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THINKING ABOUT DOLPHINS THINKING

By Jessica Sickler, John Fraser, Sarah Gruber,
Paul Boyle, Tom Webler, Diana Reiss

The Wildlife Conservation Society saves wildlife and wild lands around the world. We do this through science, conservation, education, and the management of the world's largest system of urban wildlife parks, led by the flagship Bronx Zoo. Together, these activities inspire people to imagine wildlife and humans living together sustainably. WCS believes that this work is essential to the integrity of life on Earth.

In designing animal exhibits, zoo and aquarium professionals are faced with an increasingly complex set of demands, hopes, and standards arising from visitor expectations, the scientific and conservation community, and the needs of the animals themselves. In managing an urban system of four zoos and an aquarium, we see no more urgent need than for informal science institutions to involve the social sciences in building our understanding of how to effectively connect people to nature and to make these connections more durable than the length of a particular visit, go deep enough to change attitudes about nature, and migrate beyond the walls of the institution into the actions of peoples' daily lives.

This research project was founded, in part, on our belief that information about dolphin cognition and communication could more successfully engage the public in thinking about this species and wildlife in general. By focusing more attention on the whole animal and providing visitors with new information about the social lives and intelligence of dolphins, particularly in ways that people can relate to their own learning and behavior, we believe they will feel more of a connection to and empathy for the animals. We believe that this approach will encourage people to see dolphins as highly evolved sentient beings deserving of protection from human-caused species decline.

For more information on the Wildlife Conservation Society's audience research program, please write to
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INTRODUCTION

Dolphins have fascinated humans since the earliest pictograms were painted on the walls of caves. The genetic kin of humans and other terrestrial mammals, dolphins separated from the land and followed an evolutionary path back to the sea. Perhaps, what makes them so intriguing to such a broad spectrum of people is their superlative compatibility with the ocean, an environment that is so attractive but foreign to us, and their high level of intelligence, which is obvious even to the non-scientist.

This intrigue with dolphins has made them a historical focus of rising human interest. The overwhelming appeal of this species has led many institutions to display dolphins in exhibits intended to provide educational experiences. It is notable that these exhibits focus principally on the physical prowess and exciting behaviors of dolphins and the training expertise of staff. The result has been an increase in the popularity of dolphins both to visitors and as an evocative visual icon in films, television, and other media.

In a parallel track, during the past few decades, scientists have intensified their efforts to better understand the dolphin mind. This research led to a groundbreaking milestone in 2001. A study conducted at the Wildlife Conservation Society's New York Aquarium demonstrated unequivocally that dolphins are self-aware, a complex, cognitive capacity previously known only in humans and great apes (Reiss & Marino, 2001). This finding stimulated us to consider trends in the design of dolphin exhibits as well as the overall educational content and the effectiveness of social messaging connected with these displays throughout the zoo and aquarium community.

For decades, dolphin exhibits increased in popularity and dolphin husbandry evolved to a highly professional endeavor, especially among accredited institutions. Yet, the basic trend in the creation of marine mammal facilities had been more or less just to build larger and larger pools. Certainly, newer facilities have been generally more "naturalistic," from at least a superficial perspective, but beneath the veneer of artificial rockwork the primary distinguishing feature of each new marine mammal facility has been size. Our research findings on dolphin cognition stimulated interest in finding ways for designing future exhibits that will more comprehensively meet the mental needs of these exciting and intelligent animals and significantly increase the educational outcomes resulting from their display to public audiences.



FLIP LICKLIN AND MINDEN PICTURES

Dolphins

Fish-like in form, and living in a fishy environment, they are clearly so much more than fish—more versatile and intellectual, more entertaining—with knowing eyes and warmth that no fish ever aspired to. (*Stonehouse, 1985*)

On All Fronts

The Wildlife Conservation Society is committed to saving wildlife and wild places throughout the world. We do this through careful science, international conservation, education, and the management of the world's largest system of urban wildlife parks. Together these activities change individual attitudes toward nature and help people imagine wildlife and humans living in sustainable interaction on both a local and a global scale. WCS is committed to this work because we believe it is essential to the integrity of life on Earth.

Over 150 million people visit zoos and aquariums in North America each year. These institutions hold a unique endowment in the form of their diverse living collections, which we feel should be displayed in ways that connect people to nature and involve them in protecting it for future generations. Yet, broad acceptance of the value of this kind of informal science education for accomplishing such outcomes is a relatively recent phenomenon.

Thus, in managing an urban system of four zoos and an aquarium, we see no more urgent need than for informal science institutions to involve the social sciences in building our understanding of how to effectively connect people to nature and to make these connections more durable than the length of a particular visit, go deep enough to change attitudes about nature, and migrate beyond the walls of the institution into the actions of peoples' daily lives.

To that end, while we are confident that our scientific research is advancing knowledge of the mental lives and the cognitive capabilities of dolphins and further benefiting their behavioral husbandry, we have also begun to focus more intensively on the visitors themselves, exploring questions we hope will provide a basis for building a more substantive public understanding of wildlife. As part of this effort, we have begun to investigate the social value people place on our institutions and the experiences in contact with nature that they provide, using this information to inform program and exhibit development. With this publication, we address three primary goals:

- Investigating whether technology can be used effectively to make the science underlying our understanding of wildlife more accessible to general audiences;
- Developing tactics that enhance public concern for animals and motivate them to become personally involved in conservation action;
- Understanding how the perceptions and beliefs our visitors hold as they walk in the door influence their experience of programs and the messages they take away with them, and determining how long this learning lasts.

Project Background

In designing animal exhibits, zoo and aquarium professionals are faced with an increasingly complex set of demands, hopes, and standards arising from visitor expectations, the scientific and conservation community, and the needs of the animals themselves. In addition to this, over the last three decades, researchers have begun to explore the complex perspectives held by people concerning animals in general, and, specifically, animals in captivity (Kellert, 1979, 1980, 1993; Myers & Saunders, 2000, Dierking, Burtnyk, Buchnar & Falk, 2002). Prominent themes that arise from this research include perceived care of the animals (Woods, 2002), empathy towards animals (Myers, Saunders & Birjulin, 2004; Schultz, 2000), desire for proximity to animals (Woods, 2002; Kellert, 1996; Kreger & Mensch, 1995), and desire for the opportunity to interact with animals (Woods, 2002), as goals for a positive visitor experience. However, on the face of it, some of these goals are potentially conflicting: Good animal care may mean the animals are provided space and opportunity to wander out of view, giving visitors less of what they want, and perhaps fewer of the experiences that may lead to greater concern for the animals.

Today, the zoo and aquarium community finds itself attempting to address a crucial question about its mission: Can we ensure that our living collections contribute to public concern for wildlife and motivate conservation action? We believe it is critical for the zoo and aquarium community to address this increasingly complex set of demands, hopes, and standards and to answer this question if we are to fulfill our mission of connecting people with wildlife in

ways that successfully advance more proactive conservation behaviors in the general public.

The Wildlife Conservation Society begins all exhibit projects with an established internal mandate to meet these standards. We require each program and exhibit to be developed in ways that are

- good for animals;
- good for conservation;
- good for visitors;
- good for the zoo and aquarium community.

This IMLS-funded project focused on dolphins, taking advantage of our New York Aquarium’s decision to relocate these collection animals during its facility and program improvement planning project. Unlike past programming in this field, which focused primarily on the live demonstration of dolphin physical prowess, we proposed that a far greater and as yet untapped learning potential could be found in the exhibition of information relating to the amazing cognitive, social, and communicative skills of dolphins. By connecting visitors in compelling ways to these aspects of dolphins and other marine mammals, based on a foundation of good science, we hypothesized that we could inspire increased interest in the animals, the oceans, and science in general, and ultimately, increased concern that would foster a more positive attitude toward preserving life in the seas.

The dolphin provides a fertile subject through which to explore the broader topic of animal intelligence, or cognition, a relatively novel content area for zoos and aquaria. This topic, in turn, offers entry into a unique arena for visitor study. In order to facilitate and inspire conservation concern, we believe it is necessary to identify a range of “ways in” to caring for other species and, ultimately, the planet. Understanding more about the minds of other animals and, especially, being able to make connections between animals and ourselves is one such doorway. Animal intelligence also provides a wonderful opportunity to present science on the frontiers of learning, another important role of zoos and aquariums as public, informal science institutions.

We sought, specifically, to discover methods that would best deliver informal learning experiences on animal intelligence, using dolphins as a model. The methods and technology used by researchers to investigate dolphin intelligence and to study animal cognition and communication are often difficult for the general public to readily understand. Beyond this, dolphins and other marine mammals have evolved radical adaptations in their physical form and sensory systems that are vital to their success in the sea. These adaptations are so different from human attributes that they require innovative and creative presentations in order to be clearly and cogently conveyed. We felt that current technology could provide valuable tools and opportunities to explore new modes of presenting this information. The interpretive goals for this project included finding technological delivery systems that could make these messages accessible to a broad and diverse audience, including those who are not technologically savvy, in order to maximize the educational value of the experience. To that end, we set out to

1. investigate public understanding of the concepts surrounding dolphin intelligence;
2. explore how people form an understanding of the scientific research surrounding animal cognition;
3. survey appropriate methods, technologies, and software to address the effective delivery of this content to diverse public audiences;
4. understand how learning occurs in a free-choice exhibit setting.

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of the [dolphin].**

Project Overview

At the outset, we knew that dolphins have long captured the interest and imagination of the public and scientific community. These charismatic creatures have inspired fascination in those who have observed them in the wild, on screen, and in aquariums. In the last few decades, aquariums have made dolphins the centerpiece of demonstrations that intend to provide educational value, but instead tend to focus on the physical prowess and the trained behaviors of these highly gregarious animals.

This research project was founded, in part, on our belief that information about dolphin cognition and communication could more successfully engage the public in thinking about this species and wildlife in general. By focusing more attention on the whole animal and providing visitors with new information about the social lives and intelligence of dolphins, particularly in ways that people can relate to their own learning and behavior, we postulated that they would come to see dolphins as highly evolved thinking beings and would feel more of a connection to these animals.

A number of researchers have begun to identify the emotional underpinnings of conservation concern (Kals, Schumaker & Montada, 1999; Schulz, 2000; Myers, et al., 2004; Saunders, Myers & Fraser, 2005). With this research, we proposed that by evoking a stronger sense of empathy and affinity for animals we could potentially activate greater overall caring for wildlife in general and motivate further interest in tangible conservation action. By identifying specific ways to evoke and establish this level of empathy and affinity, we sought to uncover the process through which visitors become more interested in the care of marine mammals, as a mechanism to build greater concern for the ocean and nature in general. We also imagined this work might ultimately stimulate a paradigm shift in the way professionals approach the creation of marine mammal exhibits, with interpretative elements that inspire a sense of awe and respect for the animals, including their cognitive abilities. More broadly, we believed this work would suggest similar advances in the design of many other animal exhibits.

We wanted to create a learning environment that would effectively teach our visitors about higher order thinking and communication—taking them beyond the physical prowess and trainability of the animal. One example of the kind of information we believed could potentially enhance visitors' attitudes toward dolphins builds on the work of WCS senior scientist, Diana Reiss. Dr. Reiss' recent groundbreaking research indicated that dolphins recognize themselves in mirrors, a rare ability previously attributed only to humans and the great apes (Reiss & Marino, 2001). Other topics studied in this project include information about dolphin vocal repertoires (McCowan & Reiss, 1997) and striking similarities between how humans, dolphins, and many avian species learn their vocal signals. Another area of Reiss' research provided dolphins with the opportunity to exercise choice and control over some environmental contingencies through the use of an underwater keyboard to communicate with the scientists (Reiss & McCowan, 1993).

In our pilot exhibit, we provided visitors the opportunity to learn about Dr. Reiss' mirror recognition work and to understand its significance. We showed video clips of dolphins using keyboards to obtain a variety of acoustic signals and objects. This exhibit presented information depicting dolphins as active learners capable of discovering new associations without explicit training and showed that, in many ways, they exhibit cognitive and learning abilities that are similar to humans'. We also presented research showing how dolphins have gone beyond mere playfulness to show another rare ability in the animal world—dolphins create their own toys. Video clips showed dolphins creating bubble rings, which they then interact with in a variety of intriguing ways

(Reiss, 1998; McCowan, et al., 2000).

This project was created to explore a model of how dolphins and other marine mammals are presented in exhibitions and understood by the public. To accomplish this, we undertook an extensive, two and a half year research program that

- evaluated the scientific and educational concerns of the marine mammal research community;
- researched current public understanding and beliefs about dolphins;
- evaluated visitor experiences with dolphins in live dolphin shows;
- considered the value of technology and video assets for exhibition potential to effectively convey scientific information to general audiences;
- identified key scientific concepts about animal cognition research appropriate for an aquarium exhibit;
- evaluated how family groups made meaning from film footage and interactive components that presented evidence of dolphin cognition in comparison to similar human cognitive abilities;
- evaluated how a free-choice setting influenced visitor learning of previously identified key scientific concepts about dolphin cognition.

With this project, WCS further expanded the toolbox of designers, aquarium managers, and zoo and aquarium researchers by using a range of evaluative methods to address the following key topics:

1. Dolphin/Marine Mammal Exhibits—As part of a broad strategy to change the way dolphin facilities are built and the animals are exhibited to the public, our in-depth research has applications for both the creation of new exhibits and the enhancement of current exhibits. By demonstrating how to effectively incorporate science and specific information on the mental abilities and behavior of animals, this project can increase the strength of informal science delivery, and foster more concern for the conservation of all oceanic life, by drawing clear and distinct connections between visitors and the animals they see. This research is also applicable to other marine mammals and potentially all big-brained mammals.
2. Technology and Science—The results of our audience-based research provide valuable information on how to use technology dynamically to make scientific research accessible to the general public. This research can be instrumental in building and enhancing any exhibit with educational, intellectually stimulating interfaces designed to improve the value and quality of visitor experience.
3. Education—Our evaluation of audiences and technology applications provides information about three separate learning environments: a) Informal Learning: educational experiences directly related to the exhibit; b) Formal Learning: appropriate classroom education related to an aquarium visit; and c) At-Home Learning: Web site and other media delivery of content. Our findings are predominantly applicable to the first learning environment, but have relevance to all three. The results of the formative evaluation can support practitioners in developing successful curricula and programs.

How Smart? How High?

Since the early days of Flipper, the public's most common question regarding dolphins is "how smart are they?" Yet while dolphin presentations might include the information that dolphins are social, large-brained, and highly intelligent, the majority of shows focus primarily on the physical characteristics and abilities of the species, demonstrations of training or animal husbandry procedures, and some commentary on conservation. The public expectation for viewing dolphins has come to be for higher and higher jumps with little focus on their mental abilities.

Significance of This Work

To Aquarium and Zoo Animals

This research focused specifically on dolphins and their unique cognitive capabilities. While it offers insights to improve public understanding of dolphins, in so doing, it also suggests a new approach to the design of exhibits in ways that will benefit dolphins as well as fostering better public understanding of other ocean wildlife. Similar studies hold equal potential for the benefit of a broad array of zoo and aquarium animals. By focusing more attention on the whole animal and introducing people to the mental capabilities and social behaviors as well as physical abilities of animals, we improve the overall learning environment, make animals more relevant to human activities, and foster a sense of stewardship. By using scientific research to show people similarities between animals and their own behaviors, we can stimulate interest in the broader condition and the protection of animals in the wild.

To the Zoo and Aquarium Community

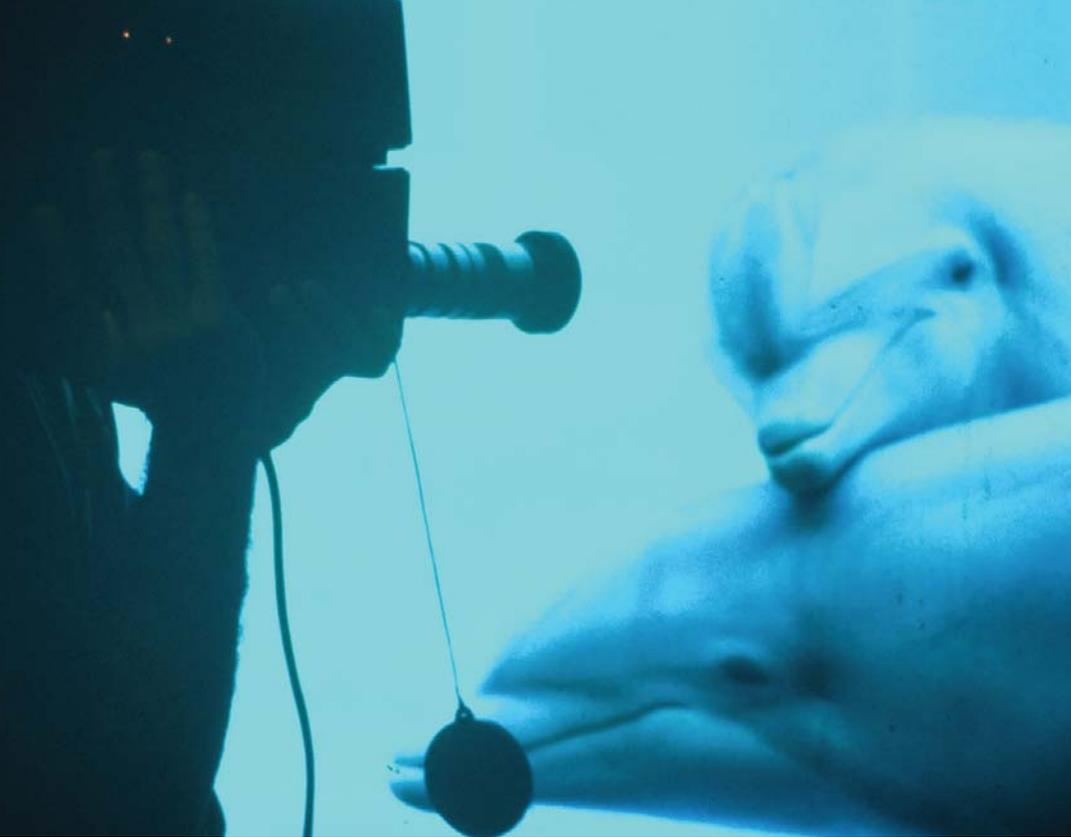
Focused introspection is often somewhat uncomfortable. It sometimes suggests that change is needed, which can be difficult. Yet, as zoos and aquariums shift programs to meet public expectations, it is crucial to openly explore questions about animals in captivity and how our institutions can meaningfully connect people to the environment. Such analyses are vital if we are to succeed in getting people to change their behaviors for the benefit of conservation. The application of social science research will assist zoos and aquariums in creating interpretive elements that inspire a sense of awe and respect for animals and their habitats. It will also allow these institutions to build better understanding of their mission and the relevance of animals and nature in their public community.

