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## **How Studies of Wild and Captive Dolphins Contribute to our Understanding of Individual Differences and Personality**

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The study of individual differences in animals and humans has flourished in recent years. This work has revealed personality traits in a wide range of species, including dolphins. However, there are few systematic studies of dolphin personality despite many reasons to assume that personality plays an important role in dolphin behavior. Dolphins live in complex societies and demonstrate a broad and diverse behavioral repertoire, which allows for the possibility of consistent individual differences. In this paper, we discuss the available evidence for individual differences and personality in dolphins from a variety of behavioral contexts from both captive and wild populations, as well as the significance of such differences for theories of dolphin behavior, dolphin welfare, and conservation.

Interest in the individual differences displayed by animals is not new. In fact, Darwin (1859) suggested that animals exhibit consistent individual differences in their behavioral traits and that these traits could evolve in the same way as physical traits. More recently, there has been a surge of interest in the possibility that individuals from a variety of species exhibit consistent individual characteristics, one of the hallmarks of personality. Accordingly, we will use personality as a synonym for “consistent individual differences” in this paper. Personality has been discovered in numerous species, including primates, marine mammals, insects, fish, invertebrates, and birds (see Gosling, 2001, for review). Personality has been most thoroughly studied in non-human primates (e.g., chimpanzees: Bard & Gardner, 1996; Lilienfeld, Gershon, Duke, Marino, & de Waal, 1999; gorillas: Gold & Maple, 1994; vervet monkeys: McGuire, Raleigh, & Pollack, 1994; rhesus monkeys: Capitanio, 1999; baboons: Sapolsky & Ray, 1989). Studies of dolphin personality are sparse despite many reasons to assume that dolphin personalities exist. Dolphins possess a broad and diverse behavioral repertoire, which makes possible consistent individual differences in preferred behaviors. Much of this behavioral repertoire has to do with the complexity of dolphin social life. Dolphin societies exhibit a variety of relationship-types, including higher-order alliances, long-term pair bonds, and cooperative associations (Connor, Wells, Mann, & Read, 2000). The types of relationships into which a dolphin enters likely reflects the dolphin’s personality. For example, both captive and wild dolphins maintain a social hierarchy in which some animals are consistently more dominant and others are consistently more submissive individuals (e.g., Connor, Heithaus, & Barre, 2001; Herman, Kuczaj, & Holder,

1993). When faced with a dominant animal, a lower ranking dolphin can either fight back or flee from the situation (Herman, 1980). The choice that a dolphin makes in such situations may be indicative of the animal's personality, particularly if the choices are stable over time and across situations. In the remainder of this paper, we consider the available evidence for individual differences and personality from a variety of behavioral contexts.

### **Feeding Behaviors**

Observations of dolphin feeding behaviors in various geographic locations (e.g., Bahamas, Florida, Australia) have demonstrated a variety of strategies. For example, depending on the population, bottlenose dolphins may pursue schooling prey, search in the sand for prey, or even beach themselves to obtain fish (Mann, Connor, Tyack, & Whitehead, 2000). A particular foraging technique is often performed by all of the members of a given social group, but there is also evidence for consistent individual differences within a group. Observations were made of two groups of bottlenose dolphins near the coast of Florida, both of which used a specialized technique to acquire fish (Gazda, Connor, Edgar, & Cox, 2005). This technique involved one animal using fluke slaps to herd or drive fish toward the other members of the group. Using photo-identification techniques, it was determined that the identity of the driver in each group remained the same during each fishing bout. Specifically, there was one individual in group 1 that always served as the driver, and one individual in group 2 that always served as the driver. This foraging technique is obviously a cooperative effort, but it is unclear why only one individual from each group developed the specialized role of driver. A number of models examining group cooperation indicate that consistent individual differences within a group may facilitate the evolution of cooperation within a population because each member can contribute according to their strengths (Fishman, Lotem, & Stone, 2001; McNamara, Barta, & Houston, 2004). The extent to which this is the case for the dolphins studied by Gazda and colleagues remains to be determined.

