The propensity for visitors to Lowry Park Zoo and Knoxville Zoo to exhibit indications of naturalist intelligence is based on questions to a survey given to visitor groups at both zoos.

<table>
<thead>
<tr>
<th>Question</th>
<th>Lowry Park Zoo study (% responses)</th>
<th>Knoxville Zoo study (% responses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have annual pass to zoo/ Are you a zoo member?</td>
<td>50</td>
<td>84</td>
</tr>
<tr>
<td>Do you visit zoos, aquariums, and other animal attractions?</td>
<td>59</td>
<td>96</td>
</tr>
<tr>
<td>Do you have pets at home?</td>
<td>50</td>
<td>66</td>
</tr>
<tr>
<td>Do you garden or have houseplants?</td>
<td>57</td>
<td>86</td>
</tr>
<tr>
<td>Do you believe conservation is an important issue?</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Do you do something to support conservation?</td>
<td>97</td>
<td>77</td>
</tr>
</tbody>
</table>

In both instances, the percent zoo pass holders/members interviewed were higher than the numbers who entered at the front gate, where such information is collected for determining admission price. At the front gate, 36.3% of Lowry Park Zoo visitors held an annual pass, compared to 50.5% who walked past the bird exhibit and agreed to participate in the survey. At Knoxville Zoo, 27.08% of visitors at front gate were members, but 84% of those interviewed in Kids Cove were members.

Visitors at Knoxville Zoo were more likely to visit other animal attractions, despite the fact there are more animals attractions in Florida than in East Tennessee and more of the Lowry Park Zoo visitors were members at other zoos. Knoxville Zoo visitors were also more likely to have pets at home and garden or have houseplants than visitors at Lowry Park Zoo. While this may relate to naturalist intelligence, it may also be a function of the number
of housing communities in Florida where pets are limited or not allowed and gardening is managed by home owners associations.

That all visitors believe conservation is an important issue is revealing in a number of ways. While it may indicate the socially desirable response, especially in the context of the zoo, it reflects the fact that visitors know that zoos are conservation agencies and that education efforts to impress this information on visitors are being successful.

The response to whether or not the visitor does something to support conservation may also show the efficacy of zoos at educating visitors on the importance of action for conservation. In Florida, 97% of visitors report they do something active for conservation. In East Tennessee, that falls to 77%. In both areas, the responses indicate a diverse appreciation for the environment and the conservation activities ranged from zoo membership and recycling to supporting other conservation organizations, voting, and practicing a sense of stewardship for the natural world. A number of those interviewed at Lowry Park Zoo were Bronx Zoo members, all of whom responded to the question of conservation action with, “I’m a Bronx Zoo member.” Indeed, zoo membership is the first action many zoos suggest for those interested in conservation, one that the Bronx Zoo has clearly communicated to its members. In Knoxville, however, 84% of those interviewed were zoo members, but only 77% said they did something proactive for conservation.

Whether it is the case that Knoxville Zoo members do less for conservation, or are simply less able to articulate the positive actions they take is unknown. This is supported in part by the literature, in the Man and the Biosphere Study (Man and the Biosphere Program, 1966), which suggests that residents of Southern Appalachia were more willing to make sacrifices for the environment than in most other sections of the country, but were naïve about what actions to take.
Significance of observations

Despite having used standard methods for data collection in zoos and museums, and employing analysis methods suggested by the literature and based on the variables chosen for study, the data overwhelmed statistical processes in the three areas of primary interest: visitors seeing animals, holding time, and number of engagement activities. Specifically, the data did not match expected curves and standard deviations were too large to allow use of parametric statistics, particularly an analysis of variance (ANOVA), as had been planned.

A non-parametric test, the Kurskal-Wallis test, found differences between the treatments for holding time at Lowry Park Zoo (χ² (3)=15.00, p=.002) and between treatments for engagement activities at Knoxville Zoo (χ² (1)=6.91, p=.009). Given the fact that no significance was attached to seeing animals, and that holding time was significant between treatments only at Lowry Park Zoo (combination signs had the most significant impact on holding time) and engagement activities were significant between treatments only at Knoxville Zoo (wordless signs had a significant impact on number of engagement activities), no further discussion of statistical results will be presented.

Qualitative findings

In addition to the quantitative data presented above, observations of zoo visitors are reminders that cultural institutions are repositories of the stories we tell ourselves about ourselves (Geertz, 1973). Numerous visitor conversations overheard or conversations held with visitors in the course of surveys at Lowry Park Zoo and Knoxville Zoo added a new dimension of understanding to visitor motivation, interest, and the influence of the zoo on visitor behavior.
At Lowry Park Zoo, many conversations between visitors included stories about birds, most often for local visitors, about sandhill cranes who are frequently seen in yards and on golf courses in the area. One habit of the cranes, resting while standing on one leg, engendered numerous comments and stories. One male visitor was upset at seeing this natural behavior. His complaint centered around what he believed to be the zoo's habit of exhibiting “crippled birds,” noting that he had seen similarly afflicted birds at other exhibits, including flamingoes and whooping cranes, indeed animals that rest while standing on one leg.

Other stories, most often related by adults to children, talked about the need for birds “to take naps, just like children,” with the explanation that you could tell a bird was napping when you saw it standing on one leg. One grandmother challenged her grandchildren with the question, “Why do you think the cranes tuck one leg under their bodies while they sleep?” After much family discussion, the grandmother, chuckling, told the children “if the birds picked up the other leg, they’d fall down.”

When the wordless signs were in place, a few visitors wondered, aloud, what the birds were. It was an obvious surprise to some parents that their children knew names for the birds. One mother in particular, was shocked that her 5-year-old daughter could recognize and correctly identify the sandhill cranes when the mother could not and wordless graphics were in place. (The mother looked around, saw me, and asked if the child’s identification was correct.)

In other instances, however, children and adults verbally misidentified the birds even when identification was available. Numerous young children referred to all birds as “chickens.” Another identified all three birds as “ducks.” Most adults could identify the cranes, but often referred to the red-tailed hawk as an owl, falcon, or eagle.
In many instances, the ripple effect described by Bashaw and Maple (2001), was observed. This happened most frequently with the hawk, where one group of visitors would be pointing at the hawk and their actions would attract the attention of other groups who would also look up to see the bird. When this occurred, it often triggered between-group conversations, with more-informed visitors identifying the bird for less-informed visitors. This between-group conversation was also observed when an adult would misidentify the hawk as either a falcon or an eagle. Visitors from other groups, who might be described as Vygotskian “more qualified peers,” were frequently observed to correct animal identification and engagement in subsequent conversation.

Although the ripple effect and subsequent sighting of the birds was also triggered by photographers with sophisticated camera equipment, visitors seemed less likely to engage in conversation with the photographers, perhaps out of consideration for the concentration of the photographers.

There were numerous instances of the group dynamic affecting exhibit use. In some cases, children would notice the sandhill cranes and want to pause to look at them. One mother pulled her child away from the exhibit, saying, “There’s just grass in there,” despite the child’s repeated, “Birdie, birdie, birdie.” In other instances, a parent or grandparent would want to stop to see the birds, but children would want to move directly to Stingray Bay.

Numerous behaviors were seen that appeared to be tied to the study. When there were no signs and wordless signs, a few visitors were heard to complain that they could not identify animals. A number of groups, frequent visitors at Lowry Park Zoo, noticed there were new signs at the exhibit even when these signs contained information identical to the signs that were in place prior to the study. When the combination signs were in place, many
visitors read an entire sign aloud, something not observed in a single instance when the signs
with words only, including scientific name, were in place.

A single group of visitors, a family of three, noted the lack of range maps on zoo
signs, and the general lack of “informative signs” at Lowry Park Zoo. While this is not an
uncommon comment from visitors in zoos, Swanagan (2000) and Heinrich and Birney
(1992) found that while visitors frequently asked for more signs, they responded more
favorably to animal interaction. Certainly empirical studies in zoos have shown that more
signs do not mean more readers (Heinrich & Birney, 1992; Swanagan, 2000).