To the Public

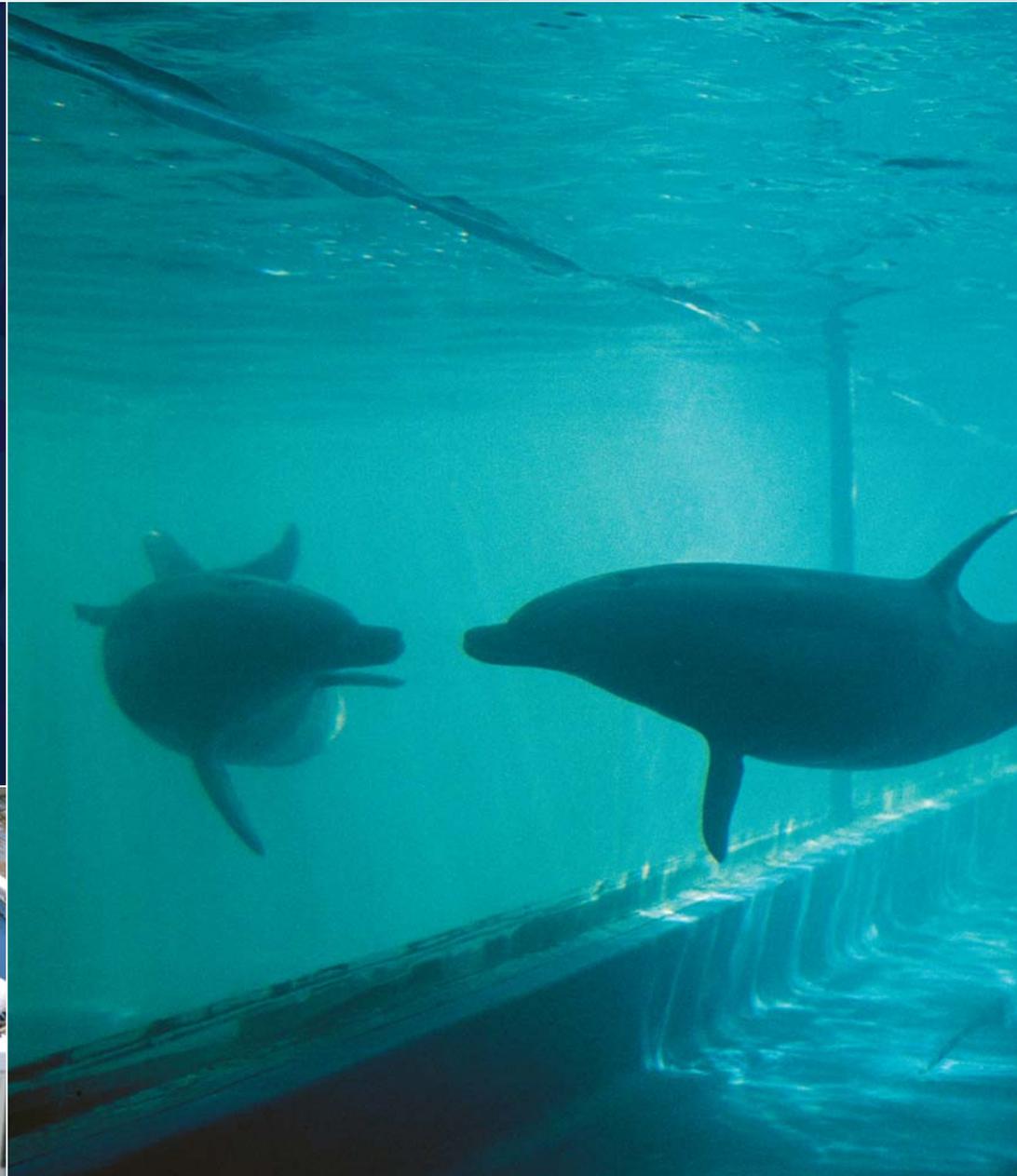
People are becoming increasingly separated from nature (Louv, 2005), yet are also having an increasingly negative impact on the natural world (Sanderson, et al., 2002). Connecting social science research with modern exhibit design, as presented in this report, can lead to a deeper and more lasting public understanding of the importance and sensitivity of wildlife. Ultimately, this outcome holds the potential to connect people to nature more powerfully than has been accomplished in the past. If zoo and aquarium programming can effectively bring people to understand animals, it can stimulate personal involvement in actively protecting animals and wild places for future generations. National trends in the reform of science education tie learning and motivation to attitudes about science. Stimulating interest, engaging students in solving problems, and demonstrating relevance to real life are recommended strategies for creating stronger, more lasting attraction to science. We believe zoos and aquariums can be instrumental in establishing such bridges by using social science research to connect people to animals and nature in dynamic, compelling ways.

What Did We Learn?

1. Visitors do not gain an understanding of dolphin intelligence from dolphin shows alone.
2. Visitors hold a very positive stereotype of dolphins, including their intelligence, but most are unable to describe the extent of that intelligence.
3. Dolphins' ability to communicate is widely recognized and accepted by visitors; it can serve as a highly accessible topic for promoting understanding about dolphin cognition and cognitive research.
4. Along with affective appreciation, science learning about animal intelligence offers an effective tool for promoting conservation concern, and this concern can be evoked with minimal explicit interpretation on the topic.
5. Using technology to explain dolphins' uses of echolocation facilitates increased comprehension of the concept.
6. Aquarium visitors have a practical understanding of dolphins that is generally not mystical in nature; however, they vary in the extent to which they are comfortable with mystical or idealistic characterizations of dolphins. They also vary in their comfort level with negative portrayals of dolphins. These varying comfort levels influence interaction with and learning from exhibit content.
7. Visitors' comprehension of various concepts is confounded by their lack of understanding of the complex nature of these concepts and abilities. That is, they may take for granted those activities that they engage in easily and without awareness (e.g., trial and error learning) and therefore may be less likely to consider these as representing complex cognitive ability.
8. Visitors have a tendency to attribute behaviors that reflect dolphin intelligence to training, particularly when these behaviors are demonstrated by dolphins in aquariums. This misconception can be mitigated by being mindful of context and interpretation in presenting dolphins interacting with humans, and by highlighting dolphin behavior in the wild.
9. One way to increase the accessibility of difficult or less salient concepts about animal intelligence is to correlate these concepts as directly as possible to human intelligence and behavior.
10. There is no such thing as a general public. Understanding the varying perspectives through which visitors interpret an exhibit is critical to ensuring that the exhibit reaches its goals — that there are qualities, features, atmospheres, and content that can appeal to various belief systems. We believe that exploring these belief systems provides invaluable information with which we can build lasting bridges between visitors and the natural world.
11. The perspectives uncovered in this project suggest that social narratives influence how scientific information informs the development of environmental concern. Some visitors will respond from an affective dimension to the subject of dolphin intelligence; these visitors can increase their affective appreciation for the animals at the same time as they explore more scientific information about the animals. Other visitors, who tend to ground their beliefs in scientific evidence from the start, can be encouraged to interact with content that inspires awe and wonder about dolphin abilities, if presented in the context of more comfortable science-based content.
12. Pre-existing visitor perspectives about dolphin intelligence influence which exhibit elements a visitor will focus on. These perspectives also influence how visitors express their concern for these animals.



Like chimpanzee societies, dolphins and other cetacean social groups may show evidence of “culture” that includes tool use and the transmission of information across individuals.



CHAPTER 1

Dolphin Cognitive Research: Applying Scientific Discoveries to Develop Empathy in Visitors

Scientists have captured aspects of the rich cognitive and social life of dolphins through systematic observational and experimental investigations conducted in aquariums, research laboratories, and the field. Reports of the cognitive achievements of bottlenose dolphins (*Tursiops truncatus*) leave little doubt that they are intelligent mammals. This research has challenged traditionally held views of humans as uniquely capable of complex cognition and the Western dualistic belief systems that have historically excluded non-humans from moral and legal codes of conduct (Massanari 1998).

These remarkable findings about dolphins' abilities represent some of the information that inspired the development of this project. Surprising similarities between dolphins' and humans' cognitive capacities seemed rich with opportunities for inspiring empathy and awareness among New York Aquarium visitors. Below, we review some of the more notable scientific discoveries that guided our work.

Longitudinal field studies of bottlenose dolphin groups have indicated that their social organization is a complex fission-fusion type social structure, with complexity rivaling that attributed to chimpanzee societies (Connor & Smolker, 1985; Wells, Scott & Irvine, 1987; Würsig, 1978; Connor, Smolker & Richards, 1992). This complexity has prompted many scientists to refer to dolphin groups in the wild as "societies in the sea." Further evidence of this social complexity is seen in the strong mother-calf bond and unusually long lactation period of at least four years, which has also been suggested as evidence for required learning and social enculturation (Brodie, 1969; Cockcroft & Ross, 1990). Demographics, social structure, and behavioral ecology may vary in different populations, however, the formation and maintenance of social relationships and coalitions seems critical to the social lives of these mammals for collaborative foraging, protection from predators, mating, and the raising of young. Although the existence of "culture" in non-human animal societies is still of great debate, there is a growing literature supporting the hypothesis that, like chimpanzee societies, dolphin and other cetacean social groups may show behavioral variations and evidence of "culture" that include tool use and the transmission of information across individuals (Connor, Mann & Tyack, 1998; Krutzen, et al., 2005).

Dolphins and other cetaceans show many unique cognitive adaptations to a totally aquatic existence. Although dolphins share a number of features of brain organization with other mammals, there are numerous differences between cetacean brains and those of other terrestrial and aquatic mammals (Glezer, Jacobs & Morgane, 1988), including uni-hemispheric sleep patterns (Mukhametov, 1984, for a review) and a high degree of hemispheric independence and asymmetry (Ridgway, 1986, for a review). It has been suggested that this asymmetry may be a consequence of the brain economizing in order to accommodate complex functioning.

Dolphins, like chimpanzees, show advanced capabilities for classifying, remembering, and discovering relationships among events, for forming response rules of general utility, and for manipulating symbols (Herman, 1988, for a review). Notably, dolphins and possibly other cetaceans are vocal learners (Payne, Tack & Payne, 1983; Tyack & Whitehead, 1983; Richards, Woltz & Herman, 1984; Reiss & McCowan, 1993; McCowan & Reiss, 1995). Vocal learning is rare in the animal world and, other than in humans, has only been

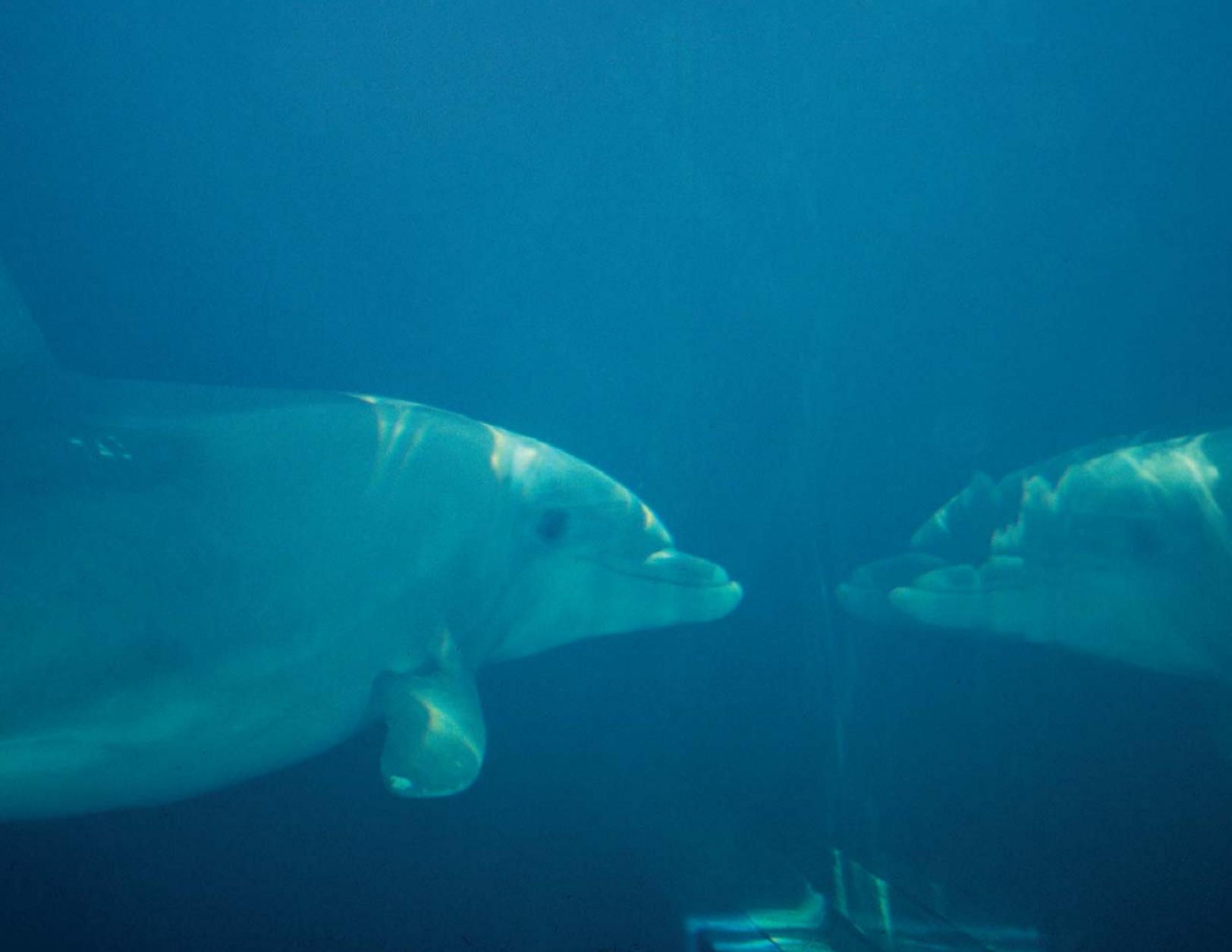
We hypothesize that by highlighting the patterns that connect us to dolphins, we can create empathy and increase concern for individual dolphins, the species, and their environment.

demonstrated in avian species (Marler & Peters, 1982) and possibly in elephants (Poole, Tyack, Stoeger-Horwath & Watwood, 2005). Research on the ontogeny of dolphin whistle repertoires has indicated that dolphins show stages in their early vocal learning, such as imitation, overproduction, babbling, and attrition (Reiss and McCowan, 1993; McCowan and Reiss, 1995) that parallel those previously described for humans and avian species (Marler & Peters, 1982). Finding such parallels in phylogenetically distinct species is striking and suggests a convergence in strategies of vocal learning.

Dolphins are also capable of mirror self-recognition (Reiss & Marino, 2001), an extremely rare capacity in the animal kingdom previously demonstrated only in humans and the great apes. The demonstration of mirror self-recognition in dolphins implies that this ability is not specific to large-brained primates and may be due to more general characteristics, such as a high degree of encephalization and cognitive ability, and represents a striking case of cognitive convergence.

While the state of scientific knowledge about dolphin cognition continues to advance, fostering public acceptance of this research has proven challenging for the scientific community. Epistemological barriers continue to be critical factors in science learning (Cobern, 1991). Dolphins have also emerged as an important shared metaphor about natural human relationships in Western culture (Bryld & Lykke, 1999), which may present an even greater hurdle for science learning.

Conveying knowledge and a clearer understanding about the social and cognitive lives of dolphins to the public can be an effective tool for improved conservation and animal welfare (Aaltola, 2002). It has been proposed that the extent to which people confer moral consideration for animal welfare is related to the degree to which they believe the species is capable of experiencing pain and suffering (Herzog & Galvin, 1997). We hypothesize that by highlighting the patterns that connect us to dolphins—the behavioral and cognitive similarities between our own behavior and that of the dolphin—we can create empathy and increase concern for individual dolphins, the species, and their environment. Thus, the application of cognitive research findings to conservation and animal welfare issues has great potential and may be an effective tool for educating the public and increasing their interest and concern about conservation and animal welfare. We also believe that this education may positively increase public efforts to protect these animals, ensure their survival as a species, and safeguard the waters in which they live.



Informal learning environments, such as the New York Aquarium, have become critical venues for the dissemination of scientific research and information to the general public.



CHAPTER 2

Dolphin Exhibits and the Marine Mammal Research Community

The intersection of the scientific community and the general public is ripe for research, particularly in light of the uneven presentation of science in media and of the signs of failure being seen in our efforts to teach science in the schools (Sullivan, 2002). In order to bridge the gap in the formal school system, informal learning environments, such as the New York Aquarium, have become critical venues for the dissemination of scientific research and information to the general public. Traditionally, zoos and aquariums have relied on the scientific community to highlight the significant research they wish to disseminate, irrespective of any epistemological difficulties the audience may have with the information (Cobern, 1991).

