

# Dolphins and the Question of Personhood

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In the challenge to humanity's self-declared status as the apex of the biological hierarchy, center stage has been given to the nonhuman great apes - chimpanzees, gorillas and orangutans. Their genetic makeup, psychological capacities, and cognitive abilities reveal that these beings are so much like humans that it now seems that only patently biased and self-serving objections could be advanced against the Great Ape Project's call to recognize these mammals as members of the "community of equals". In particular, the ability of such apes as Washoe, Koko, Chantek and Kanzi to communicate via sign language or lexical keyboard has made a powerful case for the idea that these beings are self-aware with impressive linguistic abilities and a surprisingly rich inner life. In short, an overwhelming case can now be made for the claim that chimpanzees, gorillas and orangutans are, indeed, nonhuman persons.

To the extent that the debate stimulated by the Great Ape Project has advanced the standing of this group of nonhumans in the moral community, this marks major progress. However, precisely because of the close relationship between humans and other members of the great ape family, the debate about whether chimps, gorillas and orangutans are persons has been dominated by criteria that essentially mirror humanity. That is to say, the case in behalf of these great apes largely boils down to arguing how similar they are to humans. Accordingly, discussion about whether these apes are persons focuses primarily on such issues as how well they use tools, comprehend human speech, use human-designed languages and even perform on human intelligence tests. Yet while this is an understandable strategy because it makes it easier for members of our own biological family to be seen as persons, it makes it harder to extend this status to beings who have very different evolutionary histories from ours or live in environments foreign to humans. In short, the gains made on the one hand risk being offset on the other by an unwitting encouragement of species bias in the definition of personhood.

The beings most likely to be overlooked on this score are, paradoxically, those who probably have an even stronger case for personhood than the great

apes - the cetaceans, especially dolphins. These marine mammals have been the object of human fascination for millennia, and between anecdotal and scientific evidence, they have emerged as beings who are highly sophisticated - socially, intellectually and emotionally. However, dolphins remain especially vulnerable to harm from humans. Human fishing techniques regularly harass dolphin communities; tuna fishing and driftnets have killed millions of dolphins; hundreds of dolphins worldwide live in entertainment facilities; "dolphin swim" programs are spreading; wild dolphins still are occasionally taken from their home waters; and ecotourism threatens significant social disruption of dolphin communities. In order to have a firm philosophical basis to challenge these human behaviors, it is especially important that dolphins' standing in the moral community be recognized.

### Personhood

Although philosophers debate the appropriate criteria for personhood, there is a rough consensus that a person is a being with a particular kind of sophisticated consciousness or inner world. Persons are aware of the world of which they are a part, and they are aware of their experiences. In particular, persons are aware of the fact that *they are aware*, that is, they have some sort of *self-awareness* and reflective consciousness. And the presence of such a sophisticated consciousness is evident in the actions of such beings.

If we translate this general idea into a more specific list of criteria, we arrive at something like the following.

1. A person is alive.
2. A person is aware.
3. A person feels positive and negative sensations.
4. A person has emotions.
5. A person has a sense of self.
6. A person controls its own behavior.
7. A person recognizes other persons.
8. A person has a variety of sophisticated cognitive abilities.

There are, of course, potential problems with this or any such list.

– For example, precisely what do we mean by "alive"? If technological advances eventually produce an intelligent computer of the sort that now inhabits only science fiction novels, would it qualify as a person?

– As our list of necessary traits unfolds, we see a being that is unquestionably a "who", not a "what". But how sophisticated are the cognitive abilities that we

require? Must a person be able to write poetry, or will the ability to solve novel problems be enough? If we specify the capacity to solve problems, how complex should the problems be? If we expect the ability to communicate, must "communication" entail the ability to discuss philosophical aspects of life, or is something equivalent to exchanging "hellos" enough?

– How much should such a list of necessary conditions take into account differences among species? For example, even though dolphins began as land mammals, they evolved mainly in the water - something that calls for very different adaptations in order to survive. Might there be critical differences in the way "intelligence", for example, manifests itself in the water as opposed to on land? How do we define "communication" in light of the fact that dolphins lack both vocal cords (with which to form words) and hands (with which to use sign language) and instead use a system of whistles, touches and postures? In assessing dolphins' higher order abilities, how much weight should we put on the fact that technologies based on fire and electricity are impossible to develop in the water and that record keeping and data storage are far more difficult in the oceans than on land? Might there be core differences between aquatic persons and land-based persons? What is the best way to approach the issue of nonhuman intelligence?

– Not only is it impossible at this point to know the precise character of dolphins' cognitive and affective abilities, but it is more difficult to draw inferences about them than about the capacities of apes, for example. At least with trying to understand the nature of apes, there are significant genetic, anatomical and cultural similarities with humans that we can work from. In light of the more fundamental differences between humans and dolphins, what counts as a reasonable inference from observed behavior about a dolphin's cognitive and affective capacities? How much speculation is allowable in discussing whether dolphins are persons?

– Indeed, is personhood sufficiently neutral a concept to guarantee philosophical objectivity? Despite the intentions of the proponents of this concept to the contrary, does personhood reflect too closely the central traits that humans value about themselves? Is the concept colored with species bias in a way that will make it unlikely that beings who are very different from humans will ever be recognized as persons? Is there also the danger that personhood can blind us to the value of nonpersons?<sup>1</sup>

Nonetheless, while we recognize the existence of such problems in trying to assess the possibility of nonhuman persons, we believe that dolphins evidence all of the necessary traits to enough of a degree that they should be regarded as persons.<sup>2</sup>

## Dolphins and Personhood

### *Dolphins: basic facts*

Dolphins are mammals who belong to the Order known as Cetacea (whales, dolphins and porpoises). The common ancestor of the modern cetaceans was a land mammal who returned to the ocean 50 to 60 million years ago. Cetaceans are divided into odontocetes (toothed) and mysticetes (untoothed). Most of the great whales (right whales, grey whales and blue whales, for example) belong to the latter category and use baleen to strain the water for tiny organisms. Dolphins, orcas, porpoises, freshwater river dolphins and sperm whales belong to the former. Hence, dolphins are essentially small toothed whales. Humans are most familiar with the bottlenose dolphin, but there are actually more than 30 species of dolphins.