Several interviewed visitors commented that the wordless signs were, in their
opinion, excellent for children and for visitors who might not read English. This latter
comment reflects the international makeup of visitors to Lowry Park Zoo and the
increasingly diverse international population in the Tampa Bay area. That this international
population is growing is reflected by a number of visitors who did not participate in the
survey because they did not speak English, responding in what the researcher tentatively
identified as Spanish, Romanian, Punjab, and Chinese.

The visitors surveyed gave a variety of responses to the questions, especially to those
intended to determine a propensity for naturalist intelligence. The question about pets often
resulted in a listing of the pets, or for some of the elderly, a rather sad, “not any more.”
Many seniors responded to the question about gardening in a similar vein, noting they had
gardened in the past, but that the weather or their age had changed that habit since moving
to Florida.

Every visitor interviewed replied that conservation is an important issue. The
answers about conservation actions revealed a broader range of support that had been
presumed. Some visitors reported that they recycled, others supported conservation through
their zoo membership, and many donated money to conservation organizations. A German tourist reported that she “voted Green.” A local Tampa Bay resident related that he had given up the practice of littering on the highways. Others gave more sophisticated answers that they worked to preserve wetland habitats or worked to halt habitat degradation.

Certainly some of the Lowry Park Zoo visitors reflected a deep and genuine concern and sophisticated awareness of conservation and environmental issues, both locally and globally.

The stories heard at Kids Cove reflect a number of decisions made in its design. In the planning stage of the exhibit, Kids Cove was described by staff to designers as an historic Appalachian farm much like those preserved in the nearby Smoky Mountain National Park, especially in an area of the park called Cades Cove. Zoo staff spent time in Cades Cove discussing the elements of those early farms that would translate to an Appalachian-themed children’s zoo and how both the collection and interactive elements could be used to help recreate the history of the region.

The first stories overheard at Kids Cove usually related to the family farm, perhaps owned by grandparents or great-grandparents. Conversations at the milking cow interactive were often rich with memories. At times, conversations begun at the cow, near the entrance to Kids Cove, were continued by different family members throughout the visit. One young woman, in her mid-teens, began a conversation with her grandfather that started with the milking cow and led through other aspects of daily life that have changed in the past 30 to 50 years, and then moved on to discuss extended family relationships as they spent more than an hour wandering through Kids Cove.

The aviary was the scene for some fascinating family interactions. Numerous families piled into the bowl nest to be a “family of birds.” The family exchange was markedly different from interactions observed with school groups and groups of friends.
The concept of “baby bird” was universal, but the caring by adult birds for their offspring was key to the family conversations.

One father, whose daughter was sitting in the bowl nest, pulled “gummy worms” from his backpack. With a worm dangling from his lips, he leaned down and “fed” his daughter, and followed the activity by a discussion of family care and natural history of birds. More than any other area of Kids Cove, the aviary triggered discussions of family structure, dependence, reciprocity, and parental responsibility.

The egg place, the area filled with shavings and nest boxes where wooden eggs were glued in place and others were loose for children to find, was an area where many children were allowed to go without parental accompaniment. Often parents leaned in the doorway or sat on benches outside. In a brief look at activities, most children enjoyed pulling the eggs from the straw and shavings. Some removed eggs from the area and hid them around the cove for siblings and parents to find.

Earlier observations at Knoxville Zoo’s Chimp Ridge (Bryant, unpublished data, 1999) had suggested that some visitors, notably minority visitors, needed either a staff presence or a sign to “give permission” to visitors to use exhibit elements. A sign was placed at the climbing wall for just this purpose, and numerous children were seen to look at the sign before climbing on the wall.

A typical incident of a visitor’s need for “permission” to use exhibit elements was seen in the aviary. An Hispanic mother and son entered the aviary and were faced with an array of exhibit elements. The son asked if he could get in the nests and the egg shells. The mother hesitated, and then replied that she did not think he should. As they walked through the aviary, the son saw the sign by the eggs (Figure 4-12). The boy smiled and immediately jumped into the egg, going on to use other exhibit elements in the aviary.
The milking cow was the site for some of the most obvious gender differences in exhibit element use. Women and girls most often tended to “milk” the cow as was traditionally done, with the liquid being squeezed from the udders into a bucket. Men and boys, after testing the milking motion with their hands, often redirected the stream at each other and other visitor groups. Gender differences were observed on several occasions at the water feature. One school group had a distinct male/female competition going on, with the boys taking over the frogs and sitting on them to “shoot” the girls with water. Some of the boys in this group were overheard to refer to the frogs as “turrets.”

Although most of the gender differences were observed in the actions of children, at the rabbit exhibit, gender differences in parental behavior was noticed. This was not observed among visitors who walked past the exhibit throughout the day, but during interaction periods when keepers would enter the rabbit area and hold bunnies so visitors could pet and interact with the animals. Children were often the first in a group to approach...
the rabbit and the keeper. When accompanied by a female adult, the adult usually followed
the child and approached the rabbit, often engaging in conversation with the child and with
the keeper. Male adults, on the other hand, often held back, not approaching the rabbit,
even when entreated by the child.

Of the many learning opportunities seen at Kids Cove, only the water feature lacked
a child-to-child or parent-to-child educational element. Interactions were common, but
almost exclusively dealt with the degree of “wetness” that would be allowed by parents, not
about the frogs, lily pads, or life in the water.

Notable of the observations are the number that relate to the theoretical constructs
of this research. The importance of signs as advanced organizers was strongly supported by
the data collected at Lowry Park Zoo with fewest number of visitors seeing animals,
spending time at the exhibit, or engaging in any way with the exhibit when no signs were
present. A similar phenomenon was observed at Knoxville Zoo in the area that housed the
cow interactive. At opening, no signs were in place to direct visitors to costumes, the
buckboard, or the idea of looking in the barn window to see if animals were inside. Signs
were put in place three days later and those exhibit elements began to be used, although at a
rate much lower than the milking cow, the most visually obvious exhibit element in the area.

The mechanical cow was frequently the site of Vygotskian social interaction where
parents demonstrated milking to children, or children learned from more capable peers.
Very often when intergenerational conversations were taking place, the instruction was
interspersed with stories of how parents or grandparents had grown up with milking as a
daily chore. During the study a local dairy farmer visited the exhibit with his family and he
showed a number of children how to milk the cow.
A similar learning dynamic was observed at the sandbox. Apparently many children in East Tennessee have not had the opportunity to build sandcastles, and do not understand the necessity of working with damp sand and packing the sand into a bucket before inverting it. One day of observation at the sandbox noted a father teaching his son to pack the sand to create a stable, straight-sided sandcastle. For the next four hours, it was intriguing to watch the skill pass from child to child, sometimes by observation but other times by direct verbal instruction.

Explanation and discussion of results

Signs in both studies were similar in size, shape, and color. Typefaces were identical when type was present. All drawings were done in the same style by the same artist. All signs included some gross motor skill that would improve the possibility of seeing animals on exhibit if the skill was replicated by the visitor.

While the size of the exhibits studied and number of signs investigated differed greatly, the overall impression of sign density in the exhibits was similar. A notable difference was the focus in the Knoxville Zoo exhibit in presenting the signs to children. In Kids Cove, the signs were mounted, where possible, with the top of the sign at 36” above the ground, which is described to be eye-level for an average six-year old (McLean, 1998). At Lowry Park Zoo, signs are installed on visitor barriers, and the signs there were mounted with the top of the sign at 48”.

Both studies confirm what Falk and Dierking (2000) and Serrell (1989, 1996) concluded. There is a significant match between the education experiences that zoos and museums provide and what their visitors are seeking. Falk and Dierking (2000, p. 82) noted “knowledge construction is personal and inextricably connected to prior knowledge and understandings that they brought to these experiences.” The use of signs to provide the
educational experiences that visitors seek is necessarily contextual. The investigation of wordless signs, however, illustrated context in an unexpected way.

The original sign designed for the aviary entrance was a drawing of a girl pointing at a bird. This was intended to show visitors that they might encounter free-flying birds (Figure 4-13).

![Figure 4-13](image)

Figure 4-13. The first entry sign at the Kids Cove Aviary, intended to “warn” visitors who might be afraid of birds that they would encounter free-flying birds.

This was based on the assumption by the researcher and supported by staff opinion, that an unknown number of zoo visitors are afraid of birds. In fact, one woman at Kids Cove articulated her fear, saying, “I’m afraid of birds. They are too unpredictable.” For this woman, the above sign served to keep her out of the aviary. In this way, the sign was successful.