With the goal of moving aquarium visitors' learning beyond the trained behaviors and physical prowess of dolphins, this project sought to identify key areas of discontinuity between public beliefs, current scientific knowledge, and what the marine mammal research community believes about public knowledge.

The goal of this initial qualitative study was to understand how the marine mammal research community values dolphin exhibits and what priorities they hold for the design of such exhibits. The project sought to determine

- what concerns researchers have about how the public understands dolphins;
- in what ways researchers think about public exhibitions and their usefulness;
- what qualities and information researchers feel is important to include in such exhibitions and programs.

Methodology

We interviewed 18 marine mammal researchers, individually or in pairs, who were attending a national research conference on marine mammals (see Box). Responses were recorded, as were participants' names, affiliations, and specific areas of research. The interviews were also videotaped for later transcription.

Responses were initially grouped into categories based on their similarity and frequency, as well as on the questions they addressed (see below). The results were then scored by counting the number of responses that fell into each category. Respondents were initially classified into



DIANA REISS

Dr. Reiss handing ring to Delphi

What's the Question?

The survey included seven questions about the public and dolphin programs and exhibits:

1. What is your greatest concern about what the public sees in dolphin programs?
2. What is your greatest concern about the public's misconceptions about dolphins?
3. If you could design a new dolphin exhibit, what would it be like?
4. What information would it include?
5. What use would it be to you?
6. If it were to include scientific information, what should it include?
7. What is the most amazing thing that you know about dolphins?

More than one-third of the researchers surveyed believed that the public holds a number of misconceptions about dolphins.

two subgroups, because eight of them were personally familiar with the research of the two interviewers. An initial assessment of the two subgroups showed little variation in responses, so we considered all respondents together.

Six of the respondents were interviewed in groups of two. In a few cases, one person in the interview simply agreed with their colleague; in most, each of the researchers responded individually to the questions. We acknowledge that it is possible that the responses of one colleague influenced those of the second, but, based on the thoroughness of most of the responses, and the collegial disagreement within the dyad interviews, we believe paired interviews had little effect on the results.

Results

The categories used for organizing responses were 1) Concerns about Live Dolphin Programs and Public Misconceptions, 2) Designing a New Dolphin Exhibit, and 3) Amazing Things about Dolphins.

Concerns about Live Dolphin Programs and Public Misconceptions

Responses in this category address question 1, concerns about what the public sees in live dolphin programs, and question 2, concerns about public misconceptions about dolphins. The most frequent responses to question 1 were classified as concern about the lack of educational value in these presentations. Nearly three quarters of the researchers interviewed expressed this concern. The quality of the physical dolphin habitats and facilities was the second most prevalent concern, and concerns about animal welfare and animal mental health were third. In addition, one researcher expressed specific disapproval of programs that allow physical contact between visitors and dolphins.

The concern most frequently expressed regarding the public's misconceptions related to the anthropomorphism of dolphins. More than one-third of the researchers surveyed believed that the public generally holds a number of misconceptions about dolphins. These include

- perceptions of dolphins as fun, friendly, and/or non-wild creatures, as unrealistically intelligent, or as mystically significant;
- misconceptions about the intentions of researchers who work with dolphins, leading to negative perceptions and hostility toward dolphin research;
- the diminishment of dolphin intelligence and the perception that the purpose of dolphins is to do tricks for an audience.

Designing a New Dolphin Exhibit

The next series of questions asked researchers to describe their ideal vision for a new dolphin exhibit, from general description to the specific information that it would include. In addressing the first general question on this topic, respondents' descriptions of ideal dolphin exhibits were vivid, detailed, and very diverse. All of the scientists surveyed described features of the dolphin habitat in the exhibit, out of concern for either the quality of life for the animals or the facility requirements for increasing ease of research. Features most commonly mentioned included tank size, depth, shape, structure, location, and viewing opportunities. Beyond their focus on quality habitats, the scientists' leading descriptions were of educational components and of features that would facilitate research and/or medical care for the animals. Other responses included opportunities for interaction among dolphins and husbandry and animal care concerns.

Regarding information to include in such an exhibit, there appeared to be no consensus on specific content. However, there was general agreement on a few

topics. More than 80% of those surveyed indicated that general information about the species was important for such an exhibit. Such information included general biology, behavior, and evolution. In addition, more than half of the researchers indicated that information about conservation issues and/or current dolphin research would be important components of an exhibit. Finally, a few respondents would include information about the following topics: the individual animals on exhibit, sensory capabilities, motor abilities, communication, and cognition.

Question 6 of the survey was a follow-up of question 4, and asked specifically about scientific information that should be part of a new dolphin exhibit. Again, the responses covered a wide range of specific ideas. The most frequent response was to include information about dolphin cognition, learning, and intelligence (with just fewer than half of respondents mentioning these topics). Other information, mentioned by three or four individuals, included species information, human impacts and conservation, information about on-site research, general biology, husbandry, and communication/acoustics. Several other categories were mentioned by just one or two researchers.

With question 5, we inquired about what utility researchers might find in a public dolphin exhibit. Most described its usefulness in terms of their own professional goals. Over half of those surveyed indicated that it would provide a facility for performing research and a venue for informing others about current dolphin research. Other uses mentioned by several scientists were to support conservation efforts and provide the opportunity to educate the public, though they did not elaborate on why such educational goals required a living collection. In addition, the following uses were each mentioned by one researcher: to provide good care for animals; to change public misperceptions; to create empathy in visitors; for human entertainment or recreation; and to make money.

Amazing Things about Dolphins

Finally, the researchers were challenged to state the most amazing thing they know about dolphins. Several of them named more than one quality or fact in their answers, and several others found difficulty answering at all. However, the greatest number of responses to this question (from seven of the researchers) related to dolphins' communication, auditory, and sonar capabilities. Another three researchers indicated amazement about either dolphins' adaptations for life in the water or their social relationships and interactions.

What information would [the exhibit] include?

"...the perception of the animal, not just the echolocation, but their vision and other things and how they might perceive the environment and things that might be important from the dolphin's perspective."

"...what has been learned from studying them in captivity."

"...a history of the study of dolphin intelligence and...of the dolphins themselves...and the studies in the wild of dolphins' natural behavior."

What Did We Learn?

- Dolphin researchers' primary concern is that dolphins in captivity are kept in the best possible physical conditions and that these conditions be established with the research community in mind. While this project did not directly address captive habitat issues, these researchers' concerns represent critical criteria for how scientists will judge a living dolphin exhibit and the institution's reputation as a facility.
- The research community feels that an important purpose of dolphin exhibitions should be to further research goals and to increase support for these projects; therefore, featuring dolphin research prominently in exhibits—presenting researchers in action, working to answer specific questions about dolphin intelligence and other features—would be welcome by members of this community.
- Researchers feel strongly that audiences should be made aware of the relationship between dolphin behavior and capabilities in aquariums and in the lives of the animals in the wild. To address this concern, these scientists appear to want exhibit developers to try to make the connection from the research and concepts featured in an exhibit to the animals in their natural environment, variously explaining what a particular ability or capacity might “look like,” or how dolphins might use the ability or behave in the wild.
- When asked specifically what scientific information to include in an ideal exhibit, researchers most frequently spoke about dolphin intelligence and cognition. And when researchers discussed what they feel is interesting and exciting about dolphins, they most often cited the animals' acoustic and communication abilities. In responding to scientists' concerns, these represent potential organizing ideas for an exhibit about dolphin intelligence, perhaps about animal intelligence in general.
- Many researchers, concerned about misconceptions about and anthropomorphism of dolphins, would like to see basic scientific information about dolphins included in an exhibit.

Dolphins are uniquely characterized in the popular media as fantastic animals ascribed attributes seldom accorded to terrestrial life.



CHAPTER 3

Public Perceptions of Dolphins

Any good educational endeavor develops learning goals and strategies to achieve those goals. Strategies have to start from the existing knowledge and understandings of the intended audience. Consequently, we inquired directly into how likely aquarium visitors perceive and feel about dolphins. In particular, we investigated how ideas related to intelligence fit into the public's existing attitudes towards the animals. We anticipated that people would have different knowledge and different perceptions about dolphin intelligence, and we sought to reveal and categorize these differences so that they could be addressed in the exhibit design.

Our review of the literature found few significant empirical studies that examined public perceptions of dolphins (Kellert, 1999; Herzog & Galvin, 1997; Barney, Mintzes & Yen, 2005). Kellert's (1999) study provided a thorough examination of public opinion about marine mammals and their conservation, finding widespread positive attitudes and support for these animals. As for dolphins, the study found strong concern for their welfare in captivity, but did not examine perceptions about cognitive abilities.

A far smaller study (Barney, et al., 2005) of students in North Carolina drew connections between knowledge of and attitudes towards dolphins. Their study found that higher knowledge scores were related to higher eco-scientific attitudes and lower utilitarian attitudes, although other confounding variables may have contributed to these results. Among descriptors of dolphins used by students, "intelligence" was relatively common, but less so than other physical and habitat characteristics.

Herzog and Galvin (1997) studied public beliefs about the mental capacity of a wide variety of animal species, one of which was dolphins. The study revealed a broad consensus in the perception that dolphins are moderately to highly able in the mental capacities examined in the study. Beyond that, they found that a large number of people felt that dolphins experience mental states at human-like levels, and that concern for animal welfare was related to degree of belief in sentience and affect.

Dolphins, however are also uniquely characterized in the popular media as fantastic animals ascribed attributes seldom accorded to terrestrial life. One study (Bryld & Lykke, 2000) investigated the complexity of these fantasy depictions and the causal roots of these fantasies in unfounded claims published in the 1960s by dolphin researcher John Lilly (Lilly, 1961; 1967), or uses reported by the military (Bryld & Lykke, 2000).

In order to accurately appraise public perceptions and attitudes in the context of aquarium experiences, this project examined the following topics, with methods noted in parentheses:

- Knowledge of and interest in dolphins (survey);
- Recollections of learning at live dolphin displays and programs (survey);
- Socially-agreed upon traits ascribed to dolphins (semantic differential survey);
- Representations of dolphins in popular media and how these representations may promote misconceptions about the animals (media review);
- Social beliefs regarding dolphins' thinking (Q method study).

Public Perceptions

As a first step toward addressing these topics, we conducted an informal survey that investigated how the visiting public understands dolphin cognition, relat-



It seems that aquarium presentations of dolphins are failing to address the public's prior understanding of dolphin intelligence in a meaningful way.

ing it to prior aquarium visitation and other media outlets (N=48). Respondents were interviewed using a set of five questions about their perceptions and knowledge about dolphins:

1. What does “dolphin” mean to you?
2. What do you know about dolphins?
3. Is there one thing you would like to learn more about dolphins?
4. a) Do you remember going to a dolphin show?
b) If yes, what do you remember about dolphins from the show?
5. Where did you find out about dolphins?

We learned several things from this research. First, the majority of our sample is predisposed to think and feel positively about dolphins, describing them with such words as playful, cute, happy, friendly, and peaceful, and most are interested in learning more about them. They are generally aware of dolphins' high level of intelligence, although they may not know the extent of that intelligence or how it is expressed. It also seems that the primary sources of public information about dolphins are television and books.

One area of great concern to our research was the result indicating that viewing live dolphin demonstrations or “shows” primarily leaves the public with an understanding and memory of tricks, training, and physical ability, rather than of an appreciation for the cognitive capabilities of the animals. In this regard, it seems that aquarium presentations of dolphins are failing to address the public's prior understanding of dolphin intelligence in a meaningful way. Similarly, by missing the opportunity to enhance the public's knowledge and appreciation of these animals, they are failing to meet the educational and conservation goals of the aquarium and research communities.

These findings reveal an opportunity for aquariums to focus research on how they might develop presentations that communicate with visitors and access visitors' knowledge in a new way. We propose that by providing visitors with experiences that introduce them to more than the physical, acrobatic capabilities of dolphins, including those related to their cognitive abilities, aquariums can meet several goals at once. Such programs could build on the visitor's experience and perception of dolphins as intelligent creatures, as well as on their desire to learn more about this animal. In this way, these exhibits would also more directly address the goals of education and conservation that are central to both the aquarium and research communities.

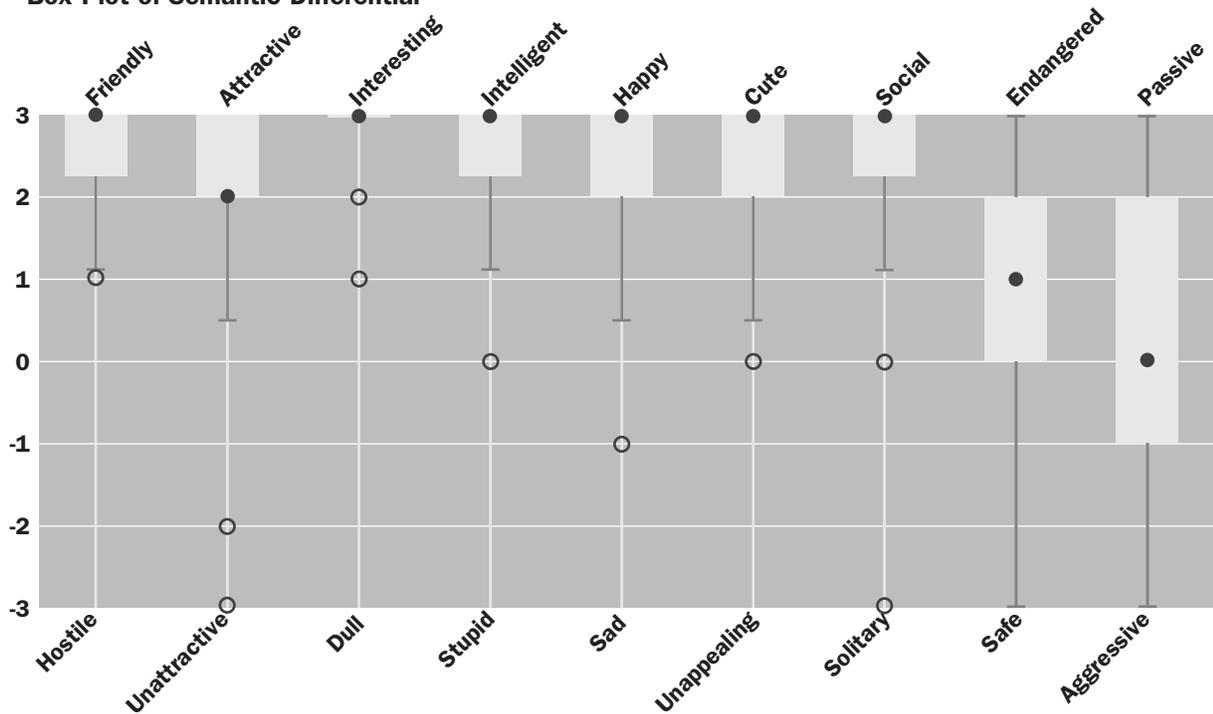
Public Stereotypes

As a follow-up to our initial survey, we cross-validated our findings about positive traits using two survey techniques. First, respondents (N=30) were asked to name three traits they associate with dolphins. Each of these respondents then completed a questionnaire using Osgood's (1952) Semantic Differential (SD) technique. The instrument utilized positive traits that emerged from the public perception survey to represent the social (consensus) stereotype for dolphins.

Respondents rated dolphins on a series of nine 7-point scales, each of which represented a continuum between two opposite traits (e.g., Friendly versus Hostile; see the CD ROM for full survey instrument). For each scale, respondents indicated their rating of dolphins in relation to each pair of traits. The space in the middle of each scale (numbered 4) was used to indicate that dolphins represented neither trait or both traits equally.

The findings of this study confirmed earlier research indicating the public maintains a highly positive perception of dolphins (see Figure 1). The SD technique helped us to understand the specific traits that comprise the public's dolphin stereotype, and that this stereotype includes no negative traits. The

Figure 1
Box Plot of Semantic Differential



strength of this positive predisposition towards dolphins provides an opportunity and entry point for presenting to visitors new information about dolphins' cognitive abilities, as well as promoting empathy and conservation concern for the species.

Dolphins in Media

With a review of the portrayals of dolphins in popular media (including literature, film, television, and music), we sought to uncover the ways in which dolphins are characterized as a way of determining commonly-accepted attributes ascribed to the species. We used a variety of resources to locate and identify representations of dolphins in popular media, such as works of film, television, music, and adult and children's literature (including fiction, non-fiction, and humor/satirical writing). These resources, all published since the 1950s, were collected through a database search that included libraries, children's libraries, online retailer Amazon.com, search engine Google.com, and several online lyrics databases. We did not review every example of dolphins revealed in these searches (see Lamb, 2005, for a comprehensive bibliography), but focused primarily on well-known or "popular" works in order to establish the common themes around dolphin portrayals.

We grouped media based on its general portrayal of dolphins' intelligence and communication abilities. We also looked at when and how dolphins were ascribed values and when the animal was used as a literary device. In looking at portrayals of intelligence, we noted whether dolphins were ascribed intelligence as demonstrated by knowledge, complex learning skills, and/or ability to plan. For communication abilities, we categorized whether they communicated (or "talked"), how they communicated, and the context of that communication, including with whom they communicated (other dolphins, humans, other species). We noted when values were ascribed to dolphins, such as peaceful/forceful, helpful/unhelpful, friendly/unfriendly, or innocent/knowing. Finally, instances were noted when dolphins were used as literary devices, such as metaphors and other figurative language.

Four themes emerged from the review:

What do we mean by “social perspective”?