Dolphins are social animals, living in groups that range from a few members to thousands. Some communities are coastal; others are pelagic. Dolphins appear to have a rich social life, devoting considerable time and energy to rearing children and tending to relationships which will sometimes stretch over decades. Dolphins are bisexual, and their societies are similar to that described for bonobo society; sex is part of a constant social negotiation within and between both gender and age class. Dolphin cultures engage in highly complicated social and sexual politics, which both affirm relationships between individuals as well as provide basic mating needs. Dolphins are usually considered fission/fusion societies, with dynamic hierarchical relationships tending towards fluidity. Calves stay with their mothers for 3 to 5 years, then are overseen in juvenile groups for about another 5 years. Females generally have their first calf between 6 and 12 years, depending on the species, at which time they rejoin their mothers and other adult females in the center of the community. Adult males tend to swim together and form long term alliances which seem to function in monitoring and protecting the group.

Dolphins have large brains with a substantial cerebral cortex. They appear to have considerable cognitive ability (detailed below). They communicate with each other through a complex system of whistles, postures and touches that is only just beginning to be decoded in its details. Sound is the dolphins' primary tool for perceiving their world. They project sonic "clicks" and generate three-dimensional images of the world around them from the returning echoes. This system (echolocation) is so sophisticated that in one famous experiment, dolphins could tell apart two small copper and aluminum disks only 1/16 inch thick. Since sound passes through living tissue, dolphins are also able to "see through" each other. There are even stories of dolphins detecting human pregnancies.

*Are dolphins persons?*

In what specific ways, however, do dolphins fulfill the necessary conditions for personhood?

## 1. 2. 3. Life, awareness, positive and negative sensations

There is little question that dolphins meet the first three qualifications for personhood. Like all other animals, they are alive; they are aware of their surroundings; and they experience physical pleasure and pain.

## 4. Emotions

Among scientists and dolphin trainers, there is also little doubt that dolphins have emotions, that is, that dolphins behave in ways that suggest that they have such feelings. But this too is not surprising since a growing number of humans seems willing to concede that nonhumans have some kind of emotional life.<sup>3</sup> A variety of behaviors are taken to suggest anger or displeasure, for example: tail-slapping, open mouth behavior, head to head confrontation, penile display. Dolphins also show fear of predators and grieve or become despondent after the death of a calf or companion.<sup>4</sup> Captive bottlenose dolphins have acted in ways that suggest excitement, sadness, surprise and even humor.<sup>5</sup> Many trainers speak of the captive dolphins with whom they work in a way that suggests that the dolphins have such a sophisticated emotional life that they have "personalities". Some dolphins are described as "timid", while others are seen as "adventurous", for example.<sup>6</sup>

Dolphins themselves appear to recognize these individual differences in emotional character and behave accordingly. The complex social interaction in which they engage would probably be impossible without such an awareness. The ability to recognize siblings, friends, and neighbors and the capacity for subtle interpretation of emotion in conspecifics are crucial to survival in the dolphins' socially and politically complex world and borne out by known facts of their associations with each other lasting years.

## 5. Sense of self

It is one thing to experience physical pleasure, pain and a variety of emotions. But it is quite another to be aware that one is having these experiences and to be able to reflect on them. And so, we come to one of the more important requirements for personhood - self-awareness. Can a dolphin look inside and say "I"?

There are at least two grounds for believing that dolphins have some concept of self. First, dolphins use a unique whistle called a "signature whistle". That is, each dolphin has the equivalent of a "name", a concept that seems to require

some sense of “self”. Dolphins have been observed using the signature whistle of another dolphin when that dolphin is absent or distant.<sup>7</sup> Although other contextual situations have been reported during the production of the signature whistles, the primary use of the signature whistle is as a contact call between individuals separated at a distance.<sup>8</sup> Because of both the individually identifying information contained in the whistle and the physical nature of the whistle, which allows it be transmitted over miles, a primary function of the whistle is to reduce separation between specific individuals, e.g., mother and calf.<sup>9</sup>

Second, preliminary evidence suggests that dolphins are able to recognize reflections of themselves in mirrors as just that, reflections.<sup>10</sup> To date, only humans and the other great apes have demonstrated this capability. All other nonhumans - and human children before a certain age - mistake the image for another animal or child. For dolphins to join us in this group, they would clearly need the capacity to say the equivalent of: “The image in this surface is a representation of *me*. It is not some *other*”.<sup>11</sup>

## 6. Self-controlled behavior

By “self-controlled behavior” we mean actions that are generated from within the person and are not the direct result of irresistible internal or external forces. This means minimally a noteworthy ability to act independently of instinct, biological drives or conditioning. The capacity of a person to be the author of its own actions is important for two reasons. First, it demonstrates that a being’s cognitive and affective states are sophisticated enough to have an impact on its actions. Hence, a person’s actions can be construed as being more than automatic, unthinking responses to stimuli. Actions can in some fashion be said to belong to the person doing them, that is, to be evidence of, as it is traditionally put, a “free will”. Second, some significant capacity of choice allows us to say that the being in question is “responsible” for its actions. And a concept of responsibility is necessary for us to enter the domain of ethics, and to begin to lay the basis for some of the strongest claims for regarding dolphins as members of the community of equals.

Do dolphins control their actions sufficiently that we can say they *choose* them? Do dolphins behave in ways that suggest that they expect that they and/or others control their actions in certain ways? That is, do they show any evidence of understanding and using a concept of responsibility?

Choice and control of behavior are demonstrated by some of the most mundane actions that dolphins perform: sex and feeding. One of the traditional claims for human superiority over other animals is that we have much greater control over our sexuality than they do over theirs. Most nonhumans mate because instinct drives them to respond in one way to their own or their mate’s reproductive cycle, and they mate *only* because of this. Human beings, by

contrast, stand almost alone among animals in having sex for reasons other than procreation. Dolphins, however, appear to share this trait.<sup>12</sup>

Another example of self-controlled behavior comes from the way that some dolphins have been observed feeding in the wild. For example, Bernd Wursig has observed that when small groups of dolphins discover a school of anchovies, they herd them together, signal nearby dolphins about the catch, and wait until the others join them before eating. The group will herd the anchovies into a ball against the surface, then take turns passing through it to feed while others keep the ball intact. As many as 300 dolphins may join in orchestrating such a meal. Such complex cooperation suggests that these dolphins are in control of their actions. As Wursig notes,

herding and holding of prey are not a stereotyped series of actions. At times, the fish school may fragment into smaller balls. When that occurs, a few of the dolphins break off from the group and herd the fish back into the central fish school. It is a dynamic, ever-changing system, which may require organization by these large-brained and communicative social animals. Differential role-playing and premeditation (such as a decision that certain members do particular things in order to meet various contingencies) may be important in this kind of cooperation. The degree of behavior flexibility to encompass novel situations appears well developed.<sup>13</sup>