The layout of Kids Cove is such that the aviary, with its free-flying birds, is situated between the playground with a large sandbox and the water feature. No other place in the
zoo encourages visitors to remove their shoes. Kids Cove has changed that dynamic, and piles of shoes are often seen at the entrance to the playground and near benches that are situated in the vicinity of the water feature. Because of the presence of free-flying birds, however, it is important that visitors wear shoes in the aviary. After noting the number of visitors who entered the aviary without their shoes, the entry sign was revised (Figure 4-14).

Figure 4-14. The second entry sign at the Kids Cove Aviary, intended both to “warn” visitors who might be afraid of birds that they would encounter free-flying birds, and to remind visitors that shoes were needed to enter the aviary.

As was discussed as this sign was planned and produced, this picture was difficult for visitors to understand. Personal context influenced interpretation of the sign. Barefoot visitors interpreted it as intended: Shoes were needed in the aviary. However, visitors wearing shoes often interpreted the sign incorrectly: Many removed their shoes before entering the aviary. In this instance, the wordless sign was not effective in providing the necessary message that visitors needed shoes.
The sign that combined words with the above picture was effective for visitors who read the sign (Figure 4-15).

Shoes!
Although many pioneer children spent their days going barefoot, you must put on your shoes before you enter the aviary.

Figure 4-15. The combination entry sign at the Kids Cove Aviary, intended both to “warn” visitors who might be afraid of birds that they would encounter free-flying birds, and to remind visitors that shoes were needed to enter the aviary.

However, as anticipated from the literature, numerous visitors do not read signs. As of this writing, the zoo is still exploring solutions that will work with the greatest number of visitors.

Against this contextual background, it is no wonder that zoos struggle to create signs that are used and are effective. In East Tennessee, where the number of high school graduates in some counties is 53%, adult literacy may have an impact on sign use (Center for Literacy Studies, 2005). In other parts of the country, where zoos welcome an increasingly international audience, they may well be hosting literate visitors who are unable to read signs written in English.
Signs are also a problem as zoos strive to create profound experiences for children. This interest in the impact of a zoo visit on children is based both in the literature (Chipeniuk, 1995; Tanner, 1980; Yoesting & Burkhead, 1973) and in the researcher's personal experience. Although there is occasional speculation on what triggers this response in children, no literature was found that addresses this topic. Falk and Dierking (2000) explicitly suggest that empowering children influences their experience at a museum. The content of wordless signs is more readily available to children, but it is unknown if the wordless signs served to empower young children. The standard measures of experience such as holding time and engagement are likely not useful in determining this, since these are not always dictated by children, but rather by parents who may have their own agenda or timeline for the zoo visit.

Many of the findings presented here were anticipated. Notably, at Lowry Park Zoo, that the no sign and words-only treatment would be the least effective at helping visitors see animals on exhibit. This study confirms that interpretive signs in zoos do act as Ausubelian advanced organizers. Read or unread, an interpretive sign of any type tells a visitor that there is something to see.

How the signs functioned beyond this level were not always as expected. At Lowry Park, the combination signs were more effective than the wordless signs for all visitors, but sign efficacy was closely associated with direction of approach. Both combination and wordless signs helped visitors locate animals better when there were fewer visual distractions at visitor eye level.

The next research question addressed whether the different sign treatments affected holding time. The broad variance in holding time was anticipated. In even casual observations of zoo visitors, it is obvious that some visitors move through at a brisk pace,
talking, pointing, taking pictures, and engaging with exhibits. Other visitors stroll, taking seriously the concept of the zoo experience as a leisure-time activity. Because of the continuum of visitor practices, holding time from this study did not correlate to number of engagements. A “quick” visitor may spend 10 seconds at an exhibit and perform multiple engagement activities. A “leisurely” visitor may take 45 seconds or more to walk through the exhibit area, not noticing the exhibit or engaging with the exhibit in any way. The fact that phenomenon takes place, was no surprise. That holding time would be problematic in the analysis of data was not anticipated from the literature reviewed, possibly because of the preponderance of qualitative rather than quantitative studies. It may also be related to the lack of statistical analyses in many of the reports of zoo-based evaluation studies.

Although the lack of statistical value of the data on holding time was unexpected, holding time is still of considerable interest to zoo managers. Holding time is not an issue for visitors who come with a pre-determined amount of time to spend at the zoo, but for visitors who have open ended visits, extending holding time within an exhibit can serve to extend visit duration and its positive relationship with earned income.

While interactive elements are known to increase engagement, the relationship between sign treatments, the ability to see animals in a zoo exhibit, and engagement activities was not expected although it is clearly evident that visitors do not talk about nor point at animals they do not see.

Of particular interest are the reasons that visitors give for coming to the zoo. Literature and personal observation presents a confusing look at this, with Mills (Kevin Mills, personal communication, September 23, 2004) saying that most visitors come to a zoo to spend time with family and friends. Visitors to the two zoos in this study provided little clarity to this debate. At Lowry Park Zoo, 38% of the visitors, the largest group of similar
respondents, said they came to the zoo to see the animals. At Knoxville Zoo, 70%, reported they had come to the zoo to have a good time with family and friends. As mentioned above, that difference, while possibly a reflection of regional values, may also be a function of the playground emphasis that the zoo has placed on the Kids Cove experience.

Exploring those points, one necessarily asks if visitors just want a good time with family and friends, why visit a zoo? Within contemporary American culture, families and friends can have good times in a wide variety of venues, from the mall and movies to amusement parks and sporting events. If visitors are looking for time outdoors, why pay zoo admission when a local park would be cheaper and often more convenient?

Insight may be provided by Falk (personal communication, 19 April 2004), who suggests there are “deep reasons” that visitors come to a zoo:

1. It is an element of good parenting
2. It is for social reasons (a good time with family and friends)
3. It fits their personal ideals
4. The zoo is where people recharge in a similar manner as ritual and religion function.

While the current study provides no statistically conclusive results to the efficacy of the sign treatments tested here, the study does support the importance of these signs as part of the visitor experience. It also provides some information on visitor specific reactions to sign treatments and their potential to help visitors develop their naturalist intelligence.

Perhaps the greatest insight that results from this study is that visitors at zoos are never taught to see animals. This oversight may be a function of the high levels of naturalist intelligence in zoo staff, many of whom do not realize that their own intuitive understanding
of nature is not shared with at least that portion of zoo visitors who are unable to see animals in zoo exhibits.
Chapter Five
Findings, Conclusions, and Implications

Introduction
A summary of the study provides an overview and links the research at Lowry Park Zoo with that at Knoxville Zoo. This is followed by study conclusions that address the specific findings of the research. Recommendations for future study and implications of the study address the issues of signs, especially a number of questions raised during the conduct of the research.

Summary of the study
Based on nearly 20 years experience and an extensive literature review from zoos, museums, formal and information education, and visitor studies, an investigation of interpretive signs was conducted in 2005 in two AZA-accredited zoos. As was suggested by the literature (Belcher, 1991; Robinson, 1931; Serrell, 1988a, 1988b; Zaremba et al., 1992), few zoo visitors read interpretive signs—those signs intended to function as a bridge connecting visitors with the collection (Alexander, 1995; Burcaw, 1997; Dierking et al., 2002a, 2002b).

This study was innovative in its use of wordless signs in a zoo. The idea, which arose during a conversation about how exhibit signs could be improved, quickly took on a life of its own. A review of zoo literature revealed no information on any trials of wordless
signs in zoos had been published. As the review expanded, it found several appealing theoretical foundations that lent credence to the concept of removing words. The idea of wordless graphics, especially for a children’s zoo whose target audience includes pre-readers, evolved into this study.

The idea of using drawings that illustrated what a visitor would need to do to see animals in an exhibit or use interactive exhibit elements, was intended to empower children, especially pre-readers. The idea that wordless signs had the potential to allow children to take charge of the family dynamic, based in part on personal observation and on the work of Falk and Dierking (2000) who write, “Imagine being five years old and for this brief moment being in charge of your parents. It is a truly memorable and thrilling experience” (p. 187).