By “social perspectives” we mean coherent patterns of beliefs that are idealized in ways that may not exactly mimic individual beliefs. Consider that two social perspectives on American democracy are Democratic and Republican. There are a few individuals (party leaders and ideological politicians, for example) whose individual perspective matches one of these societal perspectives exactly, but most Americans will adopt beliefs from both perspectives in constructing their unique viewpoint on an issue, even if they choose to identify more with one perspective over the other. The premise of defining social perspectives is that it is both possible and useful to develop a set of perspectives that represent, or encapsulate, common composites of most individual beliefs. Understanding social perspectives provides a way to balance understanding stereotypes with understanding individual opinions.

- 1) Dolphin as peer to humans—of equal intelligence or at least capable of communicating with humans or helping humans;
- 2) Dolphin as symbol of an ideal existence, freedom, peace, or love;
- 3) Dolphin as naïve or innocent, in which they are subordinate and vulnerable;
- 4) Dolphin as superior to humans, associated with a higher power or intelligence.

All of the material reviewed appeared to match at least one of these four themes, though some depictions represented more than one theme. In addition, a strain of humorous dolphin characterizations were found to lampoon one or more of the four themes, lending support to an assumed cultural prevalence of these narratives.

Social Narratives (Q Method Study)

In this study, we sought to delve into public beliefs about the capacity of the dolphin mind by determining whether there are, in fact, differing social perspectives about dolphins among the public, and, if so, to document the nature of

these perspectives. Ultimately, we would want to use these perspectives to understand whether belief might influence people’s acceptance of new knowledge about dolphin intelligence.

We began with the premise that people are likely to hold varied perspectives on dolphin intelligence simply because they have different knowledge, experience, and worldviews. Furthermore, we surmised that, while individuals would have their own personal perspectives on dolphins, these views would tend to represent a set of more commonly held social perspectives on dolphin intelligence. We were interested in revealing the content of these broader social perspectives.

More on Q methodology

In a Q study, researchers assemble a set of statements that they presume will supply all the ingredients necessary for the subjects to express their personal perspective on a given topic (e.g., dolphin cognition). It is important to note that in a Q study the sample is not the people who sort the statements; rather, the sample in a Q study is the set of Q statements, the population is the “concourse” of utterances that have been made on the topic, and the sorts completed by people are the variables. This highlights a unique value of Q method: Because participants do not represent a population, but rather are the means by which we measure the variables, only a small number of participants are needed, if chosen carefully.

Q statements are taken from a collection of text that has been written or spoken about the subject of study. Normally four or five dozen statements are included in the study (getting people to sort more than this number is difficult). The sample of statements must represent key aspects of all the relevant perspectives on the issue and are selected in such a way that researchers do not impose their attitudes on the study. Q statements are typically different for children and adults to account for developmental differences, comprehension of concepts related to intelligence, and reading skill.

Additionally, we presumed that children and adults would have different perspectives on dolphin cognition. Since the intended audience of the exhibit design included both children and adults, we investigated how each population perceived dolphins.

Methods and Subjects

In order to reveal social perspectives about dolphin intelligence and cognition, we employed a technique known as Q methodology. With Q methodology, one begins by collecting a small number of distinctly different individual perspectives and then employs non-parametric statistics to reveal the underlying social perspectives. This is achieved by having individual respondents react to pre-selected statements by assigning relative ranks to each statement according to how important (or close) each statement is to how they think. This is called a “Q sort.” Inverted factor analysis is then used to find patterns in the individuals’ responses and this analysis is used, in turn, to compose the social perspectives.

We generated two independent sets of Q statements for our study, one for adults and another for children. We generated each set in two ways. First, we interviewed adults and children and selected statements directly from those interview transcripts. The interviews were loosely structured around two guiding questions:

- What can you tell me about dolphins?
- What do you think about dolphins’ thinking?

The interviews were conversational and open-ended, with the intention of producing statements for use in the Q study that would be expressed in the individual’s own words.

Secondly, we collected statements from popular media, including adults’ and children’s books, newspapers, magazines, and websites. We focused on selecting statements that addressed dolphin intelligence. In all, these two activities yielded some 150 statements for the adult study and some 80 statements for the children’s study. From these pools, we selected a much smaller set of statements for use in the Q sort exercise.

In order to ensure that we had a collection of statements that captured the breadth of what people might think about dolphin intelligence, we developed a conceptual taxonomy and sorted each statement into one of six categories: capacity for emotion; capacity for learning; communication; spiritual/mystical/healing capability; self-awareness; and intentionality. We then selected four to six statements in each category. Some slight rewording of statements was necessary for clarity, and several statements for children were generated by researchers to fill in categories using age-appropriate language. Thirty-two statements were selected for adults and twenty-eight were selected for children. A complete list of these statements is available on the CD ROM.

Because Q method is intended to reveal social perspectives, we strategically sought out individuals to complete the Q sort who held clear and distinct points of view and a wide range of experiences with dolphins and aquariums. For the adults, we selected a variety of visitors to the New York Aquarium, as well as a marine mammal trainer, a poet who wrote about dolphins, and people who have had significant life experiences with dolphins. In order to broaden our reach beyond the facility, we also approached several different social groups, such as running clubs, health care groups, and professional organizations.

In selecting children, we interviewed students from second through fifth grade classrooms. We intentionally sought out classes in a variety of neighborhoods in the New York metropolitan area. Additionally, we interviewed three children from western Massachusetts. We sought out students who held a diversity of knowledge and attitudes about, and diverse experiences with, dol-

Q Method Data Analysis

For data analysis we used a freeware program called MQMethod, which performs a factor analysis upon a correlation matrix. A factor analysis is a way of identifying a handful of underlying variables that account for changes among a larger group of variables. In this instance, the Q sorts were the variables and the factor analysis reduced them to three factors, or social perspectives. (Each factor is a unique Q sort, hence it represents a social perspective.). The tricky part of factor analysis is determining exactly what each factor means. For each factor, MQMethod produces a Q sort and more detailed statistical data about the how the Q statements in each sort relate to each other. We interpreted each of these sorts and composed a written narrative that described that particular point of view.

The software also computes how closely each person's Q sort is related to each social perspective. For each person a "factor loading score" is computed for each perspective, in essence revealing the degree to which that individual subscribed to that perspective. This score ranges from +1.00 (indicating that participant's sort exactly matched the perspective) to -1.00 (indicating that participant's sort was the exact opposite of the perspective). Zero indicates no similarity at all.

phins. Some students had little to no knowledge, others had studied dolphins, some had visited aquariums, and some had swum with dolphins.

Each participant was handed a set of 4" x 6" cards, each showing one Q statement, and was given the following instructions:

We are interested in how you think about dolphins. We have a number of statements on these cards of things people may believe about dolphins. Please sort the statements according to what you most believe [indicated to the participant's right] and least believe [indicated to the participant's left].

Results

Analysis of the adults' and children's sorts each produced three social perspectives, which we labeled A, B, and C, for adults, and X, Y, and Z, for children. The Q statements did not include the most common or fundamental statements of belief—those with which it was clear, based on earlier studies, most respondents would agree (e.g., dolphins are smart)—since these would not effectively define different profiles. Although for the most part the Q statements were ranked very differently among the three perspectives, we did uncover a few statements that were ranked similarly by all three perspectives.

Table 3.1

Consensus statements for the adult perspectives and their rankings by each of the three perspectives.

#	Statement	A	B	C
12	Dolphins communicate to each other and understand each other.	1	1	1
5	Dolphins are inventive and creative.	5	2	2
23	Dolphins have their own language.	2	6	3
15	Dolphins draw on their memory to interpret new situations.	6	5	6
11	Dolphins can recall happy or sad experiences.	11	11	10
26	Dolphins seek friendship for altruistic reasons, without thought for personal gain.	15	19	14
2	Dolphin languages could help with the recognition of an extra-terrestrial language.	25	25	20

Adult Perspectives

Table 3.1 presents the seven adult consensus statements and their rankings for each perspective, A, B, and C. A rank of 1 refers to the statement that is most like how the respondent thinks. Conversely, a rank of 32 (out of 32 statements sorted) would indicate the statement with which a respondent agreed the least.

The first five statements shown in Table 3.1 are strongly supported by all three perspectives. They speak to the underlying social consensus that dolphins are extremely intelligent animals with substantial cognitive abilities in the areas of language, creativity, memory, and, to a lesser extent, emotion. Statement 26 is ranked near the middle of the distribution for all perspectives, suggesting that it does not elicit a strongly negative or positive reaction. Statement 2, however, falls into the “what I least believe” area of the distribution for all three perspectives. People may have reacted negatively to this statement because they believe that there are no “extra-terrestrial languages,” nullifying the statement to begin with. In retrospect, we would likely not include this statement again, as it has little revelatory value.

Perspective A

Perspective A was responsible for most of the strength of reactions to statements about the spiritual/mystical aspects of dolphins (negative) and dolphin communication (positive). This perspective placed less emphasis on issues of intentionality and self-awareness. Learning and emotion each received attention on a par with that given by other perspectives.

Across all perspectives, there was scant support for conceiving of dolphins as spiritual or mystical, but support was lowest in this perspective. Instead, Perspective A highlights dolphins’ capacities for learning and communication, at the same time that it views dolphins as animals no different from other beasts, including humans.

Perspective A’s view of communication is moderate. On the one hand, it holds that dolphins do have their own language; on the other, it emphasizes that communication between humans and dolphins is more like speaking to a dog than to a friend.

With regard to learning and intelligence, this perspective tends to believe strongly that dolphins have a keen intelligence, but certainly not superior to humans. Instead, dolphins are seen having a capacity to learn that is similar to dogs, and as incapable of higher learning.

Perspective B

Perspective B focuses most of its attention on the learning capacities of dolphins. It is willing to grant dolphins abilities that Perspective A is not; for instance, Perspective B would disagree with the assertion (representative of Perspective A) that dolphins are incapable of higher learning, or that they only learn if rewarded. It strongly resists comparisons between dolphins and dogs and suggests that dolphins are highly intelligent. It is not, however, willing to go so far as to claim they are more intel-

There is nothing magical or mystical about dolphins; they are beasts just like us.

STATEMENT 30

Perspective A seems to conceptualize all animals, including humans, in an intelligence hierarchy. In this way of thinking, dolphins are extremely intelligent but remain firmly below humans on the animal intelligence hierarchy. While this perspective is comfortable classifying humans as animals, it is very resistant to depictions of dolphins as superior to humans in any way. This perspective is far more comfortable classifying the dolphin mind as being more similar to other animals than to humans.

Perspective B tends to hold a highly favorable view of dolphins, attributing to them a range of cognitive abilities. This perspective seems to more adamantly delineate the superiority and uniqueness of dolphins in comparison to other animals, specifically in terms of learning and emotional capacity. The context of how such capacities are expressed also seems to be important. This perspective tends to attribute to dolphins capacities such as intention and emotion when such behavior is presented in a favorable or altruistic light, and do not support such capacities if portrayed in a negative light. This group also is the most open-minded of the three perspectives to portrayals of dolphins representing spiritual or healing qualities, although they do not whole-heartedly subscribe to such portrayals.

Dolphins are the humans of the sea — wise, shrewd, and super-intelligent.

STATEMENT 9

Perspective C, in contrast to Perspective A, attributes far more human-like mental capacities to dolphins, particularly in regard to self-awareness. While they do not go so far as to explicitly equate dolphins to humans or to indicate that their intelligence surpasses our own, they do recognize that there are many cognitive similarities that place humans and dolphins at a similar level on an intelligence hierarchy. This is, however, a far more pragmatic view of dolphins than the idealistic perspective of B; this perspective does not adhere to a perception of dolphins as unerringly kind creatures and rejects concepts of healing and spirituality.

Dolphins possess self awareness similar to humans and other primates.

STATEMENT 25

liger than humans.

This perspective highlights intentionality more than do the other perspectives, maintaining that dolphins might show altruistic tendencies. For example, they are seen as unwilling to hurt humans under any conditions, and eager to help humans in need. The perspective also strongly rejects the idea that dolphins “harbor murderous urges.” In terms of emotional capacity, this perspective stands out for its belief that dolphins love humans unconditionally.

Although statements about dolphins’ spiritual and mystical qualities are only weakly emphasized in this perspective, most of these statements are ranked much more sympathetically than in the other perspectives. For instance, the statement about dolphins having no mystical qualities and being beasts just like

us was soundly rejected in this perspective, having been ranked second to last. This stands in stark contrast to the support given to that statement by perspectives A and C. Likewise, the mid-level ranking in this perspective of the notion that dolphins have magical healing powers is significant relative to the low ranking it received in perspectives A and C. We conclude that, while this perspective emphasizes learning and intelligence much more than magic, it is also willing to entertain the possibility that dolphins are spiritually or mystically potent.

Perspective C

The hallmark of this perspective is the emphasis on qualities of self-awareness. Dolphins are seen as showing self-awareness similar to that of humans, as making conscious decisions, including reasoning and planning their futures, and as having a sense of humor. Other beliefs in this perspective are fairly evenly shared across all the themes, but a little more attention is given to emotional qualities. Reasonably strong support is given to the idea that dolphins experience emotions in the ways humans do.

Along with Perspective B, this perspective resists the idea that dolphins are *incapable* of higher-order learning or that they only learn for reward. But unlike Perspective B, it does not entertain any notion of dolphins as spiritual, mystical or magical. The essential notion in Perspective C is that dolphins are complex creatures, more advanced than dogs, with many human-like mental capacities, possibly equaling or surpassing humans.

Table 3.2

Consensus statements for the children’s perspectives and their rankings by each of the three perspectives.

#	Statement	X	Y	Z
15	Dolphins do amazing stunts.	1	1	1
25	Dolphins make funny noises and chirps.	6	7	6
2	Dolphins are aware of themselves.	7	5	9
3	Dolphins are born knowing how to swim.	12	9	10
23	Dolphins learn by watching other dolphins.	15	15	14
22	Dolphins know what we think.	27	26	26

Children's Perspectives

As noted, three social narratives also emerged among children, and again, while the three perspectives are distinctly different from each other, there were also points of agreement across all three perspectives.

Table 3.2 shows the six consensus statements and their rankings for each perspective. The first three statements are ranked high, signifying broad acceptance. Statement 15 leads the rankings of all three perspectives, suggesting that dolphins' physical ability represents a widely held belief and a primary association that children make about dolphins. We note that not all the children who did the Q sort reported that they had attended a dolphin show, so it appears that this belief has quite deeply permeated our culture. Interesting, too, is the wide-spread acceptance of the idea that dolphins are aware of themselves. All three perspectives soundly rejected Statement 22, which asserts that dolphins know what we think. Children reacted variously to Statements 3 and 23, which fall at or near the middle of the distribution for all three perspectives. Indeed, an analysis of the raw data from the Q sorts reveals that these statements were ranked very inconsistently by children.

Perspective X

Similarly to adult Perspectives A and C, Perspective X generally reacted strongly against any suggestion that dolphins are “magical” or mystical beings. However, Statement 5, “Dolphins are magical creatures,” was different; conversations with several of the children during the sorts revealed that they had interpreted the word “magical” to mean “beautiful” or “special,” which may explain why the statement received a less negative response than the other spiritual/mystical statements. We recognize that this highlights the need to pay close attention to cognitive and language development issues when designing children's Q prompts, and we visit this issue again later in this chapter.

Perspective X credited dolphins with a relatively high emotional capacity, asserting that dolphins like to be with people and can feel sad, and, to a greater extent than did Perspectives Y and Z, credited them with feeling human emotion. This perspective also contributed relatively strongly to the idea of intentionality, in particular ranking highly the statement that dolphins sometimes choose to help people. Other statements about dolphins making choices and doing things to make themselves happier were also ranked high in this perspective. However, this perspective resisted attributing to dolphins certain human-like capacities, such as having names, or the ability to pretend or talk to people.

Most of these children indicated that their prior experience with dolphins had come through visits to aquariums or dolphin shows, which was not found to be true of children in the other two perspectives.

Perspective Y

This perspective placed rather equal emphasis on four categories: capacity for learning, communication, spiritual/mystical, and self-awareness. Among the three perspectives, this perspective made the largest contribution to the self-awareness category, while comparatively less was said about emotional capaci-

*Dolphins
enjoy being
with people.*

STATEMENT 16

Perspective X focuses on a very positive relationship and on interactions between dolphins and humans. Children with this perspective think dolphins sometimes choose to be, and even enjoy being, with people. Dolphins are seen as having emotional and intellectual capacities that are strong, though not equivalent to or in excess of humans'. Dolphins can feel sad and get angry, but support was weaker for the claim that dolphins feel human emotions. Children who represent this perspective believe dolphins are self-aware and make choices, yet on the whole they identify these abilities as more similar to those of dogs than humans, disagreeing strongly with claims that dolphins are more intelligent than humans, that dolphins know what people think, or that they can talk to humans.

*Dolphins know
that people
think about
different things
than they do.*

STATEMENT 21

Perspective Y depicts dolphins as having a highly complex sense of self and believes strongly that dolphins think different things than humans do. This perspective clearly asserts that dolphins can talk with people, yet does not give dolphins high marks when it comes to emotional capacity, learning capacity, or a strong sense of intentionality. They are not smarter than people; on the contrary, they are seen as primarily instinctual

Dolphins possess self-awareness similar to humans and other primates.

STATEMENT 25

dolphins can get bored and dolphins can pretend—rank lowest in this perspective.

Perspective Y ranks lowest statements that are generous about assuming dolphin intentionality, including that dolphins can make themselves happier, they sometimes choose to help people, and they can make choices. This is also shown in the relatively high ranking of the statement about limited intentionality—dolphins always act instinctively. Interestingly, this perspective ranked highly the assertion that dolphins can talk to people; while it did not take a stand on whether or not there is a dolphin language, it did strongly reject the notion that dolphins only share simple feelings with each other, suggesting they are capable of quite competent communication.

Finally, this perspective is notable for having the least intense (negative) reaction to (i.e., showing the greatest support for) mystical/spiritual dimensions of the three. Three of the four statements in this category received higher ranks by this perspective than any other perspective. The most significant of these, by far, was the strongly supported claim that dolphins bring sailors good luck. However, out of all six statement categories, spiritual/mystical was still the least supported category overall in Perspective Y.