And there is at least one case in Brazil where dolphins and humans have cooperated in catching fish since 1847. Karen Pryor and Jon Lindberg note:

In Laguna, a resort town in southern Brazil, forty or more thrownet fishermen standing in a line is a daily event. [About 30] resident bottlenose dolphins [out of an estimated local population of approximately 200] have developed a technique of driving mullet toward the fishermen in order to catch fish the nets miss, for themselves. The technique is highly ritualized and involves learned behavior on both sides. The fishing takes place all day, every day, all year, except in the worst winter weather. This highly effective system may have begun over 100 years ago... When a dolphin senses a school of fish entering the lagoon, it [*sic*] rounds up the fish and drives them toward the line of men. At net-diameter distance from the line, the dolphin makes a conspicuous roll, which indicates both the location and the approximate quantity of fish. The men cannot see the fish in the muddy water. Relying on the dolphin's cues, they cast their nets. The dolphins choose the fishing locations, which may vary from hour to hour; the men must follow if the dolphins move. The men do not try to train the dolphins, or signal them, or feed them. The dolphins are in charge. Some mullet are trapped under the nets. Others, which the nets missed, are disoriented momentarily and make easy prey for the well-positioned dolphin.<sup>14</sup>

The most significant aspect of these two examples is that the dolphins' behavior is neither stereotyped nor conditioned. The situations are simply too complex for that to be likely. The dolphins appear to make purposeful choices in particular situations, a fact that is underscored when one keeps in mind the restraint that dolphins are showing in light of their likely considerable hunger.

Choice is also suggested in the actions of a community of wild Atlantic

spotted dolphins that for approximately 15 years has interacted with humans. These dolphins initiated this contact, which typically takes place in shallow waters approximately 50 miles offshore. Interaction with humans offers neither food nor protection from any sort of danger. The social interaction itself - whether it be some combination of curiosity, socializing or recreation - appears to be the motivation for this phenomenon. These encounters can last from 5 minutes to 4 hours involving anywhere from 1 to 50 dolphins. Given a dolphin's superior speed and agility in the water, the dolphins obviously control the duration and character of these interactions. Cetaceans are the only animals known to actively seek out contact with humans in the wild. Accordingly, it seems difficult to imagine any other explanation for this behavior than conscious choice.

Even more interesting, however, is the fact that dolphins seem to employ some sort of concept of responsibility, that is, they behave as though others have the power to control their actions. This may be true both intraspecifically and interspecifically. An intraspecific example stems from the fact that as they move from infancy to adulthood, they gradually oversee other individuals in the group. After a mother gives birth to another offspring, the older calf begins associating with its own juvenile age class (4-9 years old). (A typical juvenile subgroup contains 5-6 individuals with ages ranging from 3-9.) These juvenile subgroups are independent from mother/calf nursery groups during part of their daily activities. While the group travels, forages, and the like, the oldest individuals engage in disciplinary and controlling behavior which functions to keep the younger ones in line and out of harm's way. Just as young calves test their boundaries with mothers, young juveniles test boundaries with their older peers, who are expected to give feedback for inappropriate behaviors. Signals used by the experienced and older juveniles to discipline others include signature whistles (when trying to round everyone up to leave) and tail-slaps - both at a distance and directed to the face of an individual. In an extreme situation, a supervising dolphin will physically push and maneuver another individual to action. In other words, signals - acoustic, gestural and postural - are directed at an individual to gain attention and enforce a change of action. It may also be part of their social structure to give feedback to a babysitter or supervising individual to further their learning of this new responsibility. This type of feedback regularly occurs within juvenile as well as other subgroups of the society.

However, there is at least one interspecific example of the possible application of a conspecific signal from dolphin to human that suggests that dolphins may both understand and utilize a concept of responsibility in their interactions with humans.<sup>15</sup> The above mentioned community of spotted dolphins has not only sought out human interaction, but it has allowed humans to observe aspects of its culture. Since 1985, one of the authors of this paper, Denise Herzing, has observed and recorded these interactions with the aid of a changing group of volunteer

assistants. Over time, two distinctly different encounters emerged. In the one, the dolphins desire a high degree of social interaction with the humans. In the other, the humans are expected simply to watch, as the dolphins go on with aspects of their lives. This includes: child-rearing, nursing, interspecies and intraspecies aggression, mating, fishing and the like. In one particular encounter, however, a mother dolphin was teaching her calf how to fish. One of the human swimmers mistook this encounter as one in which interaction was appropriate, and her attempt to engage the calf distracted the youngster from his task at hand. The mother then swam in front of Herzing, performed a tail-slap (a sign of displeasure or attention getting), gathered her calf from the swimmer and returned to teaching her offspring how to fish.

What is striking about this action is that the mother dolphin tail-slapped in front of Herzing, not the offending swimmer. Given the context of this encounter and the history of Herzing's interactions with the community, is it possible that the mother targeted Herzing, and not the offending swimmer, because the dolphin recognized Herzing from years of encounters as the individual who was dominant in the hierarchy of humans and held her "responsible" for the actions of the other swimmers?<sup>16</sup> Could the dolphin's behavior have been a way of saying: "These are your people; keep them in line"? That is, how likely is it that the dolphin's rebuke of Herzing might have employed a concept of responsibility?

What are the possible explanations and interpretations of the mother tail-slapping in front of Herzing? 1) The mother's tail-slap was just coincidence. This is highly unlikely since the use of tail-slaps is infrequent. 2) The tail-slap was directed at the calf - also highly unlikely since the calf was at a distance and the mother moved specifically in front of Herzing before tail-slapping. 3) The tail-slap was directed at Herzing for something she did. This is also highly unlikely since Herzing was observing from the surface and had no opportunity to physically interfere in the activity. And 4) the tail-slap was directed at Herzing to alter the behavior of another *Homo sapiens*. This actually is the most simple explanation given the specific nature of the signal, the intentional position and proximity of the mother to Herzing, and the signal's regular use in trying to alter the behavior of its intended recipient. In addition, this explanation is consistent with the natural behavior of the species. That is, it is exactly the way this signal is used when directed to a responsible party of a juvenile subgroup of dolphins. Hence, it is the most likely signal to be tried by dolphins who want to communicate with a human in the water and in the context of their own society.<sup>17</sup>

## 7. Recognizing other persons

Do dolphins act in ways that suggest not only that they have a sophisticated inner world, but that they can recognize other persons? Do they behave in ways that suggest that this recognition matters to them?