To ensure the idea of wordless signs had merit, a preliminary study at Lowry Park Zoo, Tampa, Florida, tested four sign types:

- No signs
- Signs with words only
- Combination signs
- Wordless signs

The wordless signs featured a black-and-white drawing of a visitor using the exhibit; combination signs featured the same drawings with words designed to assist visitors who might not otherwise see animals.

The formal hypothesis for this research was that zoo visitors exposed to wordless signs were more likely to see animals, spend longer holding time at an exhibit, and participate in more extensive engagement activities than those zoo visitors exposed to no signs, signs with words only, and combination signs, which are those that combine words with the images from the wordless signs.
The full hypothesis was tested at Lowry Park Zoo, Tampa, Florida, and further study at Knoxville Zoo, Knoxville, Tennessee, tested combination signs and wordless signs at a new children’s zoo, Kids Cove. These two sign treatments had been the most effective in assisting visitors see birds in the observed exhibit at Lowry Park Zoo, Tampa, Florida, and fit well with the original intent of empowering children during a zoo visit.

The two studies, following standards for visitor research in zoos and museums, used a sample of convenience—visitors at the zoo—systematically selected for observation or inclusion in the group to be surveyed. Using both unobtrusive observation and short surveys, an instrument, IMIGUZ (Investigation of Multiple Intelligence Graphics Use in Zoos, see Appendix A), was used to collect data on more than 664 visitor groups (2235 visitors) at Lowry Park Zoo, Tampa, Florida, using two signs at the red-tailed hawk/sandhill crane exhibit, and 538 visitor groups (1804 visitors) at Knoxville Zoo, Knoxville, Tennessee, using 31 different signs placed at 37 locations (six signs were put at either end of an exhibit area) at a children's zoo. In both zoos, the groups observed and surveyed included a range of age, gender, group makeup and size, and tourists and local residents. Those surveyed were asked if they were members (Knoxville Zoo) or held an annual pass for zoo admission (Lowry Park Zoo). All interviewed were asked an array of questions intended to elicit information about the visitor’s propensity for naturalist intelligence.

While the findings of seeing animals, holding time, and engagement overwhelm statistical processes, at Lowry Park Zoo in Tampa, Florida, two of the four tested treatments provided anticipated results. Based on frequencies and means, at Lowry Park Zoo, both combination and wordless signs were more effective than no signs or signs with words only. The combination signs were more effective as measured by number of visitors able to see
animals on exhibit, length of holding time, and number of engagements than the wordless signs.

The latter two treatments from the Lowry Park Zoo study, combination signs and wordless signs, were tested in a much larger study at Knoxville Zoo. Here, in a study on 31 signs, the wordless signs were more effective than combination signs at all but five signs, where the results of the combination signs showed longer holding time and engagement when compared with the wordless signs. Again, because the standard deviations were so high, the data overwhelmed the statistical processes.

While the study tested and found meaning in the wide range of visitor use of signs, the fact that data overwhelmed the statistical process was unexpected. This problem was not mentioned in the literature or reported personally to the researcher by other professionals who had tested signage using similar methods.

The qualitative data provided a rich understanding of visitor experience and provided the greatest insight into the impact of signs and exhibit elements. At Lowry Park Zoo, the observations and conversations provided a new perspective. At Knoxville Zoo, where the local newspaper had published information about this study the day before Kids Cove opened, numerous visitors looked for “the sign lady” at Kids Cove, asked about the study, and volunteered their opinion of the project. Most visitors had a positive opinion about the concept of wordless signs, although one mother mentioned that her son had just reached the age where he wanted to read all the time. She liked the signs, but stated that for her son’s developmental stage, words would have had greater appeal for him.

A professor of early childhood development at University of Tennessee, Knoxville, was interested in the study. She was particularly pleased that it included a look at signs as
Ausubel’s advanced organizers, a theoretical perspective she felt was too often overlooked in training pre-service teachers.

The most significant result of the study, however, is closely related to the concept of naturalist intelligence that was of interest from the initiation of the study. It was, however, a visitor who most succinctly stated the main conclusion of the study:

“Until these signs, no one ever showed me how to see animals.”

Conclusions

The conclusions of the study point to some differences in zoo audiences between two AZA-accredited zoos, but results were similar. The conclusions are presented in sections that outline results based on sign types, on visit motivation, and then on the theories that underlie learning in zoos, including the use of signs as advanced organizers (Ausubel, 1960, 1963), as elements to trigger social interaction and learning (Vygotsky, 1962, 1978), and naturalist intelligence (Gardner, 1999).

Conclusions based on visitor use by sign types. The four sign treatments tested at Lowry Park Zoo, while not statistically differentiated, show consistent similarities in influencing visitor experience.

1. Removal of signs, as had been suggested by the concept of signs as Ausubelian advanced organizers (Ausubel, 1960, 1963; Falk & Dierking, 2000), limited the number of visitors who realized there was something to see in the red-tailed hawk/sandhill crane exhibit at Lowry Park Zoo.

2. While signs with words only function as advanced organizers, no visitors were observed reading these signs aloud. Fewer engagements were observed when this treatment was in place. With fewer engagements, the ripple effect (Bashaw & Maple, 2001) played a smaller role in between-visitor group assistance with seeing animals.
This phenomenon, where visitors were triggered to look for animals as a result of seeing other visitors pointing, photographing, or looking intently, was observed at both zoos. The data from Lowry Park Zoo, suggest that this type of sign is better than no sign, but does not function as effectively as other sign types as a bridge between visitors and the animal collection.

3. For visitors who read English, combination signs were very effective. The signs with both words and images functioned well as an advanced organizer for visitors. At Lowry Park Zoo, many visitors were observed read these signs aloud. It is possible that this combination sign appealed and was functional for visitors whose strongest propensity among the multiple intelligences (Gardner, 1983, 1999) includes linguistic intelligence as well as the spatial, bodily-kinesthetic, and interpersonal intelligences, presumed to be related to the use of the drawings on the signs and thought to be linked to naturalist intelligence based on writings by Gardner et al. (2001) and Binford (2001).

4. The wordless signs were effective for a number of the non-reading visitors at the zoo, including pre-literature children, visitors whose ability to read English was limited, and the visitors who glanced at signs and were able to interpret the message from the picture more rapidly than they would have been able to read a semantically equivalent message in words.

The observations and conversations with visitors added unanticipated insight. The attention paid to signs by Lowry Park Zoo visitors was noted by the numerous comments about “new signs” being in place at the exhibit. While many visitors did not read the new signs, they commented on the change and often on the efforts of the zoo to improve visitor experience.
The impact of signs on self-perceived education, however, is reflected best in the response of one group of visitors. The visitors, who had an annual pass at Lowry Park Zoo and were frequent zoo visitors, commented that they had “learned” at the zoo on their first visit, but on subsequent visits they knew about the animals and did not feel repeat visits were educational, rather “for fun.” These visitors, however, went on to describe numerous things they had “noticed” this visit, including their first sighting of the red-tailed hawk.

In a discussion of this visitor conversation with Craig Pugh, Lowry Park Zoo, Pugh mentioned that he knew of researchers who had encountered similar problems with visitors and the concept of learning in the zoo. He reported that the use of the words “discover” or “find out” rather than “learn” would provide the desired information. This was tested during the Lowry Park Zoo study, but when asking adults if they had “discovered” anything new at the zoo, most replied, “No, I didn’t learn anything.”

Such responses, and the interest of researchers who investigate the impact of informal or free-choice learning in zoos and museums, suggest that the concepts of “learning” and “education” are articulated and understood very differently by visitors and zoo educators and researchers.

**Visit motivation.** Beyond these findings about the four sign treatments, information from the study on visit motivation is of considerable difference and that visitor responses and observations of visitor behavior do not always lead to the same conclusions.

A conversation with one Lowry Park Zoo visitor is an example of this challenge in evaluating research findings. In the course of the Lowry Park Zoo study, an elderly man entered the exhibit area by himself and was systematically chosen both for observation and for survey. He was seen throughout the day, returning to the red-tailed hawk/sandhill crane on three separate occasions. Each time he was alone. When asked why he was at the zoo,
however, he replied, “To spend time with my family.” He went on to describe, quite fondly, that he lived in Tampa and was bringing his visiting daughter and grandchildren to the zoo as a special way for all of them to enjoy a day together.