The four children whose sorts defined this perspective are all residents of suburban or rural areas outside of New York City. Additionally, none of them reported having seen dolphins in captivity or in shows.

Perspective Z views dolphins as extremely smart, self-aware, rational creatures with highly developed capacities for learning, communication, and emotion. These abilities are used to make intentional choices for their own benefit. At the same time, dolphins are qualitatively different from people. They have different emotions and are not able to communicate or achieve deep understanding with humans.

Dolphins are more intelligent than humans.

STATEMENT 6

ty or intentionality.

Although all the perspectives assert that dolphins are aware of themselves, Perspective Y stands out in the strength of this belief; indeed, this perspective goes further to assert that dolphins know that people think different things than they do, presuming dolphins maintain a fairly complex sense of self. In addition, this perspective gives more credibility than do the others to the statement that dolphins have names for each other. In contrast, two other statements that we felt made comments about self-awareness—

Perspective Z

Perspective Z places most of its emphasis in the spiritual/mystical (negative) and capacity for learning (positive) categories, and the least in self-awareness. Statements about communication and emotional capacity are more strongly emphasized than statements about intentionality or self-awareness.

The most remarkable assertion of this perspective is that dolphins are more intelligent than humans. This statement was ranked fourth high-

est in this perspective, whereas it was 24th and 25th in the other two, respectively. This perspective also supports the emotional capacity of dolphins, particularly that they can feel angry and sad, however it distinguishes these emotions from those that humans feel. This perspective, like adult Perspective A, consistently discredits any spiritual/mystical claims about dolphins: dolphins are not magical, they cannot heal sick people, they weren't put here to teach people, and they do not bring sailors good luck.

In contrast to Perspective Y, this perspective believes that dolphins have their own language, although it does not believe that they can talk with people—indicating a belief that dolphins' language is for their own purposes. Dolphins are,

however, granted the skill of good listening. This perspective also believes strongly in dolphin intentionality. Dolphins are seen as making choices and are not seen as having to act instinctually at all times.

Discussion

Social beliefs surrounding dolphins' cognitive abilities do not appear to be consistent across our culture. We uncovered three distinct perspectives for adults and three distinct perspectives for children related to dolphin cognition. These results demonstrated that members of the aquarium-going public may approach the subject of animal minds quite differently, and that the world views of adults and children pose different challenges for communicating scientific research on the topic.

Adult Perspectives

We found that the adults in our study generally believe that dolphins are highly intelligent (consistent with our earlier research and that of Herzog & Galvin, 1997 and Barney, et al., 2005) and have an advanced system of communication that participants believe constitutes "language." While researchers have not yet developed evaluative tools for uncovering whether dolphin communication can be characterized syntactically as language, our findings suggest that the general public will assume that marine mammal researchers studying dolphins are working within the context of decoding language.

The popular media we reviewed in order to develop our Q statements suggested that a distinct population may consider dolphins to be more intelligent than humans and potentially to have spiritual capacities or mystical powers. The results of this study indicated that, for people who may visit aquariums, concepts of dolphins as mystical and spiritual beings are not generally supported or are less supported than other concepts of intelligence. We presume that the mystical and spiritual stories of dolphins are acceptable as a literary device, but not transferable to realistic social narratives for the majority of the public, and that mystical elements of belief are less strongly held than other aspects of their intelligence. We further believe that, when confronted with either live animals or realistic exhibits about dolphins, adults will not be influenced by the idea that dolphins are spiritually meaningful or superior to humans in ways that prevent them from understanding dolphin intelligence.

Two of the three perspectives reveal a willingness to believe that dolphins might demonstrate human-like abilities regarding learning capacity, personal agency (planning or self-direction), and emotional intelligence. We cannot comment on the distribution of these perspectives among a larger population, but scientists wishing to present research on the emotional or learning capabilities of dolphins may count on adult individuals whose beliefs tend toward Perspectives B or C to be open to these notions. These results challenge prior research suggesting that most adults rarely ascribe the capacity for complex thinking to non-

On Dogs and Dolphins

Our results suggest that analogies to dogs and dog-like capabilities marked a reference point that was significant in distinguishing between different perspectives of dolphin intelligence. Perspective A agreed with all three of our Q statements that drew comparisons with dogs (S1, S17, S19) while Perspectives B and C rejected or ignored these statements. Exhibits that remark that dolphins have capabilities beyond those of dogs would strike as challenging people holding Perspective A.

We do not have data that comment on the robustness of these perspectives. It may be that people holding Perspective A will readily change their views when confronted with new information. Depending upon the context, the use of dog references in discussions of dolphin cognition may offer researchers a baseline that will help the general public understand the greater capabilities of dolphins. However, we believe the connection between dolphins and dogs may also prevent certain unique information about dolphins from being entertained, particularly when the capacity of dolphins is presented as surpassing that of dogs.



**Children's
Perspective Y
suggests some
receptiveness
to dolphins
as a mythical
construct,
similar to their
depiction in
much of the
media.**

human animals (Rasmussen, Rajecki & Craft, 1993). Additionally, while research may demonstrate that dolphins have some cognitive abilities and learning skills that are similar to humans, these data suggest that many visitors who hold Perspective A may find some of these topics difficult to accept or not credible without substantial evidence.

A unique attribute of Perspective B is an apparent idealized belief about dolphins as altruistic animals, attributing to them a variety of positive characteristics. Perspective B suggests a strong belief in dolphins as uniquely capable and unwaveringly good creatures, and reacts very negatively to any unfavorable portrayal of their capabilities or behavior, or even their intentions.

One feature of Perspective C offers animal cognitive scientists an entry into public discourse. This perspective's willingness to consider that animals have a sense of humor and self-awareness similar to humans provides an opportunity for recent findings on self-recognition in dolphins (Reiss & Marino, 2001) to enter public discourse, though the contrasting opinions of Perspectives B and A would suggest that not all audiences will be equally open to this information.

Children's Perspectives

Children's conceptions of dolphin intelligence appear to be more varied than those of adults, though these beliefs are likely strongly influenced by individual cognitive development and social experience. Children demonstrated a consistent openness to dolphins' ability to learn through observation, interspecies communication, and dolphin self-awareness. This receptivity contrasts in some measure with the more fixed adult narratives—we believe the interaction of adult and child perspectives represents a promising area for further research.

Perspective X views dolphins as emotional and intentional creatures, albeit not at a human level. Most of the children who comprised this perspective noted that their experiences with dolphins came from seeing them in aquarium exhibits, in shows at aquariums, and in swim-with programs, which was not the case for the children in Perspectives Y or Z. It is conceivable that the children's experience seeing dolphins interacting with humans has influenced their more anthropocentric perspective, although further research would be required to accurately test this idea.

Children's Perspective Y believes strongly in dolphins' self-awareness, which suggests they will be unsurprised by Reiss' research that demonstrated self-recognition. This perspective also suggests some receptiveness to dolphins as a mythical construct, similar to their depiction in much of the media. While some of popular children's literature supports the mythologizing of dolphins consistent with this perspective, we do not assume that children will carry these beliefs into adulthood. Beliefs in spiritual and magical elements do not feature at all prominently in any of the adult perspectives. Further research could tell us whether exposure to or experience with scientific information about animal intelligence might help children develop a more science-based concept of animal minds.

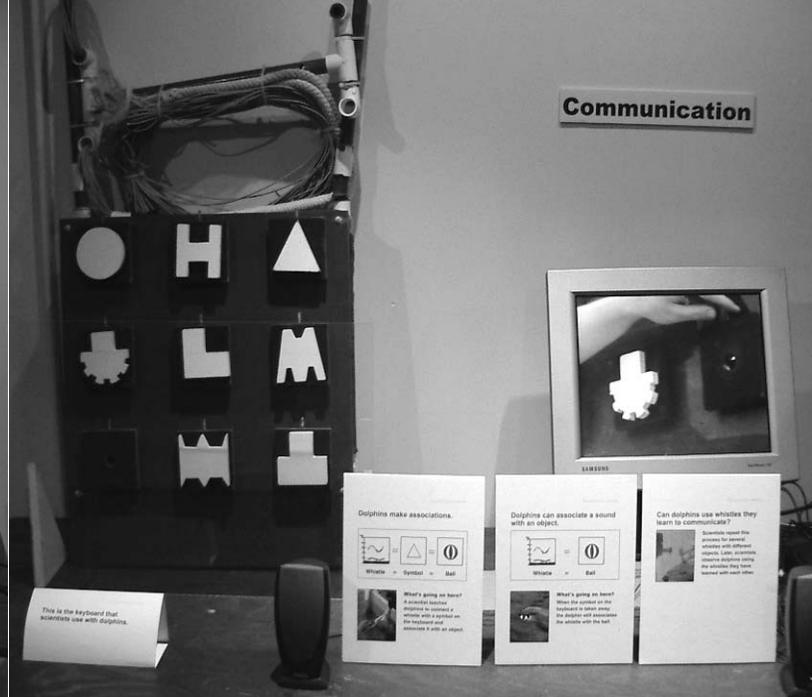
Interestingly, at the same time as they do not reject the mystical, the children in Perspective Y appear to have a theory of dolphin mind as primarily instinctive, and as lacking emotional attributes associated with humans. As learners, these children may prove resistant to reconstructing their theory of dolphin mind, even in response to new evidence. For example, considering their belief that dolphins only act instinctively, this perspective may be more prone to discount research findings regarding dolphin intentionality. However, because this perspective appears receptive to the idea that dolphin communication is complex, discussion of dolphin communication may provide entry for these children into understanding other areas of dolphin research.

Children's Perspective Z demonstrates a more complete comprehension of

animal lives as distinct from human life and appears to support characteristics of the Myers, et al. (2003) concept of a psycho-social way of thinking, in which animals are understood to have distinct ecological needs not necessarily mirroring those of humans. In our study, this perspective focused on statements indicating the animal's distinct cognitive abilities, rather than on dolphins' ability to demonstrate human-like ways of thinking or feeling. For instance, this perspective believes that dolphins have their own language, but discounts the more human-centric idea of interspecies communication. Generally, these children will accept findings regarding dolphins' advanced cognitive abilities at face value, and will potentially ascribe even greater attributes than have been demonstrated in the research.

What Did We Learn?

- The general public holds a very positive perception of dolphins, including a belief that they are “smart” animals. However, this perception is not related to any specific cognitive capabilities.
- We uncovered a variety of social perspectives regarding the dolphin mind, each of which is receptive to the idea that dolphins have a high degree of intelligence.
- The variability in these perspectives offers the opportunity for presentation of a variety of concepts that might resonate with individuals and could facilitate an engaged discussion within groups in an exhibit setting.
- A notable similarity between all three of the adult perspectives was the strong belief in dolphins' advanced system of communication. We feel that the commonality and strength of this belief could provide a useful entry-point into cognitive research about dolphins, and act as a comfortable way for visitors to encounter aspects of cognitive research that may be more in conflict with their beliefs.
- This study found dogs to be a common reference point for the public's understanding of dolphin intelligence. However, we believe that the unique position of dogs in visitors' minds is not clearly a useful schema; we do not know whether it has greater potential to hinder or facilitate understanding of dolphins, since we did not determine the precise influence of this comparison, only its presence. Gathering more detailed information about the comparison and its impact on visitors' understanding would, we feel, be both valuable and interesting in considering visitor interaction with content about animal intelligence.
- Because of the likelihood that aquarium visiting groups will include visitors with different perspectives or belief systems about animal intelligence, the interaction among individuals, including family members, is fertile ground for exploring how people socially navigate challenging concepts. We recommend further study of the interactions among adults and children as they explore theories of animal minds, as a source of new insights into how the public considers animal cognition research.
- We noted distinctive characteristics of children who defined Perspectives X (aquarium experiences with dolphins) and Y (residing in suburban and rural areas). Our study design and small sample sizes do not allow us to draw any conclusions from these patterns, but they do invite further study.
- Uncovering children's perspectives is challenging because children's linguistic and conceptual development varies significantly. In this project, interpretation of words like “magical” or the phrase “aware of themselves” were not consistent across the interviews. Such challenges require additional confirmatory discussion with the children to ensure accuracy in the results.



CHAPTER 4

Visitor Experiences with Dolphin Cognition Research

Introduction

One challenge facing exhibit developers is in operationalizing what we learn from studies of belief in order to improve the effectiveness of exhibits for science learning. In our work, we felt it was necessary to understand how the various perspectives and beliefs held by visitors influenced their engagement with and meaning-making from the presentation of dolphin cognition research. To uncover this information, we set out to talk with aquarium visitor groups about their thoughts on dolphin cognition, and about what they believe from seeing evidence from dolphin cognitive research. To this end, we developed a series of interactive opportunities, or stations, to facilitate our interview process. These stations were created to help us understand how best to 1) frame and present ideas and themes identified in previous studies as particularly compelling for visitors, and 2) meet the goals identified by experts in the field of marine mammal research as key to understanding the dolphin mind.

From earlier research, we learned that visitors ascribe to dolphins a high degree of intelligence, but do not necessarily understand the nature or complexity of that intelligence. The laboratory offered us the opportunity to evoke and examine visitor understanding in greater detail. Our method was conceptual; we provided prompts and tidbits of explanation along with simple activities and films from dolphin research. Our hope was that we could provoke the next layer of visitor knowledge and identify ideas needing greater or lesser explanation. Our goal was to create a set of recommendations for exhibit developers that could improve the informal learning process for a broad audience.

The Stations

The stations described here were presented three or four at a time, for approximately three weeks per set.

Station 1: Imitate

Message: Dolphins use the process of learning through imitation in similar ways to humans.

Activity: Visitors encountered a metal puzzle of two shapes linked together, which are difficult to take apart. Along with the puzzles, a video played of someone solving the puzzle; visitors could choose to imitate the solution.

Video: Several clips of dolphins engaging in imitative behavior and imitative learning (in aquariums and in the wild).

Study Design

The stations were presented in a dedicated space at the New York Aquarium and testing was done nearly every day from June 21 to July 30, 2004. There were three rounds of evaluation; during each round, 3-4 stations were set up, each pertaining to a different theme or aspect of dolphin intelligence. Most of the stations included an activity or interactive component and a looping video showing dolphins demonstrating the same cognitive abilities as the visitors engaged in with the activity. One goal of the study was to determine the minimum interpretation necessary for visitors to take away our intended messages; that is, how much would they be able to comprehend from the images and activities alone?

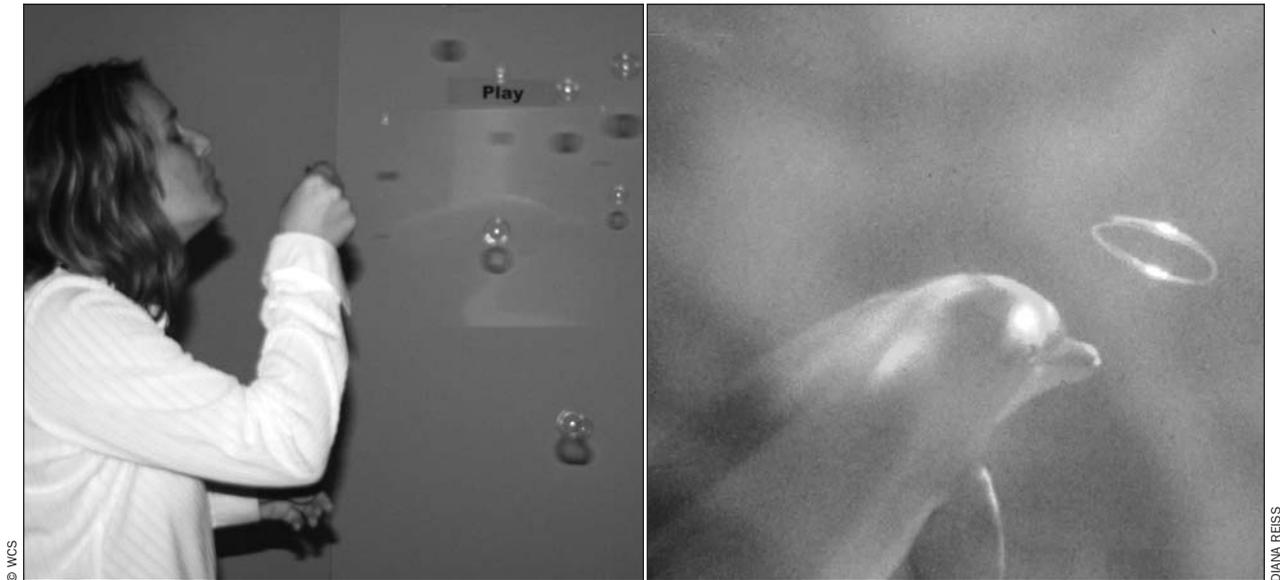
Each station presented as little explanatory text as possible, attempting to tell the story primarily, though not exclusively, through activity and image. Each station was labeled with a single word summarizing the cognitive task or process (Imitate, Communicate, etc.) and had, at most, one to three small instructional cards to guide the visitor. The videos contained no captions or audio narration.

Station 2: Remember

Message: Dolphins have the capacity for mental representation and performing a delayed match to sample task, similar to the abilities of humans. This station also demonstrated how the process of mental representation works.

Activity: On the table was a cloth bag containing five discs. Each disc had an image of a distinct shape on one side and a letter (A-E) on the other. Visitors were instructed to select one item from the bag, look at it, put it back, and look at a graphic that faced away from them (providing the needed delay). There they found pictures of all five shapes. The visitor would choose the shape she had pulled from the bag and check to see if the letter matched.

Video: Dolphins engaged in the task (in an aquarium) of seeing an item, having it hidden for a minute, and then selecting the correct item from two options.