Stories have been told for thousands of years, of course, of dolphins coming to the aid of lost sailors and drowning swimmers. Dolphins are altruistic with each other, engaging in baby-sitting and assisting ailing dolphins for no apparent reward.<sup>18</sup> If they recognize that we and they are both aware and intelligent, it would not be unreasonable that they might value our lives and well-being as they do their own. Many of these tales are difficult to document, however.<sup>19</sup>

Wild sociable dolphins have been documented around the world, but in most encounters lone, bottlenose dolphins are involved.<sup>20</sup> Wade Doak has also reviewed other human/dolphin encounters worldwide and reports of possible individual recognition to both boats and humans.<sup>21</sup> Certainly the wild spotted dolphins previously mentioned show one of the most complex and interesting levels of such recognition, that is, they are an intact society, and they not only allow observation of their full culture, but engage humans on a similar level. Given the nature of a dolphin's life in that part of the Atlantic, certainly one possible explanation for this phenomenon is that they recognize us as beings similar to themselves - beings who are intelligent and curious about other intelligent beings.

These dolphins began seeking out human interaction in the 1970's, and they have continued, with varied levels of interest and enthusiasm, to interact with passengers on dive boats and with members of Herzing's research team. In 1991, these dolphins began allowing humans to observe their culture. To date, these dolphins have shown: hunting and feeding; sexual behavior; disputes and the resolution of disputes; adult dolphins teaching the young skills like fishing; baby-sitting; disciplining the young; juvenile behavior; both peaceful and aggressive interactions between different species of dolphins (spotted and bottlenose). The significant issue is why these encounters take place. The interactions satisfy none of the dolphin's basic survival needs. They receive no food or protection. There's no tactile or sexual stimulation. Moreover, the interactions themselves do not seem to be that rich from the dolphins' perspective. Humans are not that agile in the water, so we surely do not represent a challenge for an aquatic mammal to swim with. The interactions occasionally consist of playing a kind of "seaweed keep away" with humans. But it seems similarly unlikely that humans are amusing or interesting enough as "play"-mates to sustain the dolphins' long-term interest. In wild dolphin society social interaction is pivotal and possibly primary in survival. That dolphins extend this to other cetaceans and even the human species, could be viewed as a natural social extension of their world, having potential survival value because of information available about other species in their world. So the dolphins' primary motivation in engaging in these encounters is most likely some kind of gratification that comes solely from social interaction with humans.

## 8. Variety of intellectual abilities

To most humans, the most important criteria for personhood are intellectual. Persons must be able to think analytically and conceptually. Their behavior must demonstrate cognitive capacities. Are there any suggestive data on these fronts? Highly suggestive are facts about: the dolphin brain, their ability to work with artificial languages, their flexible modeling system, their ability to adapt to foreign cognitive environments, their social learning and cultural transmission, and their problem solving abilities.<sup>22</sup>

*a. The dolphin brain.* Dolphins have a complex brain, and it's reasonable to infer that it performs complex operations. Features it has in common with the human brain are: 1) complexity/convolutions, 2) brain to body weight ratio, and 3) neural complexity. Features it doesn't have in common are: 1) its overall structure and organization, 2) connections to the limbic system, and probably other unknown characteristics. Lori Marino's recent studies on the relationship between brain size to body size place toothed cetaceans, specifically the dolphin family, second only to humans.<sup>23</sup> Dolphins are higher in encephalization quotient (the ratio of the brain volume to the surface area of the body) than even the great apes. Marino also suggests that because of the additional weight of blubber in the cetacean body, such a measurement may not be comparable to terrestrial body weights. The dolphin encephalization quotient may, therefore, be an underestimate and possibly closer to humans than currently measured. The dolphin family, therefore, may be the aquatic parallel to the human encephalization quotient. The significance of the EQ is that as social structures get more complex, the EQ gets higher.<sup>24</sup> The toothed cetaceans, including the dolphin family, also display the feature of "cortical adjacency" reminiscent of an early evolution into the water as well as sensory systems that are placed in close proximity to each other. That is, the higher functions are in direct connection with the major sensory areas, and this may explain the emotional/subtle nature of dolphin's communication. A society based on emotions and relationships might run everything through those channels first, and might also allow equal time to the association areas for sensory information. If so, the rational wouldn't necessarily override the emotional, and might provide more of a balance between these two elements.

Dolphin brain structure is older than ours. Our species has had the brain that we do for only about 100,000 years. Dolphins have had brains the same size or larger than ours for about 15 million years. Although different in structure, dolphin brains have apparently evolved through a similar process as those of humans: the needs and pressures for intricate societies, relationships, and complex communication between each other and their neighbors. Fifteen million years ago dolphins likely had the most highly evolved brain on the planet. With the arrival and development of higher primates, *Homo sapiens*

surpassed the dolphin's complexity. But dolphins have had 15 million years to develop the nuances of such complexity and remain at least the second most complex brain on the planet.

Memory, the bedrock of cognition, is also impressive in dolphins. In addition to the experimental work of Louis Herman and others (detailed below) we might be able to infer reasonable, or perhaps even long-term memory capabilities from observable behavior. Dolphins use "signature whistles", recall previous associations of individuals within their society, and perhaps recognize individuals outside their group. Short-term and long-term memory is paramount for individual recognition of sounds as well as long-term association patterns between individuals in the wild. The ability to express emotion, gauge social status and intention of conspecifics, and retrieve historical knowledge about individual personalities of dolphins is critical. In the wild, cross-species recognition of individuals and long-term relationships are also prevalent.