With this cautionary tale, the largest single response by Lowry Park Zoo visitors (38%) stated they visited the zoo to see animals. Other popular reasons for being at the zoo included entertaining out-of-town guests (18%), spending time with family or friends (16.5%), with having a good time and the positive effects of a zoo visit on children each being responsible for 5.5% of visitors. At Knoxville Zoo, most visitors came to spend time with family and friends (70%). At Knoxville Zoo, fewer than 2% said they came to see animals, none stated they were bringing out-of-town visitors, came to have a good time, or that the zoo visit was good for children. Home schooling is common in that region and 3% of the visitor groups interviewed stated they came to the zoo for educational purposes, a response not encountered at Lowry Park Zoo.

The Knoxville Zoo visitor responses more closely match reports by Mills (Kevin Mills, personal communication, September 23, 2004) on his research, which has determined that most zoo visitors (52%) come to spend time with family and friends. Visitors at both zoos support Falk’s (personal communication, 19 April 2004) “deep reasons” that visitors come to a zoo:

5. It is an element of good parenting
6. It is for social reasons (a good time with family and friends)
7. It fits their personal ideals
8. The zoo is where people recharge in a similar manner as ritual and religion function.
Despite these differences and conflicting reasons for zoo visits discovered in the literature review, this researcher believes there is some innate attraction to animals that is not being articulated by visitors. Perhaps the questions seeking such information are not effective or in situ interviews do not provide visitors sufficient time to explore their personal reasons beyond a rapid and perhaps shallow response.

What then is it that zoos, aquariums, nature centers, and drive-through safari experiences share? To many people who work in zoos, these institutions are home to the animals who are touchstones of the human relationship with the natural world. Through time spent with animals, whether the intimate interactions with a family pet or the more distant observations of exotic offerings at the zoo, many people find special meaning in the company of creatures. It is in this company where many find a unique definition not only of what it means to be human, but what it means to be human in the context of all living creatures.

It is this contextual relationship between humans and animals, especially in the sometimes artificial environment of a zoo, about which this study has found unanticipated meaning. The study noted that the dynamic perspective of humanity and its relationship to the natural world is reflected by, and perhaps prompted by, changes in zoos as they have developed from menageries to conservation parks.

At the royal menagerie, visitors were separated from animals not only by bars, but by the constraints of class within their culture. The prevailing class structures separated the royals from their subjects as effectively as the bars kept the animals at bay.

The scientific zoo of the 19th Century, which began in 1828 with the opening of the London Zoo, was a reflection of the Age of Science where nature was, for the first time, seen as organic, vital, and living. The growing interest in natural history led both scientists
and visitors to see animals as a fascinating and intricate object of study—a world created on logic, not for the romanticized beauty in nature. The scientific zoo of the 19th Century was built on a drive to understand the natural world. This was the blossoming of scholarship, especially the focus on taxonomy, which created new foundations for science, especially geology, biology, botany, and organic chemistry.

As the first efforts of the Age of Science were overtaken by the Industrial Revolution and the Victorian Age, other zoos opened to the public, often on the scientific model of the London Zoo. Certainly Victorian sensibilities, driven by a strong dose of Genesis and based on the belief that humans were the planet’s only sentient beings, were reflected by studies of the collections in zoos that served to confirm dominion over creatures of the earth just as colonial expansion was reaching its zenith of dominion over other cultures and other lands. The analogy of dominionism between a bear pit where visitors look down on the animals and the enforced servitude of indigenous cultures to colonial overlords is striking. As illustrated in a picture of Paul Schebesta (Schebesta, 1977, reprint of 1933 edition) with the Mbuti of the Ituri forest, animals and non-whites were curiosities that might amuse or entertain, but they were both physically and socially positioned below the self-proclaimed pinnacle of European civilization.

By the 20th Century, the modern zoo with barless exhibits patented by Carl Hagenbeck, Jr., in 1896, removed the visual barriers and prison-like trappings so that animals appeared to be free. However, this exhibit technique put a distance between zoo visitors and animals that removed the intimate contact that had been possible between visitors and animals in cages.

During the 20th Century, technology and design combined forces to cut the distance with glass and plastic barriers. Soon moats were replaced by glass and the nose-to-nose
contact with creatures was once again part of the zoo experience. The glass, however, sanitized the zoo exhibit. Animals were transformed from living entities—nature red at tooth and claw—to more closely resemble the ephemeral images captured on television.

Further research is needed to refine and explore such suppositions, but these ideas have arisen from the exploration of visitor experience in this study and the apparently significant impact that zoos and time spent with animals during a zoo visit have on some visitors.

While these ideas arise in the context of investigating interpretive signage, this researcher speculates it is the subliminal communications, the stories rooted in ambiance and exhibit design, that have the most profound impact on visitor experience and, in turn, on the motivation for repeat visits to a zoo. At least for the researcher and for many zoo staff and visitors, there is something special about the time spent in the company of creatures. And it is an area of research that could have substantial impact on zoo management if a better understanding of visit motivation were to be discovered.

*Signs as Advanced Organizers.* The concept of signs as advanced organizers is discussed in the literature for museums. While not discovered in the literature on zoo-based research, both observations and surveys support the premise that this is a significant function for signs. The presence of signs is such a strong signal that there is something to see, that it is not unusual to note visitors peering in exhibits that have been marked “Animals not on exhibit.” This suggests, based on a recent observation at the Rio Grande Zoo, Albuquerque, New Mexico, that visitors have only noticed the sign, not read the content. Perhaps it would be more effective when animals are removed from exhibit to remove all signage, rather than adding signage when animals are not present.
Social interaction and learning. The social interaction and Vygotskian learning from more capable peers was often noted during the study. The implications of this are far reaching. In addition to the use of staff and volunteers who are assigned to interact with visitors, the visitor-to-visitor interaction is deeply interesting. While observed to have the greatest temporal depth at the Knoxville Zoo sandbox, the ripple effect and intergroup conversations were seen to assist many visitors in locating animals on exhibit, using exhibit elements, or making personal meaning from the zoo experience. Such interactions are presumed to add value to the zoo visit, both for the visitors whose experience is enhanced by encountering more capable peers and for the more capable peers who are able to assume the role of teacher/expert.

Naturalist intelligence. In the course of this study, the researcher has spoken not only to visitors at the two zoos studied, but made informal observations as a fellow visitor at other AZA-accredited institutions and a profit-based animal attraction, Butterfly World in South Florida.

Despite the comparatively expensive admission price at Butterfly World, the researcher saw the same deep appreciation of nature from some visitors and a profound lack of understanding from other visitors, of what behaviors they needed to perform to see animals. On one visit to the hummingbird aviary at Butterfly World, a father and three children came racing through. The father promised a trip to a fast-food restaurant with a treat for the first child to see a hummingbird. A few minutes later, after frenetic exploration of the visitor pathways, the family left without seeing a bird. During that time, the researcher was able to observe not only these family interactions, but also saw several dozen birds.
The diagnosis of such an experience, supported by the literature and by research findings at the two zoos in the study, suggests that there is a lack of naturalist intelligence in some visitors. They may share some of Falk's deeper meanings of a zoo visit, notably an interest good parenting, but they are unable to empower either themselves or their children to experience the very animals they were motivated to visit.

How can naturalist intelligence be honed or taught? For children, whose visual acuity may preclude them spotting or identifying animals in a complex habitat, the benefits of a children's zoo where seeing animals is combined with the tactile experience of a contact yard may be a step toward developing an interest in or understanding of animals. When combined with play elements that open children to a broader array of experiences, such as the plastic frogs in the water feature at Kids Cove, Knoxville Zoo, the empathic experience with nature described by Sobel (1995, 1999) is made possible.

The nests and egg interactives in the Kids Cove aviary served to have children, most often in a family group, discuss parenting in the animal world and make comparisons between that relationship in birds and in human families. While not specifically honing naturalist intelligence, these experiences begin to create an awareness of nature that might not have been made without the zoo visit. An important conclusion of the study, in the opinion of the researcher, was a Lowry Park Zoo visitor who most succinctly stated the major finding of the study:

"Until these signs, no one ever showed me how to see animals."