Humans and dolphins at play.

Station 3: Play

Message: Dolphins engage in the self-directed, unique, creative play of making and playing with bubble rings, similar to the inventive play of humans.

Activity: A dish of bubble soap and a variety of bubble wands sat on a table.

Video: On a large projection screen, a film depicted dolphins creating bubble rings from their blowholes, playing with and manipulating them.

Station 4: Explore*

Message: Dolphins, like humans, learn through the process of trial and error.

Activity: A touch screen monitor displayed a 3x3 grid of 9 keys, each showing a different symbol. Touching each of three symbols resulted in a brief animation (different for each key) appearing on the screen. Nothing happened when the other six keys were pressed.

Video: A dolphin (in an aquarium) using a similar keyboard, apparently using trial and error to learn that one button resulted in receiving a hoop (which the animal did not appear to want) and another resulted in receiving a ball (which it then played with).

**Modifications were made to this station in response to technical issues and visitor confusion. Analysis was limited to data collected after the technical problems were resolved.*

Station 5: Recognize

Message: Like humans and apes, dolphins have the ability for mirror self-recognition, which is a rare skill among animals.

Activity: There was a large mirror with the questions: Who do you see in the mirror? How do you know? Next to the video on a sign was the question, Which animals recognize themselves in a mirror?

Video: Showed the behaviors of several different animals in front of a mirror: A bird and monkey that did not recognize themselves, and a chimpanzee and a dolphin that did recognize themselves. There was no explanatory text, but the animals shown were labeled.



Station 6: Perceive

Message: Dolphins have the unique sensory ability of echolocation; they use this ability in a variety of ways, including locating food and identifying shapes and objects in the water. Echolocation is an example of cross-modal perception.

Activities:

1) *Cross-Modal Perception.* There was an opaque box within which people could touch a textured cube without seeing it. Next to the box were four different textured cubes that visitors could see but not touch. Visitors were asked if they could visually identify which cube they had touched in the box.

2) *Using Sound to See.* Two black cubes and a black sphere sat on the table, each with an object inside and a simple closure mechanism. Visitors were invited to try to determine what was inside without looking—for example, by picking up the boxes, shaking them, listening; they could then open the boxes and see if their guesses were correct.

Videos:

- 1) Dolphins using echolocation to find fish buried in the sand (in the wild).
- 2) Dolphins using echolocation to identify an object within a solid black box (in an aquarium).

The cross-modal touch box at the Echolocation station.

The Keyboard Communication station.

Station 7: Communicate 1: Keyboard

Message: Dolphins can learn to associate a symbol and whistle with an object and possibly use this learned information in communication with one another.

Video: A dolphin (in an aquarium) using an underwater keyboard. When the dolphin pressed a button, there was a specific whistle, and the dolphin received a specific object. When the dolphin received the ball, he began to play with the ball.

Artifact: An actual keyboard from the New York Aquarium marine mammal research lab was displayed next to the video.

Activity: A set of signs, one explaining,





Dr. Diana Reiss readies her keyboard.

with images and minimal text, the concept of making associations between sounds and objects, another presenting an anecdote about two dolphins using the learned whistles with one another. Also provided was paper printed with “yes,” “no,” and “not sure.” Visitors could use the paper to submit their answer to the question, Are the dolphins talking to each other?

Station 8: Communicate 2: Gesture

Message: Dolphins have the ability to understand the meaning of individual hand signals, combinations of hand signals (i.e., “sentences”), and novel combinations of previously-learned signals, and to interpret the signals when clarity is degraded (via underwater video or hands holding lights).

Video: A dolphin distinguishing the difference between commands meaning “take hoop to ball” versus “take human to surfboard.” When commands were presented not from a live trainer, but through a video projection or with abstract moving lights, the dolphins continued to be able to understand the meaning of the phrases.

Station 9: Social Stories

a) Human-Dolphin Stories

Message: Dolphins and their interactions with humans have been a part of human stories and legends throughout much of history.

Activity: Visitors could read a number of newspaper articles, images, cartoons, etc., that reported on dolphin-human interactions, including tales of dolphins rescuing humans.

b) Dolphin Cooperation

Message: Dolphins work together to catch fish; fishers and others believe that dolphins sometimes help fishers catch fish.

Video: Dolphins working together to herd fish; dolphins working together to beach fish for feeding; dolphins working with fishermen, herding fish into their nets.

c) Dolphin Social Systems

Message: Dolphins have complex social systems and structures with social behaviors and elements similar to the social worlds of humans.

Videos:

1. Teaching

Adult dolphin showing young how to echolocate into ocean floor for food.

2. Community

A group of young male dolphins interacting playfully and aggressively; a large group of females with young.

Subjects and Methods

The subjects included 173 multi-generational groups, all-adult groups, and individual adult visitors to the New York Aquarium in the summer. The exhibit development lab was located in the heart of the New York Aquarium, near the touch pool and beluga whale exhibit. Visitors were recruited to participate in the study by an evaluator who opportunistically approached the first visitor encountered upon exiting the lab, asking if they would be interested in helping the Aquarium develop a new exhibit about dolphins. In the event of a refusal, the evaluator would approach the next guest encountered.

Although this sampling method was not strictly random, the demographics of the resulting sample were consistent with visitorship for the New York Aquarium during the summer (Morey and Associates, 2004). Sixty percent of adult respondents were female and 40% were male. Sixty-two percent of adults were between 31 and 55, 24% were 30 or younger, and 12% were over 55.

Visitors were encouraged to freely explore the stations until they felt satisfied

they had experienced the room. The researcher sat unobtrusively at a nearby table, noting interactions and behaviors of the group at each station. Each group was then interviewed with the following six questions (see CD ROM for instrument):

- 1) What did you discover about dolphins today?
- 2) Was there something you saw today that challenged what you already thought about dolphins? What was it?
- 3) Was there something you saw today that confirmed anything you already thought about dolphins? What was it?
- 4) Tell me about each one of the stations and what you thought about it?
- 5) Was there anything about any of the stations that was unclear?
- 6) Did this raise any other questions that you would like to have answered? What are those?

Interviews were tape recorded and later transcribed, and were cross referenced with the evaluator's written notes.

Responses to each question were categorized by grouping common and similar responses, both within and between groups, and scored by counting the frequency of responses that fell into similar categories. Due to the nature of the questions, we created different response categories for each question. For all six questions, many of the answers were specific, idiosyncratic, and difficult to categorize. Consequently, an "other" category was created for reference purposes.

Challenges

Although visitors were prompted to discuss their thoughts on each station, many chose not to respond to one or more stations. Similarly, not all visitors within a group responded to every question asked. Responses from adults and children were considered equally, since exhibit development often focuses on within-family discussions.

Results and Discussion

Despite having available only a minimal amount of interpretive text, a large number of visitors took away part or all of the intended messages. There were several patterns in responses that can aid developers in translating results into exhibit design.

Some of the stations proved to be highly successful with almost no text. Specifically, Play (#3), Recognize (#5), and Teaching (#9c.1), each communicated the intended message to more than 75% of the visitors who talked about them. Interestingly, two of these stations, Play and Recognize, had very simple activities (blowing bubbles and looking in a mirror, respectively). Additionally, the videos presented in these three stations were very straightforward and the concepts (creative play, self-recognition, and teaching others) are part of common, everyday human experience. From our results, it seems that these qualities may have helped people to understand the meaning of the dolphin behavior more readily and with less need of explicit interpretation.

The stations that caused greatest confusion for our visitors were Perceive (#6), Cooperation (9b), and Community (#9c.2). In all three, visi-

Training vs. Intelligence

Running counter to the perception of dolphin intelligence seems to be the somewhat prevalent association of dolphins' behavior and activities with animal training and performance. Visitor response in this evaluation indicated that visitors readily perceive dolphins as trained and, thus, do not necessarily digest the more complex aspects of their cognitive capacity—that is, they show a tendency to identify the cognitive abilities demonstrated at the stations as the result only or primarily of training. Particularly in situations where the exhibit shows a dolphin in captivity and/or interacting with humans, visitors are more likely to attribute the dolphin's ability to training than when the dolphin is depicted engaging in a behavior in the wild.

tors expressed being most unclear about the video content. None of these three videos included sound, narration, or on-screen captions. Visitors had to rely on their visual interpretation of the situation to understand its meaning. Unlike the videos in Play, Recognize, and Teaching (which also lacked such narration), the concepts demonstrated were fairly removed from everyday and commonplace human activities.

The Community video was often misunderstood to be simple schooling behavior or generally thought to be unclear. The section in the Cooperation video showing dolphins helping fishermen caused confusion, as many people thought the humans were hunting the dolphins or dolphins were helping the fish escape. At the Perceive station, the video of dolphins identifying an object within a black box created a great deal of confusion. The lack of explanation with this video prompted many visitors to derive their own explanations of how the dolphins achieved this, including interpretations clearly not supported by the video.

Another possible source of misconception about these presentations is an apparent disconnect between what the dolphin was able to do in the video and what the visitor did in the activity. Often, visitors translated their experience literally to what the dolphin was doing, even if the logistics of such an interpretation defied logic and/or what was seen in the video. For instance, in Imitate (#1), there were more than a few visitors who thought we were showing that the dolphins would be able to solve the metal puzzle (a feat requiring opposable thumbs). Also, in response to the Perceive video that showed a dolphin approaching the black box and subsequently identifying the object inside, one of the alternate explanations was that the dolphin picked up the box and shook it, which visitors did in their activity, but which clearly was not shown in the film and which is, again, a physically impossible behavior for a dolphin to per-

**Visitors to the Exhibit
Development Lab.**



form.

We were somewhat surprised that many visitors had difficulty making sense of the activity and concept behind Explore (#4, trial and error). We expected visitors to easily relate to this relatively simple and common way of learning; however, it may have been precisely this ease and familiarity that was at the heart of the issue. Many visitors were looking for greater complexity in the learning task, whether patterns in the placement of the keys, the significance of a symbol's representation of an object, or other symbolic connections. Visitors frequently focused on mental processes beyond trial and error, over-thinking it, to some extent. In this case, we may have provided more information than necessary to convey an innately familiar process.

In contrast to the particular confusion visitors experienced at Explore, was the response to Perceive. Although this station also resulted in substantial visitor misinterpretation, the patterns evident in their thinking about the material differed a great deal from those in Explore. From this study, it seems that many visitors are entering the Aquarium with very little knowledge of echolocation and how it works and is used by dolphins. Consequently, rather than over-thinking this concept, visitors seemed to struggle to make sense of it by creating explanations based on the discrete elements of what they themselves experienced (such as shaking the mystery boxes).

What Did We Learn?

- Many of the stations, such as creative bubble play and mirror self-recognition, were successful in communicating information about dolphins' cognitive abilities and their similarity to those of humans using minimal text. Visitors appear to accept that dolphins have high-level abilities; thus, exhibit text on these topics can be used to discuss the finer details rather than to decode basic concepts.
- While visitors accept the basic assumption of dolphin intelligence, they can be very literal about their interpretation of examples and analogies meant to elaborate on that assumption. We believe that many of the misunderstandings resulting from this tendency might be addressed by presenting more comparable or familiar analogs, by the use of more instruction on activities, and through providing narration in and explanation of the videos.
- Visitors do not necessarily understand the complex nature of their own thinking, as evidenced by their response to Explore, in which they tended to think beyond the concept. They may be likely to think of certain abilities or behaviors, such as trial and error learning, as simple or automatic and therefore not as representing cognitive capacity.
- Visitors struggled to understand the details of echolocation and the extent of its use by dolphins as presented; it appears to be an area that requires more deliberate demonstration in an exhibit. By creating greater links between activities and video illustrations, as well as presenting each of the related concepts separately (echolocation mechanisms, function, and as cross-modal perception), we may better help visitors focus and process the overall phenomenon. This separation may also allow visitors to access and make meaning from the particular elements and concepts that fit within their prior knowledge.
- Visitors sometimes focused on elements of trained behavior rather than attributing what they saw to genuine cognitive abilities. Exhibit developers need to present interactions between humans and dolphins in aquariums in ways that emphasize how the dolphins' behavior represents cognitive capability. One way to do this might be to avoid showing people in the videos. Explaining and, when possible, showing what the dolphins' cognitive abilities look like in the wild may also help rend visitors' assumptions away from the training paradigm.

We asked, What impact might this exhibit have had on visitors' concern for dolphins, the ocean environment, and conservation issues in general?



CHAPTER 5

The Opportunity to Explore: An Exhibit Development Laboratory

The *Aquarium Think Tank* was designed as an exhibit development laboratory for presenting, modifying, and refining delivery methods to achieve the highest learning outcomes. By fabricating a pilot exhibit sequence, we could look at the following in visitor experiences:

- Cumulative learning;
- Attractiveness of various concepts;
- Weighted time spent in specific areas;
- Which concepts offer the greatest potential for increased appreciation of cognitive research.

Pilot Exhibit Description

The exhibit space was organized into a “dolphin” side, highlighting behavior, affective experiences, kinesthetic exploration, and role play to provoke curiosity from the perspective of a dolphin, and a parallel, discursive, “science” side, focused on research and findings on dolphin intelligence (see CD ROM for sample exhibit graphics). The exhibit content addressed a set of five supra-topics, used as an exhibit-organizing framework:

- **Interact** provided information about the social lives and group structure of dolphins. This area included a large video display, showing dolphins cooperatively corralling an enormous anchovy ball, interacting in social groups, and apparently cooperatively hunting with humans, and featured a whole-body, kinesthetic interactive that put visitors in the role of dolphins, working together to “herd” a group of anchovies projected onto a low table top. Also included was a set of graphic panels that elaborated on the video vignettes.
- **Think** presented information on the echolocation abilities of dolphins, the cross-modal nature of this sense, dolphins’ demonstrated ability to successfully engage in a delayed match-to-sample task, and dolphins’ ability to recognize themselves in a mirror. Featured were, respectively, videos of dolphins engaging in echolocation (in captivity and in the wild), a cross-modal interactive, a touch screen demonstration of echolocation, a graphic panel explaining and presenting a delayed-match task, and a video of four species looking in mirrors, two of which can recognize themselves—dolphin, chimpanzee; two of which cannot—cuttlefish, and monkey. The mirror recognition area also included a mirror and accompanying graphics that explained the topic.
- **Communicate** related information about two strands of research done with dolphins: 1) Observing how dolphins learn to use a keyboard as a communication tool—associating symbols with sounds and

Research Goal

The *Aquarium Think Tank* was built to pilot test the sequence effect of exhibit components through four broad lenses:

- 1) Cognitive learning: How effectively did this exhibit convey its content messages? Cognitively, which of our messages left the most lasting impression with visitors?
- 2) Improvement based on earlier testing: Did visitors’ comprehension improve in the portions of the exhibits that were modified based on learning from previous interviews?
- 3) Affective experience and increased concern: What impact might this exhibit have had on visitors’ concern for dolphins, the ocean environment, and conservation issues in general?
- 4) Uses of technology: What exhibit technologies helped improve learning outcomes?

objects—and how they extend their learning and use the whistles on their own in the context of an object. Also included here were videos of the specific experimental work, as well as the actual keyboard artifact from the work of WCS' Dr. Diana Reiss; 2) Research into the complexity of dolphins' understanding of human gestural communication, also featuring video of the work.

- **Learn** presented an overview of ways of learning, including trial and error, observation, imitation, training, and flexible learning (the use of various methods as appropriate). This console offered two stations of a whistle imitation game, wherein visitors hear, and see a sonogram of, a whistle and are invited to reproduce, or imitate, the whistle by pressing four different buttons (each representing, aurally and visually, a component sound of the whistle) in the correct sequence. Visitors were then invited to close their eyes and imagine performing the task in a manner similar to the way dolphins learn whistles through imitation—without benefit of a visual cue.
- **Play** included a large video display of dolphins creating and interacting with bubble rings, alongside a whole-body, kinesthetic interactive that invited visitors to move around an area and produce bubble rings via a projection onto the floor. Brief information about dolphin bubble ring production was presented nearby.

Also included in the exhibit lab was a set of questions about dolphins, writ large along a wall, such as Do dolphins have culture? Are dolphins self-aware? Do dolphins have language? These questions were meant to prompt visitors to contemplate some of the over-arching issues and to extend their thinking about topics addressed in the areas detailed above. The final area in the exhibit presented graphics about WCS dolphin conservation efforts and invited visitors to write down their own questions about dolphins. Visitors could then place the papers in one of five tubes, labeled to correspond to the supra-topics of the exhibit.

These areas were self-contained and visitors could explore them in an informal way. However, seen as a whole, the five focal concepts presented intelligence in such a way that visitors could associate themselves—the way they learn, think, communicate, etc.—and dolphins, providing an implicit sense of connection between the species.

Methods

In order to evaluate whether visitors to the pilot exhibit were able to make sense of one or more of the intended messages and themes of the exhibit, and to understand their affective experience of the exhibit, we employed three complementary methods (see the CD ROM for complete instruments):

- **Structured open-ended interviews with individual adult visitors (n=143)**—This method was developed as a modified version of the summative questionnaire created by Serrell (1998). This interview was not cued and consisted of three questions about what visitors felt was the exhibit's main idea, one new idea they took away, and the most personally interesting area of the exhibit.
- **Semi-structured open-ended interviews, focused on individual exhibit zones (n=47)**—Evaluators interviewed individuals about their thoughts regarding a particular zone immediately after the visitor interacted with that zone. Several questions guided the interview, but interviewers were free to probe visitors to elaborate on their responses. The data from these interviews were more qualitative in nature, but provided a sample for comparison with the findings of the structured interviews.
- **Timing and tracking (Time at each zone: n=57; Total time in exhibit: n=27)**—Evaluators timed visitor movements within the exhibit space

noting how long they spent at each exhibit zone and within the exhibit as a whole.