*b. Artificial languages/Adaptation to foreign cognitive environments/Flexible modeling systems.* A second indicator of intelligence is dolphins' ability to understand representational and rule-governed behavior. The work of University of Hawaii psychologist Louis Herman with two bottlenose dolphins has demonstrated that these dolphins can comprehend artificial human languages with grammars that employ nouns ("frisbee", "ball", "person"), verbs ("take", "fetch"), qualifiers ("over", "under", "left", "right"), direct and indirect objects, and syntax. The dolphins have learned about 60 words and have successfully followed about 2,000 different commands. Herman's work has also shown that these dolphins can respond "Yes" or "No" to the question of whether a particular object is in the pool with them - a mental operation that would seem to require the ability to create or recall from memory an image of a missing object. Herman's dolphins have also learned abstract concepts such as "tandem" and "creative" (perform a new behavior).<sup>25</sup>

What is probably most significant about the "language research" of Herman and others are two striking implications that proceed from the fact that dolphins have the capacity to comprehend human language to the extent they do.<sup>26</sup> First, even though there is nothing obviously parallel to human language among dolphins, it is highly unlikely, considering the age of the dolphin brain, that the cognitive capacities that dolphins evidence in language research were sitting unused until human researchers came along. One of the core facts of nature is that organs or capacities that go unused eventually disappear from the life of a species. That dolphins demonstrate the capacity to operate within an artificial representational and rule-governed system is highly suggestive of the fact that in their own lives they employ a capacity (the details of which have yet to be identified) that is as cognitively complex as the human capacity for language without being analogous in structure and form.<sup>27</sup>

However, the fact that there is nothing obviously parallel to human language among dolphins suggests that they are then operating in a foreign cognitive environment when they participate in this sort of research. And dolphins' ability to adapt to the cognitive environment of humans is an even more sophisticated intellectual capacity than handling syntax or commands that contain abstract terms.

In fact, dolphins regularly demonstrate the ability to adapt to the cognitive environments of other species. That is, they show the ability to understand roughly what it takes to work successfully with another intelligent being of a different species. In the Bahamas, wild spotted dolphins and bottlenose dolphins make the necessary adjustments to the other species and travel, mate, forage, fight, and mutually defend together.<sup>28</sup> This suggests the ability to anticipate the consequences of social interaction both within and between species and possibly a shared understanding of each other's communication signals.

John Lilly reports an adaptation of a different sort that is no less interesting. Lilly was trying to train a dolphin to whistle in order to receive a reward. While he was doing this, Lilly writes,

I noticed that [the dolphin] had added a new rule to our "game". He was raising the pitch of each subsequent whistle. Suddenly I couldn't hear the whistles any more, but I could see the individual twitches of the blow-hole. Apparently he was whistling at frequencies so high that I could not hear them. I stopped rewarding him for each twitch. He then emitted two more "supersonic" twitches, and with the third twitch I could once more hear the whistles and rewarded him. From that time on he did not go out of my acoustic range. He had determined what my hearing range was, and stayed within it for the next few hours.<sup>29</sup>

The ability to react to changing circumstances and establishing channels of communication interspecifically (cetaceans/humans) is a very sophisticated intellectual operation.

Dolphins also display what is best described as a flexible modeling system. Learning occurs through the use of mimicry, imitation, coordination and synchronization of behavior and vocalizations. Although many other species utilize mimicry and imitation, dolphins, as a group, have been noted to use mimicry for the purpose of expressing communicative intention, a behavior that requires higher mental capabilities and a recognition of "others". Dolphins also may have shared perceptions gained by eavesdropping on each other's reflected echolocation of an object and coordination of behavior as demonstrated through the synchronization of vocalizations and actions including intradolphin and cooperative hunting.

*c. Social learning and cultural transmission.* Wild dolphins demonstrate the ability to learn - observationally and socially - and to engage in the cultural transmission of such information. Such an ability clearly contributes to life in

the wild. The transmission mechanisms of such information can be vertical (mother to calf), oblique (mother/aunt/uncle to calf/juvenile), and horizontal (juvenile to juvenile, peer to peer). The profile of a society that might favor such a system of learning, such as that of dolphins, would have aspects including terminal investment (non-reproducing elders), extended parental investment (long and involved childhoods), extended maturation periods (long years of a juvenile age class and learning opportunities), and opportunities for cross-generation rearing (mixing of and long-term associations with all age classes in the society). We might also expect complex communication systems to evolve in such a system and the study of such a repertoire may prove insightful.<sup>30</sup>

Social learning has the evolutionary advantage, and parsimony, of permitting rapid transmission and evolution of behavioral traits possibly critical to survival. It may also contribute to mate choices in social species. And it is faster than "trial and error" learning since it utilizes an existing repository of information. Natural selection would also favor a highly horizontal culture (for rapid/dynamic change) stabilized by reality checks for vertical (traditional) learning.

The above mentioned example of cooperative fishing in Brazil is clearly a case of where both dolphins and humans are passing down through generations information about how to relate interspecifically. Indeed, this can be regarded as a kind of mutual agreement or contract that is being passed down.

*d. Problem solving/communication.* Two things that we seem to expect from persons are the ability to use intelligence to overcome obstacles in life and the ability to communicate with other persons in a way that suggests thought. A number of the examples already cited in this paper suggest that dolphins are able to use their large brains to solve problems and to communicate in some fashion not only with one another but with dolphins of other species and, to some extent, with humans.

There is, however, a particularly intriguing dolphin/human encounter that suggests both problem solving and communication abilities. Wayne Grover claims that a group of dolphins solicited his assistance. While diving in waters off the Florida coast, Grover was approached by three dolphins - two adults and a baby. The baby was bleeding from a fishing hook protruding from his body, and fishing line was wrapped around its tail. Grover removed the hook and line with his diving knife. The baby dolphin's blood in the water attracted two sharks that the male dolphin chased off by ramming the sharks' gills.<sup>31</sup> The combination of soliciting assistance from Grover and then not simply leaving him to fend for himself against the sharks certainly suggests the possibility that the dolphins recognized the human as someone who could aid them, someone with whom they could communicate, and someone whose life also had value.

*e. Identifying and understanding nonhuman intelligence.* If arguments are made using intellectual and social criteria that place dolphins in similar light to other mammals, we may also look at this as showing that more nonhuman animals show consciousness than we were aware and that such emergent features are not the sole property of *Homo sapiens*, or even their closest relatives. However, rather than look for the equivalent of a human mind in a nonhuman body, it may make more sense to look for emergent properties of intelligent systems, that is, qualities or features that emerge in whole systems and are not measurable in their parts.

How might we recognize such capabilities and emergent features in a nonhuman species? If we acknowledge convergence in evolution, then mind and social systems probably develop under the same mental pressure, such as the need for communication and cooperation. However, their physical structures and pathways may differ according to their environment. One example of such "convergent evolution" is the physical convergence of body form in sharks and dolphins because of the physical pressure of swimming through the water. In order to swim through the social pressures of a society, such pressures may create parallel emergent features.