While this research was initiated knowing that many visitors did not see animals on exhibit, it was the view of the researcher that the innovation of the study was the use of wordless graphics, not the concept of showing visitors how to see animals in exhibits.
The idea of teaching visitors to see animals is one not articulated by zoo educators, at least not in the literature reviewed for this research. It may be of paramount importance to visitors, and may well be the first step that zoos must take in creating a curriculum that helps in the development of naturalist intelligence and the understanding of and lasting appreciation for the natural world.

Whether or not zoos find the idea of wordless signs an acceptable manner of education for their visitors, the above statement by a Lowry Park Zoo visitor supports the importance of helping visitors see the very creatures that inspire the existence of zoos and the personal and professional commitment shown by zoo staff. However, wordless signs are shown in this study to enable some visitors to experience the wonder of animals and in this way, the research has met the expectations of the researcher.

Recommendations for further research

Although there are countless projects that could investigate the efficacy of zoo signs, there were more substantive questions brought out through a variety of discussions with zoo colleagues, at national conference, and by knowledgeable visitors. These questions go directly to the heart of a zoo's conservation mission.

Why, with a new understanding of animals both by the scientific community and by visitors who learn from Discovery Channel and Animal Planet, with exhibit experiences never before possible without modern building materials and technology, and the wonders of a world of nature at less than arm's length, are zoos not producing thousands of committed environmentalists, spurred to leave the zoo and go forth to protect the planet?

There's no simple answer to that. But it is a question that absorbs the best minds in the zoo world. It has been a question that has been touched on by hours of conversation in the course of this dissertation, with both zoo visitors and zoo staff. Despite a differing
perspective, the two groups provide insight—albeit conflicting at times—about the meaning of zoos to staff and to visitors.

Speak with the staff of any zoo, and you will be told that the innate connection keepers feel with the animals in their care does not exist for most visitors. You will hear firm conviction that urban life and a technology-based society have destroyed the once intimate relationship between humans and the creatures whose world we share.

Certainly there is anecdotal evidence to support these observations. There were visitors interviewed in this study who were unable to see animals in exhibits. These were people, who with prompting could not articulate the idea that since birds fly, it might be a good idea to look for them in trees. In other instances, in this study and elsewhere, the disconnect between visitors and nature were illustrated by the failure of some visitors to see any animals that were camouflaged or outside of common sight lines. For many of the people who come to the zoo, anything above or below the casual glance might well not exist.

There were visitors, however, who did see the animals. Some were the visitors who could speak knowledgeably and at length on their passion for nature, and their joy in coming to the zoo to see animals from around the world. Other visitors who saw animals lacked that knowledge of nature. Being attuned with nature appeared to have little to do with the uniformly urban/suburban lifestyle of these visitors or with love and/or knowledge of animals.

At least speculatively, it would seem Gardner’s naturalist intelligence provides insight into the visitor experience. In attempt for Knoxville Zoo to better understand their visitors, the zoo provided a number of zoo members with the opportunity to fill out the instrument (see Appendix B, adapted from Rose & Nicholl, 1998) “How are you smart? Although the sample size and selection of visitors was not adequate to provide a valid base for
conclusions, the responses indicate unexpected variety in zoo members. Although these people support the zoo, their reasons for zoo membership are not quantified. Anecdotal information reports that some join to spend time nature and others find zoo membership ($75 for unlimited year-long admission for a family of four) as an economical recreational experience. Given reservations on the quality of data, it is still of interest to look at the results of the zoo’s survey.

The highest ranked intelligence was linguistic, not surprising since it is the academic intelligence most valued by the educational system in this country. Ranking of other intelligences was not as anticipated. The range in scores is shown in parentheses, with 10 being the highest score (n=19).

1. Linguistic (range of scores is 2-10)
2. Musical (range of scores is 0-9)
3. Naturalist (range of scores is 1-10)
4/5. Spatial (range of scores is 1-10) and Logical-mathematical (range of scores is 1-9) (Tie)
6. Intrapersonal (range of scores is 0-10)
7. Interpersonal (range of scores is 1-8)
8. Bodily-kinesthetic (range of scores is 0-9)

The high ranking of musical intelligence may confirm a study by Dewey-Platt (1999), who suggested that “the soundscape is as important as the landscape” to zoo and museum visitors. Soundscape has become an increasingly common part of the zoo experience, with the addition of running water, habitat sounds, or culturally related music as common ways to integrate soundscape in the visit experience. While usually added for “ambiance,” Dewey-
of visitors come to the zoo to have a good time with family and friends, and with 70% of Knoxville Zoo visitors providing that response in the research conducted for this study, one would expect that interpersonal intelligence would be more prevalent in zoo visitors. Additionally, the peer-to-peer learning that was observed suggest that at least in the zoo, inter- and intra-group communication is frequent and effective.

Again, this information is based on an inadequate sample size and a haphazard selection of members, but it suggests there is more at play in a zoo visit than currently suggested by AZA or perceived by most zoo staff. A more carefully design study of multiple intelligences, across zoo visitors, zoo staff, zoo members, and the general public who do not visit zoos, would provide a better basis for understanding the importance of naturalist intelligence in modern culture, and its development or enhancement related to zoo visits and other educational experiences that explore conservation, the environment, basic biology, and natural history.

Implications

The implications of this study are several:

1. Since signs, even wordless signs, do not reach all visitors, zoos must continue to look for additional ways to fulfill their educational mission and goal of an informed populace able to make considered decisions about the environment and conservation. Any research that attempts to fill this gap between what visitors know and what zoo staff would like them to know is of considerable
importance. Since this gap so closely matches the Vygotskian zone of proximal development, it may be of use to expand on research based on Vygotsky's work.

2. Because many visitors are at the zoo for recreational and other non-educational motivations, the importance of the subliminal educational elements attached to exhibit design deserve extensive study. At Knoxville Zoo, the zoo story is designed to be a polyphonic narrative, with the environment (including exhibit design) given a voice as strong as that of any formal narrative device such as a sign.

3. In the long-held opinion of this researcher, the animals themselves are the most effective educators at a zoo. They are not, however, able to inspire children or adults with the wonder of nature until visitors are able to see animals in a zoo exhibit. Given the findings of this research and the fact that many visitors are unable to see animals either in the zoo or report a similar problem in the wild, a comprehensive exploration of naturalist intelligence would seem to be in the interest of AZA-accredited zoos as well as the myriad other organizations interested in promoting conservation and environmental literacy. It may well be that teaching visitors to see animals is the first step toward honing naturalist intelligence.

Final summary

An investigation of innovative interpretive graphics was conducted at two AZA-accredited zoos, Lowry Park Zoo, Tampa, Florida and Knoxville Zoo, Knoxville, Tennessee. The Lowry Park Zoo study included the testing of four sign treatments:

- No signs
• Signs with words only

• Combination signs

• Wordless signs

In the study that investigated two signs in each of four treatments at an exhibit holding a red-tailed hawk and two sandhill cranes, combination signs and wordless signs were more effective in terms of visitors seeing the animals on exhibit, increasing holding time, and number of engagement activities, but the data overwhelmed the statistical processes so it is not possible to comment on its significance. With this limitation, descriptive statistics including frequencies and means show that combination signs were more effective than wordless signs for Lowry Park Zoo visitors, helping visitors see animals, spend longer time at the exhibit, and engagement in more activities related to the exhibit.

A second study, at Knoxville Zoo, tested the combination and wordless signs in a children’s zoo, Kids Cove. This study included 31 signs across a 3.5-acre exhibit. Again the data overwhelmed the statistical processes, but based on comparison of seeing the animals/using the exhibit element, holding time, and engagement activities, the wordless signs were more effective than combination signs in all but five locations in the children’s zoo, where the combination signs were more effective than wordless signs.

Visit motivation differed greatly between the zoos, with visitors from Lowry Park Zoo more often articulating their reason for a visit as wanting to see animals. The visitors at Knoxville Zoo were closer to the answers found in AZA-sponsored researcher with more saying they were at the zoo to spend time with family and friends than for other reasons.

The differences in potential for naturalist intelligence as indicated by survey questions were probably related to part of the country rather than to innate differences in naturalist intelligences. The number of communities in Florida that prohibit pet ownership
or limit it to pets weighing under 15 to 25 pounds could easily account for the lower number of people who have pets in that state. In Tennessee, however, there are few regulations on pet ownership.