Subjects

Structured Interview

Evaluators surveyed 143 New York Aquarium visitors as they exited the *Aquarium Think Tank* exhibit throughout July and August 2005. During the survey, participants were asked to provide demographic information about themselves on a questionnaire, including age, level of schooling, gender, group composition, and special training or interest in the subject matter. Respondents consisted of 75 females and 61 males (7 people declined to indicate gender), with relatively even distribution of ages and education level. These demographic data are similar to the results from a visitor satisfaction survey that was conducted at the Aquarium during the same time period (Morey and Associates, 2005).

In addition to demographic information, visitors completed a brief checklist of nine statements from the Q Method study that had proved to be representative of the three adult perspectives. Visitors were asked to indicate whether each statement was more like how they think, less like how they think, or if they felt neutral or unsure. From this data, we were able to approximate which of the three Q-perspectives best characterized how each visitor thinks about dolphin cognition. In total, 22% of visitors were identified as Perspective A, 31% were Perspective B, 20% were Perspective C, and 27% were identified as representing more than one Perspective.

Regarding the validity of the sample, the visitor satisfaction survey noted above indicated that approximately 30% of Aquarium visitors in July and August 2005 went through the *Aquarium Think Tank* pilot exhibit. Based on this information and attendance records, we estimate that 150,000 visitors passed through this exhibit. Our sample, which was collected randomly, represented 0.3% of the population that visited this exhibit.

Semi-Structured In-Depth Interviews

Evaluators interviewed an additional 47 visitors in more in-depth, less structured interviews about particular zones in the exhibit. Visitors were approached as they finished interacting with the specified zone and asked to talk about that area and how it influenced their thinking about dolphins. After the interviews, visitors were asked to complete the same demographic questionnaire and perspective checklist as had participants in the structured interviews. Four visitors declined to fill out this information. Again, the demographic profiles of these visitors reflected the results from the visitor satisfaction survey (Morey and Associates, 2005).

Timing and Tracking

On select research days, evaluators also used timing and tracking methods to determine the amount of time visitors spent in the exhibit and at particular stations in the exhibit (see CD ROM for Timing and Tracking map). Evaluators randomly selected an entering group and unobtrusively observed and recorded both the pattern of their movement and the amount of time spent looking at and engaging with each zone of the exhibit. For ease of timing, evaluators focused on one member of the group. Fifty-seven visitors were tracked for time spent in the exhibit zones, and 27 of these were also timed for overall time spent in the exhibit.

Do dolphins have culture? Are dolphins self-aware? Do dolphins have language? These questions were meant to prompt visitors to contemplate some of the over-arching issues and to extend their thinking.

“He’s looking in the mirror like someone, you know, would look in the mirror. Like I would look in the mirror.”



Diana Reiss

Dr. Diana Reiss with Preston

Results and Discussion *Understanding Main Idea*

From the results of the structured interviews, we found that the majority of our audience understood and walked away with the main concepts presented in this pilot exhibit.

Seventy-three percent (n=105) of visitors gave one or more response to our question about the exhibit’s big idea appropriate to the exhibit content. Breaking down that number, several major content areas stood out for visitors. The largest category was dolphin cognitive and communication abilities, the central theme of the exhibit. Fifty-six percent (n=80) of visitors indicated one or more concepts in the cognitive or communication realm as the central idea of the *Aquarium Think Tank* exhibit. Several different types of comments comprised this category, as seen in Table 5.1.

In addition to awareness of the cognitive focus of this exhibit, a number of visitors recognized the presence of conservation themes (13%, n=18) and the presentation of current dolphin research practice and findings (6%, n=8). These themes were not explicitly the purpose of the exhibit, but they remain central goals in the WCS mission and are key ideas we

Table 5.1

What was the main purpose of the exhibit? To show or make people aware of... (n=143)

	% of visitors*
COGNITION & COMMUNICATION	56%
Dolphin intelligence	20%
Cognitive abilities (various)	13%
Similarities with humans	12%
Communication	12%
Different than other animals	8%
Social/interactions/have culture	5%
Abilities (what they can do)	5%
Echolocation/senses	3%
Higher thinking animals	1%

*Visitors responses often fell into two or more categories, therefore percentages may add up to more than 100%.

hope to instill in visitors. This somewhat unexpected finding led to further analysis of responses for how visitors expressed concern and conservation-mindedness, as described in a later section.

Also emerging from responses to this question were associations with dolphin lives, skills, and abilities that, while not directly related to cognitive skills, were important parts of the exhibit presentation and message. Twenty-seven percent (n=39) of visitors identified these topics (see Table 5.2 for detail).

Only 8% (n=11) of our visitors described a main purpose of the exhibit that was relatively far from our intent. Two responses reflected concerns from earlier evaluations: Two percent (n=3) felt the purpose of the exhibit was to make up for the absence of live dolphins at the aquarium, and 1% (n=2) of the audience felt that the exhibit's purpose was to show training activities. While these types of comments did not completely disappear from responses to the pilot exhibit, their presence was notably less prominent than it had been in the surveys and interviews conducted before the pilot exhibit opened.

In addition, 19% (n=27) of those surveyed provided only a vague response to this question, such as that the exhibit's purpose was to educate about dolphins (14%, n=20) or simply to educate (5%, n=7). Three percent (n=5) chose either not to answer this question or indicated they did not know what the exhibit was trying to show.

New Ideas

As one way to identify what visitors learned in the exhibit, we asked them to specify any new ideas they were taking away as a result of their experience. Responses were related to a variety of elements reflecting the exhibit's content, and were grouped according to the zone or overarching concept within which they were represented. The area of the exhibit from which the greatest number of visitors gleaned new information was the zone on creative bubble play, mentioned by 21% (n=30) of interviewees. Within this zone, several specific ideas resonated with visitors, as seen in Table 5.3.

Fifteen percent (n=21) of visitors indicated that they took away a new idea from the echolocation zone of the exhibit. Comments about this topic, which was very poorly understood during prototype testing, specified a variety of new ideas, including echolocation in general (6%, n=8), how it works (5%, n=7), and that dolphins can use echolocation to identify an object inside of a solid box (3%, n=5) or to find food (1%, n=1). No visitors indicated misinterpretation of what was presented.

Mirror self-recognition was the third most identified zone for prompting new discoveries, influencing 10% (n=15) of the audience. Within this group, 6% (n=8) noted the fact that dolphins are able

Table 5.2

What was the main purpose of the exhibit? To show or make people aware of... (n=143)

	% of visitors
OTHER, ON EXHIBIT THEMES	27%
Dolphin lives or behavior	16%
Interactions/communication with humans	6%
Its purpose is to change perceptions	5%
Hearing dolphin sounds	1%

Table 5.3

What is one new idea you are taking away with you? (n=143)

	% of visitors
BUBBLE PLAY	21%
Dolphins make their own toys	9%
Bubble play (general, non-specific)	8%
Dolphins like to play, are playful	2%
Dolphins have the ability to make bubble rings	2%
Dolphins are creative	1%



SUZANNE BOLDUC

Exhibit visitors to the Bubble Play, left, and Whistle Imitation stations.

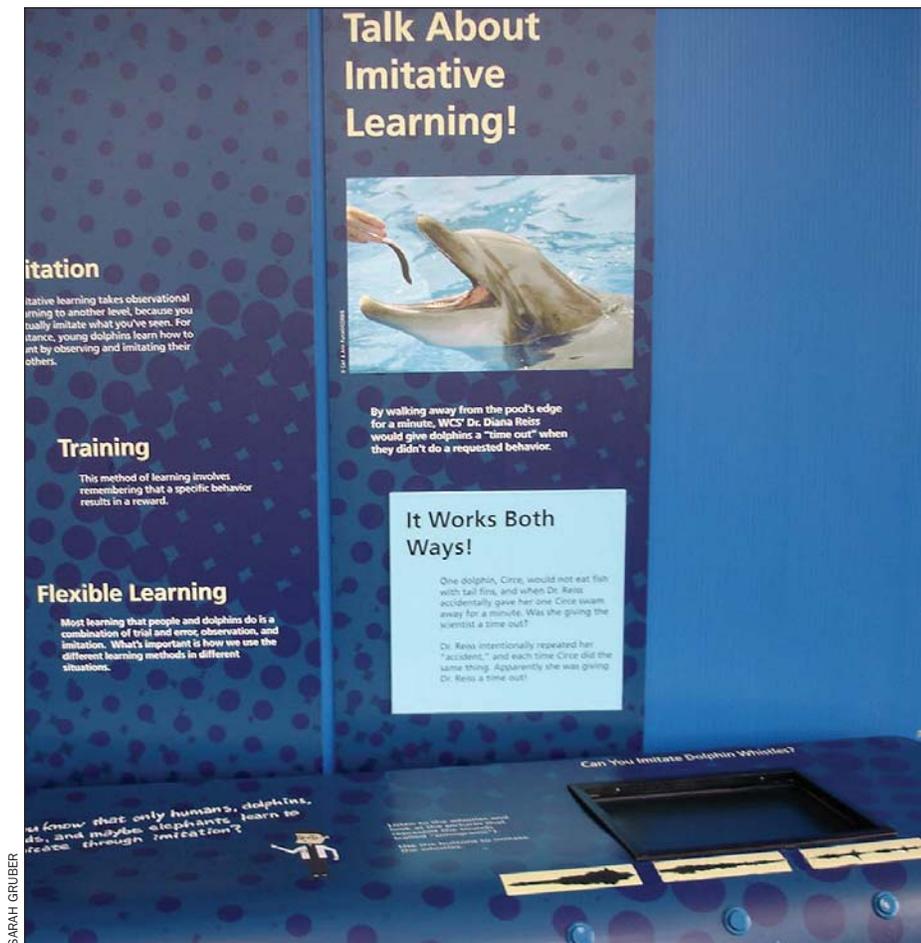
to recognize themselves, 2% (n=3) mentioned self-recognition in general, and 3% (n=4) commented on the variation of this ability across animal groups. One percent (n=1) took away the fact that research is being done in this area.

Dolphin communication was another area that provided new information, as noted by 8% (n=12) of visitors. This included information about both general and specific abilities, the latter regarding the use and interpretation of symbols and gestural communication. Information about how dolphins learn and use their whistle-based communication system was noted by another 7% (n=10) of the audience. Elements mentioned by visitors in this zone included general information on whistles (3%, n=5), the variety of sounds or whistles made (2%, n=3), the ability to learn whistles through imitation (1%, n=2), and the encounter with the sounds themselves—that dolphins are “noisy” (1%, n=1).

Finally, the exhibit zone showing the social stories of dolphins and their complex social interactions both with other dolphins and with humans apparently generated the fewest number of new ideas. Only 3% (n=4) mentioned this section, all of whom focused on having learned that dolphins help humans catch fish. This particular fact seemed to be endearing and interesting to those visitors.

In addition to these specific, zone-focused comments, 13% (n=19) of visitors talked about other concepts that were new and memorable for them. Some of these comments reflected personal associations or overarching themes, rather than specific content points from an area in the exhibit. For example, one visitor stated that he was taking away the idea that “We can learn a lot about ourselves from the study of animals.”

It should be noted, however, that a substantial number of visitors (22%,



The Whistle Imitation station of the pilot exhibit.

n=31) were unable or unwilling to provide a response to this question. Primarily these visitors said they learned nothing new (10%, n=14), declined to answer at all (3%, n=4), or reported they did not know what they were taking away (6%, n=9). Also included were a few visitors who indicated they already knew the material (1%, n=2) or vaguely indicated that "a lot of things" were new ideas for them (1%, n=1).

Most Interesting Area

In order to determine both which portions and concepts of the exhibit were most engaging for visitors and what, if any, correspondence that judgment had with their cognitive learning, we asked visitors what part of the exhibit was most interesting to them and why. These responses were scored according to which exhibit zone was mentioned; the particular reasons for the interest, or features of the zone noted, were counted as a sub-score.

Responses were spread across all zones of the exhibit, and while some zones received more attention than others (e.g., Learning and Whistle Imitation), no one area dominated substantially in the experiences of most of our visitors (see

Table 5.4

Which part of the exhibit was most interesting to you? (n=143)

	% of visitors
Learning & Whistle Imitation	25%
Creative bubble play	17%
Echolocation & Cross-Modal Perception	15%
Communication & Symbols	10%
Mirror Self-Recognition	8%
Social Systems and Interactions	7%
WCS — Conservation & Current Research	1%
Other non-zone related comments	16%

“How they help fisherman catch and they eat what is left over.”

Table 5.4).

Interestingly, while for some zones (e.g., Learning & Whistle Imitation and Social Systems) the interactive stations and activities were frequently mentioned as the reason for interest, for other interactive zones the interest was evoked by the content and information (e.g., Bubble Play and Echolocation).

In the category of other non-zone related comments, a few people said that there was nothing in the exhibit that interested them (3%, n=5). This seems to indicate that, for the most part, even the 22% of our audience who were unable or unwilling to identify a new idea found some aspect of the exhibit at least somewhat interesting or enjoyable. Other comments in this category included references to common elements of the exhibit, such as “interactives” or “videos,” or non-specific responses such as, “everything was interesting.”

Table 5.5

Percent of visitors who responded in concern-based and affective ways. (n=143)

	% of visitors*
Awe, wonder, feeling impressed	30%
Closeness to humans	21%
Emotional affinity	17%
Need for conservation	15%
Empathy, perspective-taking	3%
Indignant about harm	2%

*Visitors responses often fell into two or more categories, therefore percentages may add up to more than 100%

Comparison by Q-Perspectives

When comparing the responses of visitors from different Q-perspectives, only a few trends emerge. In reference to the main idea of the exhibit, those in Perspectives A and C seemed somewhat more likely to mention Cognition and/or Communication as a theme, whereas those in Perspective B were slightly more likely to provide a vague response (e.g., “To teach about dolphins.”).

Regarding the new ideas that were most influential, those in Perspective A were somewhat less likely to talk about the concepts from the Creative Bubble Play area and more likely to talk about the Communication zone. In contrast, those from Perspective B less frequently mentioned ideas related to Communication.

Similarly, those in Perspective A were less likely to indicate that the Bubble Play zone was the most interesting to them, while those in Perspective B tended to mention it more often.

“It shows a little bit of how dolphins really are social animals.”

Concern and Conservation Thinking

We observed in the survey results that a number of visitors made direct connections from their experiences in the exhibit to a sense of concern for conservation of dolphins and ocean habitats. Since one of the underlying rationales for this exhibit was that a greater appreciation of dolphins’ mental abilities would help visitors develop greater concern for dolphin protection, we looked at responses to the structured interviews for evidence of such concern.

We analyzed the interviews for evidence of nature protective language based on prior research into the psychology of environmental values. We coded the responses based on statements that demonstrated increased expression of empathy (Schultz, 2000), emotional affinity for an animal (an affective or emotional response) (Kals, Schumacher, & Montada, 1999), indignation about harm (Kals, et al., 1999), and willingness to consider an animal as nearer to humans (i.e., possessing human-like traits or abilities) (Meyers, 2002). Additionally, we looked for those visitors who directly expressed their concern for dolphins and ocean environments in their responses.

We also included among these attributes the quality of awe and wonder, which has not yet been related to nature-protective behavior through empirical research. However, it has been cited by many environmental philosophers, educators, psychologists, and conservation biologists as a powerful, albeit difficult

to measure, component of the development of care and concern for nature (e.g., Vining, 2003; Muerdter, 2005; Haluza-DeLay, 2005; Leopold, 1989).

In our interviews, we did not directly ask visitors to discuss their response to the exhibit in terms of emotional affinity or increased feelings of concern. In fact, we used questions that were structured primarily to elicit responses regarding exhibit messaging and cognitive learning. In spite of this, we found that we were able to examine all visitor responses for those that contained one or more of the concern characteristics; we used this as the metric for measuring the potential for increased caring or concern for dolphins.

Our results showed that 61% (n=87) of visitors spontaneously responded to the exhibit in ways that suggested the underpinnings of concern and protective thinking (see Table 5.5).

Within these broad categories, we noticed several sub-patterns in the types of responses given. Consequently, responses within each of these categories were further broken down into subgroups that better characterized the nature of how visitors expressed such concern-related feelings.

Of the 30% of visitors who indicated a sense of awe or wonder, 14% (n=20) directly expressed this awe through words such as amazing, fascinated, or impressed. Thirteen-percent (n=19) indicated a sense of awe by noting the uniqueness or superiority of dolphins to other animals. Examples of this include

“It placed them (dolphins) in a higher order of sentience and intelligence than most other mammals.”

“[The purpose of the exhibit is] to make people realize that dolphins are more than fish. They think.”

Also included in this category were statements that dolphins have abilities beyond those of humans (e.g., echolocation), increased appreciation for dolphins’ intelligence, and a new awareness that dolphins are more than show or display animals (3%, n=4 in each category).

Of the 21% who indicated after this exhibit that they recognized the closeness, or similarity, of humans and dolphins, most explicitly stated this, as well as their willingness to consider dolphins as having quite human-like abilities (18%, n=26), while 4% (n=6) implied such recognition by attributing to dolphins traits that are generally considered uniquely human, such as culture, language, or creative thinking.

As shown in Table 5.5, the responses of 17% of exiting visitors reflected an emotional affinity with dolphins. Most of these (8%, n=12), expressed this affinity through positive, affective descriptors of dolphins such as gentle, lovable, and sweet. An additional 6% (n=8) expressed this in terms of the reciprocal relationship between humans and dolphins; we can learn from them and learn to live peacefully with them. More direct expressions of affinity, such as “we love them” and “I would like to go meet them in their habitat,” were made by 2% (n=3) of visitors. The same number indicated a belief that dolphins were emotional, feeling creatures. These results appeared to parallel our findings from reviewing popular narratives, where dolphins are portrayed as peaceful and loving.