Another possible feature of intelligence is mutual curiosity, which includes the initiation and adjustment of dialogue between species. Mechanisms for such cognitive flexibility might include mimicry, imitation, and synchrony. And although cross-sensory perception is a perhaps universal feature, the ability to communicate similar information in different modalities is a feature expediting the exchange and reception of knowledge.<sup>32</sup> Syntax and grammar may or may not be part of such a feature.

Finally, communication systems based on relationship and interaction are prevalent in social species. The psychological mechanism of knowing one's self through interaction and relationship, and the fact that the brain creates self through relationship, have been alluded to. In this framework, learning is participatory, not separate. Learning takes place through the opportunity to reveal oneself to others. We might expect that other species, given the opportunity and the safe space of etiquette and trust, may then choose to reveal themselves.

Considering the problem of identifying intelligence based on terrestrial skills (visual senses, appendages and manipulation) vs. aquatic skills (acoustic senses, relationship and social fluidity), the identification of higher, emergent qualities of intelligence on a universal scale becomes even more critical. As we begin to explore other planets for life, we will have to expand our view and criteria of intelligence and emergent systems of life. New discoveries in meteors from Mars as well as bacterial life deep within the earth question and challenge even our most basic assumptions about photosynthetic life. As we continue to explore both the solar system and other species, our definitions of life and mind will, no

doubt, have to be expanded to incorporate our observations of reality outside human life.

If another intelligent life form would rate us, how would they list the important qualities of our lives? What actions and inactions would they measure? What other approach might we recommend for such measurements? If dolphins were in the position to measure our intelligence, would they recognize verbal language? Humans have certainly not expended much energy towards the recognition of natural communication signals of other species. But are there parallel features or emergent qualities of humans that dolphins might recognize as intelligence? Might our gesture towards a willingness to communicate count for something? Might we try adapting to their cognitive system to reach them? Would they recognize our visual and acoustic problem solving abilities, albeit different? How many years, decades, or millennia might they have to wait for us to demonstrate our echolocation abilities? Or might they just decide that they had tested us and we fit in an inferior category, no longer worth exploring? From the perspective of a dolphin mind, these might be pertinent questions.

Of course, these are not new questions, nor are they new perspectives on what is intelligence to one species. But such a line of thought suggests the central question: how much of our investigation and speculation about “animal minds” has been limited by the boundaries of the nature of the “human mind” and the human habitat? What conceptual shifts do we have to make to understand the dolphin intellect? Can we find unbiased criteria involving emergent properties of intelligent systems that allow us to compare the continuity, fairly, across species?

## **Conclusion**

What, then, can we conclude from this admittedly brief survey? How well do dolphins measure up against a fairly traditional set of criteria for personhood? It should be clear, as suggested at the outset of this paper, that dolphins actually do quite well - even without taking into account the distinctive features that emerge from the fact that they are aquatic mammals. They appear to be self-aware beings with personalities and emotions; they are the authors of their own actions; they have significant intellectual capabilities; and their behavior towards humans suggests that they recognize other beings who share their cognitive and affective abilities. In this respect dolphins measure up well against a fairly traditional set of criteria for personhood. But without a more unbiased and holistic view on intelligence, its emergence and criteria, we can never fairly assess another species' use of the brain and mind. Such discussion tends to be left only for human-like relatives, based on our knowledge of one direction in

evolution, that of land-based and human intelligence. Nonetheless, even in light of this concern, it does seem that dolphins should be recognized as members of the community of equals.

## Notes

<sup>1</sup> Anthony Weston comments on this problem as follows: "One of the fundamental problems for environmental ethics is the extent to which intrinsic values are monopolized by persons. That is why it has been so difficult to argue that nonpersons (individual animals, paintings, ecosystems on a non-Gaian world, etc.) have any value at all aside from 'merely instrumental' value. Transitional persons too (fetuses, the newly dead) are thrown into moral limbo, thus creating much of the problematic of modern 'applied ethics'... Environmental ethicists have wanted to insist that other things besides persons - other things that are not even like persons - can also have intrinsic value. That is why environmental ethics was supposed to offer such a radical transformation in ethics. By pointing the way beyond anthropocentrism it might also point the way beyond what we might call person-centrism". Cf. A. Weston, "Forms of Gaian ethics", *Environmental Ethics* 9 (1987), p. 224.

<sup>2</sup> One of the difficulties of asking "Is a dolphin a person?" is that there are more than 30 different species of dolphins, and it is unclear just how much one can generalize about the entire family (*Delphinidae*) from one species to another. Most of the research has been done on bottlenose dolphins (*Tursiops truncatus*) and orcas (*Orcinus orca*) in captivity; some research on these species has been done in the wild. Some research in the wild has also been done on Atlantic spotted dolphins (*Stenella frontalis*) and spinner dolphins (*Stenella longirostris*). As we cite findings, we will specify the species involved.

<sup>3</sup> The most recent popular account of such an outlook is Jeffrey Moussaieff Masson and Susan McCarthy, *When Elephants Weep: The Emotional Lives of Animals* (Delacourt Press, New York, 1995). One of the major functions of emotions in humans is to perceive very quickly important aspects of our environment and to respond appropriately without thinking - for example, the fear and panic evoked by imminent danger cause us either to run away or to freeze in place. Since emotions in such situations are such an efficient mechanism for staying alive, it is highly unlikely that humans are the only animals to possess them. There is clearly survival value for dolphins to have emotions, especially in their complex societies.

<sup>4</sup> Susan Shane writes: "Captive dolphins have been known to refuse food and starve themselves to death when a tank companion dies. Mother dolphins have carried the decomposing bodies of their stillborn calves for two weeks and longer. Such behavior indicates that social bonds between individual dolphins are very strong and emotional attachments are deep". Cf. *The Bottlenose Dolphin in the Wild* (Hatcher Trade Press, San Carlos, CA, 1988), p. 28.