Other studies examining foraging strategies in bottlenose dolphins have also revealed consistent individual differences. One example comes from the strand-feeding behavior of bottlenose dolphins in Bull Creek, South Carolina (Duffy-Echevarria, Connor, & St. Aubin, 2008). Strand-feeding is a cooperative foraging strategy in which dolphins simultaneously strand themselves onto the mud banks in a horizontal row driving a school of fish onto the shore. Once on shore, the dolphins consume the fish and then as a group they move back into the water. While the dolphins typically perform their stranding behavior simultaneously, Duffy-Echevarria and colleagues (2008) observed interesting individual differences among the dolphins of Bull Creek. For example, a single dolphin was occasionally observed restranding itself immediately after a group strand-feeding and feeding on fish that were missed during the original event. Also, some individuals that were typically a part of a strand-feeding group would not participate in every foraging event, but instead remain offshore. Also, unlike

the driver dolphins of Cedar Key, Florida, the strand-feeding dolphins do not appear to have a preference for strand-feeding positions (e.g., inside vs. outside positions). However, the authors note that their sample size may be too small to reveal any preferences that may exist.

Another specialized foraging strategy, known as sponge-carrying, has been observed in bottlenose dolphins residing in Shark Bay, Western Australia (Mann et al., 2008). For this technique, individuals use a marine sponge to cover their rostra (and potentially protect it) while searching the seafloor for prey. Interestingly, only a small subset of dolphins residing in the area has been observed carrying a sponge. This finding is especially unusual, because sponge-carrying is considered to be a type of tool use, and typically if tool use is seen in a population of animals, a majority of the group members will adopt the behavior (Beck, 1980). It is also noteworthy that there appears to be a strong female bias for sponge-carrying, and that the behavior appears to be transmitted vertically (e.g., from mother to offspring). Furthermore, Mann and colleagues (2008) compared sponge-carrying females to non-sponge-carrying females and found that sponge-carriers were more solitary and spent more time devoted to foraging than non-sponge-carriers. These distinctions reflect possible underlying personality traits that may lend themselves to the acquisition and use of certain foraging strategies.

Another foraging strategy, known as beach hunting, has also been observed in Shark Bay (Sargeant, Mann, Berggren, & Krützen, 2005). For this foraging technique, a single dolphin chases fish in shallow water near shore and will often either partially beach (ventral area touches beach) or fully beach (dolphin almost completely emerges onto the beach). Like sponge-carrying, this specialized foraging technique seems to be performed by only a subset of the population. In fact, during the field seasons of 1991-2004, Sargeant and colleagues (2005) observed beach hunting performed sporadically by only 12 individuals (six of which were calves). However, unlike sponge-carrying, beach hunting does not seem to be only transmitted vertically. Also, some individuals appear to be more specialized in the beach hunting strategy than others, and this higher level of competence may be linked to personality traits. Observations of two adult female beach hunters revealed striking differences; one was more solitary and the other was more social. This finding contrasts with the observation that the sponge-carrying dolphins are more solitary, demonstrating that some foraging strategies are likely to be used by animals with similar personalities while other foraging strategies may be used by individuals with quite different strategies. However, the solitary beach hunting individual was more successful, while beach hunting, than the more social individual. The link between sociability and foraging strategies warrants additional investigation.

### **Maternal Care and Infant Behaviors**

There is also evidence of individual differences from studies of maternal care and infant behaviors in dolphins. For example, Hill, Greer, Solangi, and Kuczaj (2007) found that dolphin mothers demonstrate consistent individual

differences in parenting styles. For this study, the behaviors of seven captive bottlenose dolphin mother-calf pairs were observed for the first year of life for each calf. Special attention was given to behaviors such as mother-calf swims, disciplinary behaviors, and social behaviors. The results indicated that while all seven mothers cared for their calves in similar ways, there were some noticeable and important differences in certain features of their maternal care. The most apparent difference was in the mothers' use of discipline. Specifically, two mothers engaged in many more controlling techniques, such as actively herding or passively following their calves. Two other mothers rarely used these controlling behaviors, and the remaining three mothers demonstrated maternal behaviors that were in between these two extremes. Parental care is costly, and individual differences in maternal care patterns may have important evolutionary implications. Although Hill and colleagues could not determine which maternal style was more adaptive, the possibility of more adaptive styles merits further examination.