Although the quantitative elements of the study were useful in providing insight into visitor behavior and exhibit use, especially sign use, it was the qualitative information that provided the richest source of meaning found in the study. There is no doubt that both institutions are beloved by visitors, especially by those visitors who feel the greatest sense of ownership in the institutions: members and annual pass holders.

At both institutions, visitor behaviors were noted that supported the educational theories on which the research was based. The importance of signs as advanced organizers (Ausubel, 1960, 1963) was shown when signs were removed at the bird exhibit at Lowry Park Zoo. Social interaction, especially between parents and children, and between visitors and more capable peers was noted at both zoos. While most significantly seen at the Knoxville Zoo sandbox, the ripple effect and between group conversations were noted at both institutions.

If, as the researcher posits, naturalist intelligence is necessary for visitors to see animals in exhibits, visitors run a continuum. Some are unable to see animals with signs and with assistance from other visitors; others see animals with little difficulty. The importance of honing naturalist intelligence was perhaps best stated by a visitor at Lowry Park Zoo, who commented on the wordless signs, saying, “No one has ever shown me how to see animals.” This potential for honing naturalist intelligence may be the key finding of this study and should be considered as zoos work to connect their visitors with the creatures in their collections.
Appendix A

Investigation of Multiple Intelligences Graphics Use in Zoos

IMIGUZ

Lowry Park Zoo
IMIGUZ (Inventory of Multiple Intelligence Graphics Use in Zoos)

Date ____________________________

Entry point: Manatee/Conservation show

Generations: child parent grandparent

# in group _______ _______ _______

Gender: _______ _______ _______

### Action | Crane | Hawk
--- | --- | ---
Pause at Manatee exit | | |
Smoke/mold/wait | | |
Read sign/not read | | |
Point at animal | | |
Act out sign | | |
Group conversation | | |
Beyond group conv. | | |
Lean at fence | | |
Smile | | |
Laugh | | |
Nodding head | | |
Shaking head | | |
Lean forward | | |
Other | | |
Other | | |
Other | | |
Holding time | | |

Why did you come to the zoo today?
- animals/nature/good time/
- exercise/cheap/spend time with family/spend time with friends/other/out-of-town guests/good for children/

Who is in your group? Family/friends/extended family/out-of-towners/other

Are you Local/Out of town?

Are you an annual passholder? Y/N

Did you see the birds in the exhibit?

Do you go to other zoos/aquariums/Busch Gardens?

Do you have pets?

Do you garden or have houseplants?

Do you think conservation is an important issue?

Do you recycle or do other activities that support conservation?

Is there anything you'd like me to tell the zoo administration?

Notes:
Appendix B

How are you smart?

A tool for investigating propensity for multiple intelligences

(adapted from Rose & Nicholl, 1998)
How are you smart?

This test based on multiple intelligences can give insight into your strengths. Check each statement which applies to you and add the totals (adapted from Rose & Nicholl, 1998)

**Linguistic**
1. You enjoy word play. Making puns, tongue-twisters, limericks.
2. You read everything—books, magazines, newspapers, even product labels.
3. You can easily express yourself either orally or in writing, i.e. you’re a good story-teller or writer.
4. You pepper your conversation with frequent allusions to things you’ve read or heard.
5. You like to do crosswords, play Scrabble or have a go at other word puzzles.
6. People sometimes have to ask you to explain a word you’ve used.
7. In school you preferred subjects such as English, history and social studies.
8. You can hold your own in verbal arguments or debates.
9. You like to talk through problems, explain solutions, ask questions.
10. You can readily absorb information from the radio or audio cassettes.

**Total:**

**Logical-Mathematical**
1. You enjoy working with numbers and can do mental calculations.
2. You’re interested in new scientific advances.
3. You can easily balance your checkbook; do the household budget.
4. You like to put together a detailed itinerary for vacations or business trips.
5. You enjoy the challenge of brain teasers or other puzzles that require logical thinking.
6. You tend to find the logical flaws in things people say and do.
7. Math and science were among your favorite subjects in school.
8. You can find specific examples to support a general point of view.
10. You need to categorize, group or quantify things to properly appreciate their relevance.

**Total:**

**Visual-Spatial**
1. You have an appreciation of the arts.
2. You tend to make a visual record of events with a camera or camcorder.
3. You find yourself doodling when taking notes or thinking through something.
4. You have no problem reading maps and navigating.
5. You enjoy visual games such as jigsaw puzzles and mazes.
6. You’re quite adept at taking things apart and putting them back together.
7. In school you liked lessons in art and preferred geometry to algebra.
8. You often make your point by providing a diagram or drawing.
9. You can visualize how things look from a different perspective.
10. You prefer reading material that is heavily illustrated.

**Total:**
Bodily-Kinesthetic
1. You take part in a sport or regularly perform some kind of physical exercise.
2. You're quite adept at 'do-it-yourself.'
3. You like to think through problems while walking or running.
4. You don’t mind getting up on the dance floor.
5. You like the most thrilling rides at the fun fair.
6. You need to physically handle something to fully understand it.
7. The most enjoyable classes in school were PE and any handicrafts lessons.
8. You use hand gestures or other kinds of body language to express yourself.
9. You like rough and tumble play with children.
10. You need to tackle a new learning experience ‘hands on’ rather than reading a manual or watching a video.

Total:

Musical
1. You can play a musical instrument.
2. You can manage to sing on key.
3. Usually, you can remember a tune after hearing it just a couple of times.
4. You often listen to music at home and in your car.
5. You find yourself tapping in time to music.
6. You can identify different musical instruments.
7. Theme music or commercial jingles often pop into your head.
8. You can’t imagine life without music.
9. You often whistle or hum a tune.
10. You like a musical background when you’re working.

Total:

Interpersonal
1. You enjoy working with other people as part of a group or committee.
2. You take great pride in being a mentor to someone else.
3. People tend to come to you for advice.
4. You prefer team sports—such as basketball, softball, soccer, football—to individual sports such as swimming and running.
5. You like games involving other people—bridge, Monopoly, Trivial Pursuit.
6. You’re a social butterfly. You would rather be at a party rather than home watching television.
7. You have several very close personal friends.
8. You communicate well with people and can help resolve disputes.
9. You have no hesitation in taking the lead; showing other people how to get things done.
10. You talk over problems with others rather than trying to resolve them by yourself.

Total:
Intrapersonal
1. You keep a personal diary or log to record your innermost thoughts.
2. You often spend ‘quiet time’ reflecting on the important issues in your life.
3. You have set your own goals—you know where you’re going.
4. You are an independent thinker—you know your own mind, make up your own mind.
5. You have a private hobby or interest which you don’t really share with anyone else.
6. You like to go fishing by yourself or take a solitary hike. You’re happy with your own company.
7. Your idea of a good vacation is an isolated hilltop cabin rather than a five-star resort and lots of people.
8. You have a realistic idea of your own strengths and weaknesses.
9. You have attended self-improvement workshops or been through some kind of counseling to learn more about yourself.
10. You work for yourself—or have seriously contemplated ‘doing your own thing.’

Total:

Naturalist
1. You keep or like pets.
2. You can recognize and name many different types of trees, flowers and plants.
3. You have an interest in and good knowledge of how the body works—where the main internal organs are, for example, and you keep abreast on health issues.
4. You are conscious of tracks, nests and wildlife while on a walk and can ‘read’ weather signs.
5. You could envision yourself as a farmer or maybe you like to fish.
6. You are a keen gardener.
7. You have an understanding of, and interest in, the main global environmental issues.
8. You keep reasonably informed about developments in astronomy, the origins of the universe and the evolution of life.
9. You are interested in social issues, psychology and human motivations.
10. You consider that conservation of resources and achieving sustainable growth are two of the biggest issues of our times.

Total:

Compare the totals from all eight intelligences and you will readily see your greatest strengths and weaknesses. The higher your score, the more you favor that particular intelligence.
Appendix C

Samples of all signs used during study

at

Lowry Park Zoo, Tampa, Florida

and

Knoxville Zoo, Knoxville, Tennessee
Look Down!
Sandhill cranes fly, but they feed on the ground, eating seeds, leaves, and insects.