<sup>5</sup> The presence of a "sense of humor" is one possible interpretation of the following episodes, both of which occurred at the Dolphin Research Center at the Florida Keys.

a) At one time, the Center had some of the dolphins doing public performances in Key West. One day, Della Schuler, one of the trainers, was attempting to teach a baby dolphin how to do a regular forward dive for the audience. But every time Della gave the "dive" signal, the baby did a back dive. Next, Della called over the baby's mother, who was a veteran of following commands, and gave the two dolphins the "dive" signal. She assumed that the baby would follow the mother's lead and learn how to dive properly. This time, however, both mother and baby did back dives. Then Della called over two more dolphins and gave all four the "dive"

signal. The whole group did back dives despite the fact that the last two had never done back dives and weren't nearby when Della had started working with the mother and baby. As this episode continued, the audience responded with greater amounts of laughter. While the dolphins may simply have decided to follow the baby's lead, it's also possible that they were taking their cues from the audience's response and trying to do something "humorous".

b) One dolphin would regularly play a kind of "seaweed catch" with visitors on a dock. She would take a piece of seaweed in her jaw, turn around and snap her head backwards, tossing the seaweed to the visitors, who would try to catch it and then throw it back. However, after a while, as the dolphin turned around to flip the seaweed, she gradually began to increase the amount of seawater she was taking into her mouth and adding to each throw. Since the humans were fully caught up in the game and the dolphin seemed to evidence great playfulness and enthusiasm for the throwing and catching, the visitors didn't notice what was going on until they were drenched - at which point they would laugh over the fact that the game seemed less about "catch" and more about "let's see how long it takes before the humans realize they're soaked".

<sup>6</sup> For a recent discussion, see Chapter 5, "Dolphinalities", in Carol Howard, *Dolphin Chronicles* (Bantam, New York, 1995).

<sup>7</sup> Peter L. Tyack and Laela S. Sayigh, "Those dolphins aren't just whistling in the dark", *Oceanus* 32, 1 (1989), pp. 80-83.

<sup>8</sup> D.L. Herzing, "Vocalizations and associated underwater behavior of free-ranging atlantic spotted dolphins, *Stenella frontalis*, and bottlenose dolphins, *Tursiops truncatus*", *Aquatic Mammals* 22 (1996), pp. 61-79.

<sup>9</sup> See L.S. Sayigh, P.L. Tyack, R.S. Wells, and M.D. Scott, "Signature whistles of free-ranging bottlenose dolphins *Tursiops truncatus*: stability and mother-offspring comparisons", *Behavioral and Ecological Sociobiology* 26 (1990), pp. 247-260, and R.A. Smolker, J. Mann, and B.B. Smuts, "Use of signature whistles during separations and reunions by wild bottlenose dolphin mothers and infants", *Behavioral and Ecological Sociobiology* 33 (1993), pp. 393-402.

<sup>10</sup> On self-awareness in dolphins see: Ken Marten and Suchi Psarakos, "Evidence of self-awareness in the bottlenose dolphin (*Tursiops truncatus*)", in S.T. Parker, R.W. Mitchell and M.L. Boccia (eds), *Self-Awareness in Animals and Humans: Developmental Perspectives* (Cambridge University Press, Cambridge, 1994), and Ken Martin and Suchi Psarakos, "Using self-view television to distinguish between self-examination and social behavior in the bottlenose dolphin (*Tursiops truncatus*)", *Consciousness and Cognition* 4, 2 (1995), pp. 205-269.

<sup>11</sup> Even though dolphins have been successfully tested with mirrors, and even though their eyesight is well developed, it is critical to ask whether this test is appropriate for a sonic being for whom vision is a secondary sense. This is an unfortunate example of species bias in our study of nonhumans and the immediate and unquestioned tendency to apply a test from a visual primate to a sonic cetacean. Researchers themselves are guilty of automatically assuming the suitability of such a test and failing to devise a more appropriate test for recognizing the self-image of a sonic being.

<sup>12</sup> The bonobos have similar proclivities. See Frans de Waal and Frans Lanting, *Bonobo: The Forgotten Ape* (University of California Press, Berkeley, 1997).

<sup>13</sup> Bernd Wursig, "The question of dolphin awareness approached through studies in nature", *Cetus* 5, 1 (1985), p. 5.

<sup>14</sup> Karen Pryor and Jon Lindberg, "Traditional methods of identifying individual dolphins in a dolphin-human fishing cooperative in Brazil", Eighth Biennial Conference on the Biology of Marine Mammals, Pacific Grove, California, December 7-11, 1989. This is not the only case of such cooperative fishing. Susan Shane notes: "Along the shores of Australia and West Africa, native people net-fishing for mullet have developed a symbiotic or mutually

beneficial relationship with bottlenose dolphins. The natives set their nets and beat on the water's surface. Dolphins swim toward shore in response to this sound and herd schools of mullet toward the nets. Some mullet are caught by the dolphins and others are entrapped in the nets: thus, both the fishermen and the dolphins benefit" (*The Bottlenose Dolphin in the Wild*, p. 5).

<sup>15</sup> An animal's perception of scientists may take many forms including scientist as predator, prey, neutral in the environment, symbiont, or conspecific. In the latter perception, one organism may direct conspecific signals, intentionally or non-intentionally, toward the other. This latter relationship has been used to benefit scientists in both the observation and the interactive insight from such a relationship. See D.Q. Estep and S. Hetts, "Interactions, relationships, and bonds: the conceptual basis for scientist-animal relations", in H. Davis and D. Balfour (eds), *The Inevitable Bond. Examining Scientist-Animal Interactions* (Cambridge University Press, Cambridge, 1992), pp. 6-26.

<sup>16</sup> Since staff and volunteers change every couple of weeks, and since even the boat's crew has changed over the years, Herzing has been the most constant presence in the water for the entire field season (May to September) over the last twelve years.

<sup>17</sup> If the dolphins can become trusting and even incorporate another species into their group to the point of sharing signals (note that spotted dolphins already do this with the bottlenose), then it is plausible and even highly likely that they would begin to expect and anticipate certain behavioral responses from that species, as is the function of communication signals. This also points to an advanced concept of mutual responsibility. By engaging and retaining the trust of another species we have entered into a kind of contract: to abide by rules and signals, and to be sensitive to feedback. Any deviations are subject to the norms of the local culture, in this case the dolphin's. This also speaks to the ethical responsibility of trust and appropriate etiquette when dealing with other species or cultures. Such change in agreement has been documented by Elizabeth Marshall Thomas in the interspecific interaction between lions and the Maasai in Africa. See her *The Tribe of the Tiger* (Simon and Schuster, New York, 1994).

<sup>18</sup> A particularly interesting example of intraspecies altruism occurred at the Dolphin Research Center, a facility on the Gulf side of Grassy Key, Florida. A community of roughly 15 dolphins live in a series of pools separated from the Gulf only by low fences, which are designed more to keep other things out than to keep the dolphins in. The dolphins can jump over the fences. One dolphin, Mr. Gipper, came and went so frequently that he simply made a hole in the fence.