Notably, 15% (n=21) of respondents directly indicated awareness or concern about the conservation or protection of dolphins and their ocean habitats in response to this exhibit, though this was not solicited explicitly in our surveys.

The two remaining categories, Empathy and Perspective-taking and Indignation about Harm, were not frequently represented, but did appear in striking ways in a few visitors’ responses. One can imagine that feelings of empathy factored in some of the responses discussed above; however 3% (n=5) of visitors used language that directly indicated they experienced such feelings during their time spent in the exhibit. Examples of such responses include

“How they help fisherman fish, that was interesting to me. I didn’t know that at all. And how they work together to get the herd of fish in so that they can eat. They signal each other, ‘Look, I’ve got some fish here!’”

“How they work together in social groups like humans. How they’re very much alike with humans. It’s interesting to know that even three generations can live together.”

“In the exhibit, you feel like you are with the dolphins.”

“[The purpose is] to educate about how dolphins think and what they go through.”

Finally, we looked at responses for an indication of a sense of indignation of harm (Kals, et al., 1999). Although this exhibit devoted virtually no space to discussions of harms faced by dolphins in the wild, 2% (n=3) of visitors expressed outrage over such concerns. These comments appeared to be a result of the exhibit experience working in combination with the visitor’s prior knowledge. Two visitors expressed indignation over of the military’s use of dolphins (part of their prior knowledge base), and another expressed indignation about the thoughtless killing of animals by humans.

“It reminded me that the military is using dolphins as underwater mines and to discover underwater mines. This is wrong. They should not be involved in war.”

“How fast their sonar works. Which is why the Navy uses them, which is horrible.”

“It reminded me that we kill animals without thinking about the consequences.”

The military use of dolphins is a narrative that emerged in the 1960s as a result of cold war research (Bryld & Lykke, 2000), and has been reinforced in film (Nichols & Levine, 1973). Irrespective of the current use of dolphins, the acceptance of this narrative appears to contribute to increased concern for dolphins following learning about the animals’ cognitive abilities.

Q-Perspectives and Concern

When we look at the question of concern based on each visitor’s Q-perspective, two categories of concern appeared to be influenced by a person’s Q-perspective: Awe/Wonder and Emotional Affinity. In the category of Awe/Wonder, visitors identified as Perspectives A and C had a somewhat higher proportion of responses than would be expected, and Perspectives B and AB (indicating association with both perspectives equally) were somewhat underrepresented in this category. The situation was reversed for the category of Emotional Affinity. In this category, Perspectives B and AB had a higher than expected representation, while Perspectives A and C were somewhat lower.

In-Depth Interviews

By conducting free-form interviews that focused attention on just one zone of the exhibit, we obtained more thoughtful responses about both the cognitive learning and affective experiences. These interviews generally confirmed findings from the structured interviews, particularly in terms of the concepts that were most influential and resonated most strongly with visitors. This data also filled in some gaps about which elements provided confirmation of preconceptions versus those that had the effect of changing visitor perceptions.

The in-depth interviews yielded more detailed response than did the structured interview on some zones, such as Social Stories, from which we saw three patterns emerge. Some visitors seemed attuned to and moved by the portrayals of the human-dolphin relationship, including helping fishermen and apparently friendly behavior. Others were more focused on the presentation of dolphin-dolphin relationships and interactions, while still others looked at these systems in light of similarities between the social systems of humans and dolphins. This demonstrates that no one type of social experience resonates for visitors more than another.

These interviews were also more revealing about how the exhibit connected

to or modified the way people thought about dolphins prior to experiencing the exhibit. Many visitors felt the exhibit confirmed their prior perceptions of dolphins, particularly in terms of affective responses (e.g., having always “liked” dolphins) and of characteristics of dolphins, such as intelligence, friendliness, and playfulness.

We were quite interested to learn how we may have influenced or even changed visitors’ characterizations of dolphins. As many visitors pointed out, because they often entered with an already positive perception of dolphins, change was not always a matter of altering perceptions in full, but of refining and enhancing those perceptions based on factual information leading to an increase in regard and concern for the animal. When we asked visitors directly about changes in their thinking about dolphins, they reported two major shifts—increases in their appreciation for dolphins and/or the provision of new or additional information about dolphins. These two trends provide evidence that the two lines of analysis (cognitive and affective) used with the first set of data were reflective of what actually took place in the visitor experience.

For those visitors who indicated an increased appreciation for dolphins, the nature of their responses corresponded to the analysis done with data from the structured interviews. We found that they demonstrated their increased appreciation through comments about dolphin intelligence (smarter than I thought, amazing, etc.), their similarity to humans (abilities, behavior, skills), awe/wonder (more than just a show animal), and affinity (increased love and affection).

Timing and Tracking

While conducting timing and tracking studies, evaluators noticed that some people entered the exhibit and engaged with several of the exhibit zones, while others seemed to enter, take a quick survey of the space, and exit relatively quickly. Such rapid exits may be due to a realization that the exhibit did not contain live animals, was not of interest to the visitor, or was not the location the visitor expected (the exhibit’s location had been used as a café as recently as a year earlier). Due to this observation, we chose to divide the visitors observed for timing and tracking into two groups, those who spent two minutes or less in the exhibit, and those who spent more than two minutes in the exhibit. We chose two minutes as the cut-off point because casual observation identified that as the approximate amount of time needed for an unengaged walk-through of the space.

As expected, those visitors who spent less than two minutes in the exhibit were recorded as having spent very little time at any of the stations. The average times spent at each station ranged between thirteen seconds and no time at all.

“We always loved dolphins. We’re just more amazed by them.”

Table 5.6

Mean and maximum times spent at each zone by visitors spending more than two minutes in exhibit.

	Mean Time	Maximum Time
Social Stories	0.33	2.03
Mirror Self-Recognition	0.04	0.36
Bubble Play	0.34	2.17
Whistles/Learning	0.53	3.14
Communication	0.42	4.50
Echolocation	0.53	4.54
WCS/Comments	0.13	2.00



SARAH GRUBER

Aquarium Think Tank Pilot Exhibit: “science” side, left, and “dolphin” side.

For those who spent more than two minutes in the exhibit space, the average time spent at individual zones ranged between four seconds and nearly a minute, with the Whistle Imitation zone and the Echolocation zone generally holding visitors for the longest amount of time (see Table 5.6). The differences in these times may also reflect differences in the amount of information, video, and activity options at each station. For instance, Mirror Self-Recognition was a relatively small zone, whereas Echolocation contained several videos, interactive activities, and substantial text.

Looking at the patterns by individual visitors, it is apparent that most visitors divided their time unevenly between the zones, spending a longer time in certain areas and sometimes bypassing other zones. For those zones on which visitors chose to focus their attention, maximum times ran generally between two and five minutes (see Table 5.6). Again, Mirror Self-Recognition was the exception, likely due to the small size and simplicity of that zone.

What Did We Learn?

- The majority of visitors to the *Aquarium Think Tank* pilot exhibit understood, were interested in, and learned something from some or all of the content presented; primarily, that the exhibit presented evidence of dolphins' complex cognitive and communication abilities. Despite the complexities of the concepts and scientific terminology used in many of the components of this exhibit, visitors were able to refine, in some way, their initial general awareness that dolphins are intelligent animals.
- Earlier evaluations aided substantially in devising ways to present information that enhanced or, minimally, maintained visitor understanding of dolphin intelligence. An exemplary case was the Echolocation zone, about which participants in an earlier evaluation tended to create idiosyncratic and erroneous explanations in the face of limited interpretation. The targeted changes in presentation, including the creation of a touch screen interactive panel to explore how dolphins use echolocation and more deliberate and explicit interpretation, appeared to greatly improve the visitor experience. In both the structured and semi-structured interviews, visitors indicated that they understood echolocation and how dolphins use it.
- The Echolocation zone also seemed to allow visitors to focus on two different levels of the content. Some visitors focused attention on new information learned about basic mechanics of echolocation/sonar for dolphins. Others, who were perhaps somewhat familiar with this concept, noted new understanding of how dolphins used this ability, particularly in ways that indicated cognitive complexity.
- The pilot exhibit visitors made fewer references to animal training in their explanation of dolphin activity than those interviewed in our earlier exhibit lab study. These references were virtually absent in either the structured or semi-structured interviews. It appears that deliberately modifying the videos and other interpretation to emphasize dolphins' capability and behavior—by focusing on wild behaviors and limiting the presence of humans in video and pictures—allowed visitors to focus more on their cognitive abilities.
- Visitors responded to both the cognitive and affective themes of this exhibit, recognizing the scientific information about dolphin intelligence and developing an increased appreciation for these animals. The success in both of these areas suggests that if visitors learn about dolphin intelligence, they will increase their regard and concern for the welfare and conservation of these animals.
- Despite the fact that the topic of dolphin conservation was minimally emphasized in the exhibit, at least 13% of our visitors absorbed, or were stirred to consider, a conservation or concern-related message. In addition, over 60% of visitors responded with awe, affiliation, esteem, or empathy, sentiments thought to be foundational to an attitude of concern and responsibility for the protection of these animals in the wild.
- Some of the pilot exhibit visitors seemed to be minimally engaged with the material. One explanation we propose for this is the absence of live dolphins, particularly in the face of aquarium visitors' expectations. In light of research that indicates that presence of a live animal can promote more synthesizing conversation among visitors than an exhibit zone that does not include an animal (Allen, 2002), we believe that integrating features of the *Aquarium Think Tank* with a live dolphin exhibit could richly complement and enhance the visitor experience, as well as better communicate both information and messages.
- Our results suggest that an individual's social perspective was related to both their content preference (i.e., which of the stations were most influential to them) and to the category of concern evinced in their responses (e.g., Awe/Wonder or Emotional Affinity). Further research could potentially uncover more detail about these interactions.



By studying and identifying specific ways to promote caring, aquariums can redesign their dolphin displays to optimize learning outcomes.



CONCLUSIONS

This WCS research project sought to

- identify how best to use aquarium interpretive design to improve understanding of dolphin intelligence;
- identify how behavioral science research influences conservation values;
- make recommendations for approaches and tactics that can be most effective at promoting conservation and action.

Specifically, we wanted to address a pair of guiding questions for developing an exhibit about dolphin cognition: What do visitors think, believe, and feel about dolphins? and How do their attitudinal profiles affect how they interact with various presentations and content related to dolphin intelligence? The research approaches included literature reviews, surveys, in-depth interviews—some involving conceptual probing, others including the presentation of concrete prompts and activities. The outputs from this project represent a comprehensive review of the influences of belief on the acceptance of scientific research. The outputs also demonstrate that some research topics have universal appeal that offer visitors access to science, while other topics may appeal more to those who already consider dolphins to be capable of complex thinking and abilities.

In order for exhibits at aquariums to operate as effective contributors to the conservation movement, we need to understand how a subject is understood by guests and what conceptual barriers may limit the acquisition and development of knowledge and new understanding. One of these access points to conservation concern is an understanding and appreciation of the minds of other animals. As discussed in Chapter 2, the dolphin presents an ideal through which to explore these issues, given the public's predisposition to value the species and recent research uncovering the extent of their cognitive capacity. By studying and identifying specific ways to promote caring, aquariums can redesign their dolphin displays to optimize learning outcomes.

Key findings:

1. Visitors do not gain an understanding of dolphin intelligence from dolphin shows alone.
2. Visitors hold a very positive stereotype of dolphins, including their intelligence, but most are unable to describe the extent of that intelligence.
3. Dolphins' ability to communicate is widely recognized and accepted by visitors; it can serve as a highly accessible topic for promoting understanding about dolphin cognition and cognitive research.
4. Along with affective appreciation, science learning about animal intelligence offers an effective tool for promoting conservation concern, and this concern can be evoked with minimal explicit interpretation on the topic.
5. Using technology to explain dolphins' uses of echolocation facilitates increased comprehension of the concept.
6. Aquarium visitors have a practical understanding of dolphins that is generally not mystical in nature; however, they vary in the extent to which they are comfortable with mystical or idealistic characterizations of dolphins. They also vary in their comfort level with negative portrayals of dolphins. These varying comfort levels influence interaction with and learning from exhibit content.
7. Visitors' comprehension of various concepts is confounded by their lack

of understanding of the complex nature of these concepts and abilities. That is, they may take for granted those activities that they engage in easily and without awareness (e.g., trial and error learning) and therefore may be less likely to consider these as representing complex cognitive ability.

8. Visitors have a tendency to attribute behaviors that reflect dolphin intelligence to training, particularly when these behaviors are demonstrated by dolphins in aquariums. This misconception can be mitigated by being mindful of context and interpretation in presenting dolphins interacting with humans, and by highlighting dolphin behavior in the wild.
9. One way to increase the accessibility of difficult or less salient concepts about animal intelligence is to correlate these concepts as directly as possible to human intelligence and behavior.
10. There is no such thing as a general public. Understanding the varying perspectives through which visitors interpret an exhibit is critical to ensuring that the exhibit reaches its goals—that there are qualities, features, atmospheres, and content that can appeal to various belief systems. We believe that exploring these belief systems provides invaluable information with which we can build lasting bridges between visitors and the natural world.
11. The perspectives uncovered in this project suggest that social narratives influence how scientific information informs the development of environmental concern. Some visitors will respond from an affective dimension to the subject of dolphin intelligence; these visitors can increase their affective appreciation for the animals at the same time as they explore more scientific information about the animals. Other visitors, who tend to ground their beliefs in scientific evidence from the start, can be encouraged to interact with content that inspires awe and wonder about dolphin abilities, if presented in the context of more comfortable science-based content.
12. Pre-existing visitor perspectives about dolphin intelligence influence which exhibit elements a visitor will focus on. These perspectives also influence how visitors express their concern for these animals.

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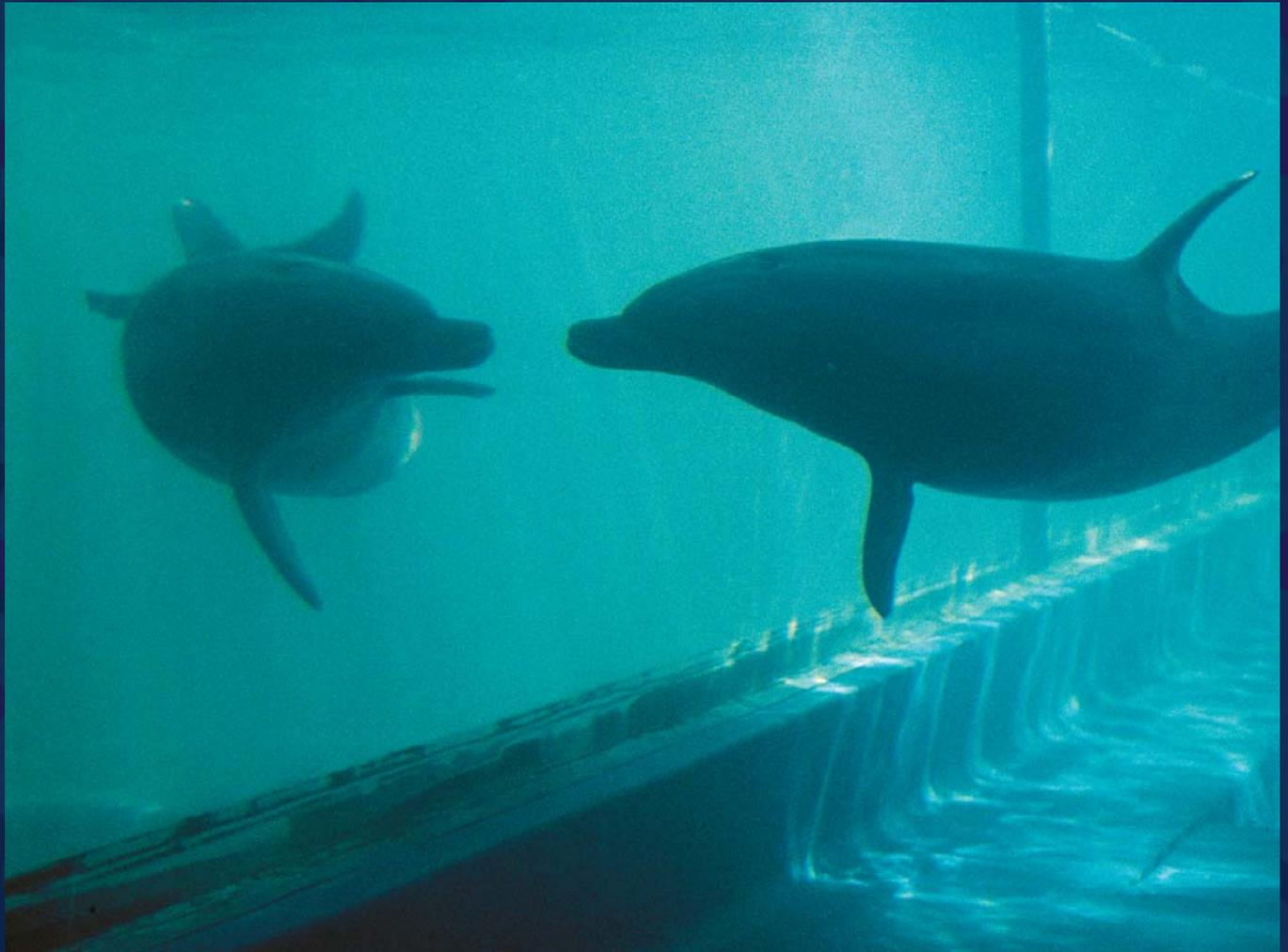
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By focusing more attention on the whole animal and providing visitors with new information about the social lives and intelligence of dolphins, particularly in ways that people can relate to their own learning and behavior, we believe they will feel more of a connection to and empathy for the animals. We believe that this approach will encourage people to see dolphins as highly evolved sentient beings deserving of protection from human-caused species decline.