Figure C1. Sandhill cranes are the largest birds in the exhibit studied at Lowry Park Zoo.
Look Up!
Red-tailed hawks often perch in trees, watching for lizards and mice to eat. If the hawk isn't in the tree, look on stumps and rocks.

Figure C2. The red-tailed hawk sits in the tree above visitors at Lowry Park Zoo.
Peek at a pig!
Early settlers to East Tennessee brought Guinea hogs—the most common pigs on family farms and homesteads in the 1800s.

Figure C3. Guinea hogs are the first exhibit visitors encounter in Kids Cove, Knoxville Zoo.
Milk a cow!
Life on a family farm had cows to milk twice each day. The milk was used to make butter, cheese, and buttermilk.

Figure C4. The milking cow interactive is a few steps beyond the exhibit housing the Guinea hogs. The cow sits at the entrance to interactives shown in Figures C5 through C7.
Barn bedrooms!
On the farm, animals spent days outside and slept in the barn. Zoo animals use the barn during day, and sleep here at night. Is someone napping now?

Figure C5. Behind the milking cow interactive, an open window allows a view of the interior of the barn. Goats and sheep rotate in and out of the barn throughout the day.
Dress up!
What does a farmer wear? What does a zookeeper wear? Put on your imagination and discover what it feels like to care for animals.

Figure C6. A line of clothes, boots, and mirrors are placed along the barn wall to encourage role playing as both farmer and zookeeper.
Travel time!
How do you get to the store? Pioneer families often took the buckboard, pulled by horses, for a trip to town or a visit with neighbors.

Figure C7. A buckboard is attached to the barn wall. The wheels turn and saddles on saw horses stand in front of the buckboard.
Farmyard friends!
Goats, sheep, and cows were important on East Tennessee farms. These animals provided milk, butter, and cheese, plus wool and meat.

Figure C8. The entrance to the contact yard, where visitors interact with goats and sheep, has hair brushes that visitors can take with them into the contact yard.
Walk like a goat!
Goats can walk—and even run—on narrow ledges. Are you as graceful as a goat? Test your balance here.

Figure C9. Behind the contact yard is a “goat wall” with small ledges where the goats can get above the crowd. A line painted on the floor of the contact yard allows children to practice their balancing skills.
Wash up!
Farmers wash their hands to keep animals and people healthy. You should wash your hands after petting goats and sheep.

Figure C10. Beyond the contact yard, two handwashing stations are available for visitors.
Watch the fun!
Enjoy a moment to rest and relax—or join your kids and grandkids as they explore farm life from an earlier time.

Figure C11. Benches located around Kids Cove provide a resting area for parents and grandparents.
More than 100 children had few toys. They made their fun climbing rocks and exploring nature.

The climbing wall!
More than 100 years ago, farm children had few toys. They made their fun climbing rocks and exploring nature.

Figure C12. Since climbing on exhibit rocks is prohibited in most of the zoo, staff felt a sign was needed to "give permission" to children who wanted to try the climbing wall installed horizontally above a rubber padded surface.
Take flight!
Discover wild birds and be a bird in kid-sized eggs and nests. Enter here for a world of fun and feathers.

Figure C13. The entrance to the aviary was difficult to sign. Some visitors are afraid of birds and choose not to enter. This sign was tested to see if potentially frightened visitors understood they would encounter free-flight birds.
Shoes!
Although many pioneer children spent their days going barefoot, you must put on your shoes before you enter the aviary.

Figure C14. After the opening of Kids Cove, staff discovered children entering the aviary without shoes—having discarded them in the sandbox or the water feature. A potential safety issue results, so this sign replaced the original aviary sign.
A bird’s eye view!
Look in the tree trunk to get a bird’s eye view of the world. Can you see yourself from above?

Figure C15. A periscope in the aviary provides viewers with a bird’s-eye-view of the aviary.
Stretch your wings!
Many birds grow up in nests like this. Stretch your wings and wait for mom to bring a tasty breakfast worm.

Figure C16. The bowl nest, a common shape used by robins and many other songbirds, invites photo opportunities and role playing. One creative dad brought “gummy worms” to feed his daughter.
Cracking up!
Baby birds crack out of their eggs without help from mom. Little birds usually stay in the nest for two weeks or more.

Figure C17. Giant egg shells, painted robin's egg blue, invite additional role playing. Numerous little boys immediately identified the eggs as "dinosaur eggs" rather than bird eggs.
Foot prints!
Have you ever looked at a foot print? Your foot print matches your foot. Knowing that, can you tell what animals walked here?

Figure C18. Casts and molds were used to create this interactive where children match animal feet with footprints pressed into the flat surface.
Knock, knock? Who’s there?
Ever wonder who might live in a hollow tree?
Birds, squirrels, raccoons, and other forest creatures make their homes in hollow trees.

Figure C19. This cavity nest was seldom identified as a nest until animals were added to the illustration. Two enterprising young boys identified the interactive as a volcano, rather than the stump of a tree.
Bird songs!
Can you tell one kind of bird from another? Learn each bird's song and you can identify them without looking.

Figure C20. The rear wall of the aviary has two push button interactives. This one has photographs of birds with push buttons that provide verbal identification and a recording of the bird calls.
Match!
Different birds have different kinds of beaks and feet. Hold down a button in each row to see if you can figure out which match.

Figure C21. The objective of this push button interactive is to match illustrations of a bird’s feet (bottom row), with an illustration of the beak (middle row). Holding down two correct buttons light up the picture of the bird on the top row.
Community pool!
Beavers swim in the pools they create. Other animals use them, too. Deer drink from these pools and ducks swim and feed in them.

Figure C22. Underwater viewing of beavers and the occasional duck engage many visitors.
Living lodge!
Beavers build lodges under their dams. Protected by branches and mud, lined with soft grass, these homes keep beavers and their families warm and safe.

Figure C23. A small room adjacent to the open air underwater viewing of beavers looks in on the lodge where the beavers sleep. Because they are nocturnal, one or more are often napping a few inches from the window.
Humans are not the only creatures who cut down trees. A pair of beavers may take down 400 trees each year.

Logging industry!

Figure C24. The terrestrial view of beavers includes vegetation for them to chew and drag through an opening into their pond.
Nature’s showers!
Early Tennessee settlers did not have running water inside their homes. Would you walk to the waterfall to wash your hands or take a shower?

Figure C25. A waterfall runs down the rocks between the beaver lodge and the terrestrial viewing area. It is a favorite with toddlers and parents, providing an opportunity to get wet, without soaking clothes and shoes.
Leap frog!
Jump aboard these frogs and imagine life among the lily pads. How would you catch a bug for lunch? With a long, sticky tongue.

Figure C26. Three giant frog interactive spit water across the streambed water feature. Children wading in the stream are sprinkled lightly.
Riddle this!
What do big frogs sit on and tadpoles under? Plant your feet firmly on the lily pads to figure out the answer.

Figure C27. Lily pads sit above the water of the stream bed. Children have a choice of staying dry, although few do that unless the weather is inclement.
A gentle touch!
Bunnies and other animals visit Kids Cove. A quiet voice and a gentle touch will help you make friends with the animals.

Figure C28. This sign sits between the rabbit exhibit and the area with stump seating where zookeepers bring bunnies, beavers, and other animals for an up-close—but carefully supervised—encounter with visitors.
Eggs in a basket!

On pioneer farms in Tennessee, a child's chores often included collecting eggs. How many eggs will fit in a basket?

Figure C29. Nest boxes, hay, wooden eggs, and baskets are used by children who seldom appreciate this was daily work for their grandparents.
Animal stories!
Listen to stories, tell stories, read a book, talk to a zoo keeper, or sit quietly to think about the animals of Kids Cove.

Figure C30. In addition to the nest boxes and eggs shown in Figure 49, this area is used for storytelling, a respite from the sun or rain, and a place for a stern parental discussion with a misbehaving child.
Gardens!
Many East Tennessee farms had large gardens.
A kitchen garden was planted with herbs and vegetables, but many pioneer families planted flower gardens, too.

Figure C31. A garden with heritage species of plants has been started behind the chicken coop. Perhaps because the garden is four steps below the coop, few visitors go to visit the plants.
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