At one point, the Center took in a sick dolphin from an aquarium for treatment. Since dolphins require social contact to survive, the staff decided to put this dolphin in with Gipper and another dolphin (Little Bit). In order to make sure that the new dolphin would remain in the pen, the staff repaired the hole. The fear was that being nervous or apprehensive about her new situation, the new dolphin could panic and simply head for the ocean. Unknown to the staff, however, Gipper reopened the hole. Once in the pen, the new dolphin quickly found the hole and headed for the open seas. This presented a serious problem. As sick as she was, had this dolphin gotten lost, she probably would have died. However, Gipper and Little Bit went after her, turned her around and brought her back. When the dolphins returned, however, the new animal wouldn't go back through the fence. Despite the fact that she'd gone through the hole once, it is not surprising that she'd balk about coming back through again. Dolphins instinctively shy away from going through openings like that. Faced with the sick dolphin's refusal, Gipper stayed by her while Little Bit swam back and forth through the hole. The third dolphin followed her example and the three returned to the pen, after which the hole was blocked again.

<sup>19</sup> There are many stories, from pre-classical times to the present, of dolphins assisting humans. These range from helping sailors navigate through dangerous waters to supporting

humans who have fallen overboard so that they do not drown. In one particularly dramatic case, a woman who survived the explosion of a yacht found herself in shark-filled waters. Three dolphins kept her afloat and protected her until she reached a buoy to climb up on - 200 miles away from where they started.

There is even a report of a group of dolphins helping a fish in the waters off the Virgin Islands. The first mate's account is as follows: "On June 23, 1989, the sport-fishing boat "No Problem" went to the north drop about 20 miles to the north of Saint Thomas. At around 2:30 we hooked into about a 400 pound Blue Marlin on the 100 fathom line. About two minutes later, dolphins started appearing from both sides of the boat. They jumped over and under the line with the marlin on, and kept moving in for a closer look at the line, it seemed. As we tried to back down on the marlin, about twenty dolphins lined up across the back transom and would not let us back up. Meanwhile, the rest of the dolphins kept swimming and jumping all around the boat. They continued this for about half an hour until the distracted angler gave slack in the line and pulled the hook, causing us to lose the marlin. As soon as this happened, all the dolphins disappeared". It is important to note that dolphins do not feed on marlin. Interspecies altruism is not unknown. The most recent highly publicized example occurred on August 16, 1996 at the Brookfield Zoo in Brookfield, Illinois where a 7 year old female gorilla named Binti tended to a 3 year old human boy who sustained serious head injuries from falling 18 feet onto a concrete area where there were seven gorillas. The gorilla picked up the boy, held him in her arms and placed him near a door where zoo keepers could get him ("Gorilla rescues boy, 3, after fall", Associated Press, August 17, 1996).

<sup>20</sup> C. Lockyer, "Review of incidents involving wild, sociable dolphins, worldwide", in S. Leatherwood and R.R. Reeves (eds), *The Bottlenose Dolphin* (Academic Press, San Diego, CA, 1990), pp. 337-354.

<sup>21</sup> Wade Doak, *Encounters with Whales and Dolphins* (Sheridan House, Dobbs Ferry, NY, 1989).

<sup>22</sup> On the cognitive capacities of a variety of nonhumans, see the groundbreaking work of Donald Griffin: for example, *The Question of Animal Awareness: Evolutionary Continuity of Mental Experience* (The Rockefeller University Press, New York, 1976) and *Animal Thinking* (Harvard University Press, Cambridge, MA, 1984). For a recent philosophical discussion that includes reference to dolphins, see Alasdair MacIntyre, The 1997 Carus Lectures, forthcoming in revised form as *Dependent Rational Animals: Why Human Beings Need the Virtues* (Open Court Publishing Co., Chicago).

<sup>23</sup> Lori Marino, "A comparison of encephalization between odontocete cetaceans and anthropoid primates", *Brain, Behavior, and Evolution* 51, 4 (1998), pp. 230-238.

<sup>24</sup> It is certainly possible that the brain evolves more if a being has to communicate and interact more with peers, neighbors and others because of complex social issues. The bigger question is: how do the features in dolphin brains different from human brains facilitate a different, but no less complex, social structure that has evolved under similarly complex environmental and social pressures?

<sup>25</sup> L.M. Herman and W.N. Tavolga, "Communication systems of cetaceans", in L.M. Herman (ed.), *Cetacean Behavior: Mechanisms and Function* (John Wiley and Sons, New York, 1980), pp. 149-197. The dolphins Herman studies have also demonstrated the capacity to comprehend three-dimensional commands through a two-dimensional representation of gestures on a TV screen. (L.M. Herman, P. Morrel-Samuels and A.A. Pack, "Bottlenose dolphin and human recognition of veridical and degraded video displays of an artificial gestural language", *Journal of Experimental Psychology* 119, 2 [1990], pp. 215-230.)

<sup>26</sup> Herman, of course, is not alone in having done "language research". Diana Reiss, for example, used a keyboard that produced computer-generated sounds that resembled dolphins' whistles. Her two dolphins could use the keyboard to request objects that they work with, e.g.,

“ball”, “rub” etc. Reiss’s dolphins not only learned the sounds’ meaning but integrated them into their own communication.

<sup>27</sup> On language and evolutionary theory, see Emanuela Cenami Spada, “Animal mind-human mind: The continuity of mental experience with or without language”, *International Journal of Comparative Psychology* 7, 4 (1994), pp. 159-193.

<sup>28</sup> D.L. Herzing and C.M. Johnson, “Interspecific interactions between atlantic spotted dolphins (*Stenella frontalis*) and bottlenose dolphins (*Tursiops truncatus*) in the Bahamas, 1985-1995”, *Aquatic Mammals* 23, 2 (1997), pp. 85-99.

<sup>29</sup> John Lilly, *Man and Dolphin* (Victor Gollancz, London, 1962), cited in Chris Catton, *Dolphins* (St. Martin’s Press, New York, 1995), p. 115.

<sup>30</sup> In social learning, one individual (teacher) gives feedback and attempts to modify another’s behavior. Measurement criteria are increased success at a task, and the like. (Does the pupil modify and improve behavior?) In employing both vertical and horizontal transmission mechanisms, dolphin society is likely to have both parental transmission and peer/other transmission, both conducive to different types of information.

<sup>31</sup> Wayne Grover, *Dolphin Adventure: A True Story* (William Morrow & Co., New York, 1990).

<sup>32</sup> See L.E. Marks, *The Unity of the Senses: Interrelations among the Modalities* (Academic Press, New York, 1978).