Individual differences have also been observed in studies of the early social development of wild bottlenose dolphins (Gibson & Mann, 2008). Observations were made of mother-calf pairs residing in Shark Bay, with focal follows conducted of the calves from birth through weaning (approximately 4 years of age). Specific behaviors examined included foraging, socializing, traveling, resting, and swimming in infant position. Calves differed in terms of their independence (e.g., amount of time spent with mothers and amount of time spent in groups without mothers). Mann (1997) also found consistent individual differences among calves, including in the amount of time spent near their mothers. Some calves spent less than 3% of their time more than 20 m away from their mothers, whereas others spent over 40% of their time at least this distance from their mothers. Mann also reported a significant correlation between time spent away from mother and time spent foraging and/or socializing. Calves that are more independent may be more likely to acquire vital socializing and foraging experience.

### **Group Movements**

Consistent individual differences are also reflected in the group movements of wild bottlenose dolphins. For example, Lewis, Wartzok, and Odell (2005) examined group movements and positional leadership in a resident population of bottlenose dolphins near the Florida Keys. Focal-follow observations and photo-identification were used to determine which individuals maintained the lead (most forward position) and which individuals initiated the group's movement. The results demonstrated that only a few individuals within the group controlled the group's movement and direction changes. However, it is not clear why certain individuals assume leadership roles within a group of dolphins. Are leaders simply the most experienced animals or the oldest animals? Or are there personality traits that make some dolphins better leaders?

Lusseau and Conradt (2009) examined the role of individual dolphins during changes in group activity shifts for dolphins residing in Doubtful Sound, New Zealand. Behavioral observations and photo-identifications of dolphin groups were conducted between April 2000 and April 2002, with a focus on two rare behavioral events: side flops and upside-down lobtails. Side flops (SF) involved a dolphin jumping out of the water and landing on its side. Upside-down lobtails (ULT) occurred when a dolphin was stationary at the surface, ventral-side up, and slapped the water with its fluke. Both SFs and ULTs seemed to precede shifts in group behavior. Males performed the majority of SFs, which initiated group traveling movements, and females performed the majority of ULTs, which terminated group traveling movements. Strikingly, SF and ULT performers were individuals with a significantly higher “reach” than other individuals in the group. Reach was defined as an individual’s social connectivity to other members of the group. Are dolphins with greater “reach” more likely to be leaders? What is it about their personalities that enable them to have more social connections or to be leaders? Lusseau and Conradt’s (2009) idea of reach may also be applicable for captive dolphins. For example, some captive animals are more likely to initiate certain social behaviors (e.g., reconciliation, toy sharing), an individual difference that might be linked to the reach of individual dolphins.

### **Dolphin Personality**

From the above examples, it is evident that dolphins exhibit individual behavioral differences. It is likely that at least some of these behavioral differences reflect underlying personality traits. Animal personality refers to an individual’s distinguishing pattern of behavior that remains consistent over time and across situations (Pervin & John, 1997). The first systematic study of dolphin personality was reported by Highfill and Kuczaj (2007). Human ratings of dolphin personality were examined before and after drastic changes to the subjects’ physical and social environments. Specifically, the personality traits of 16 bottlenose dolphins housed in three separate pools at MarineLife Oceanarium, Gulfport, Mississippi were initially assessed by a group of MarineLife trainers and graduate students. This initial assessment demonstrated that humans familiar with the dolphins could reliably distinguish individual dolphins based on their behavioral patterns, and that individual dolphins possessed unique personalities. Shortly after this initial rating, the dolphins’ home at MarineLife Oceanarium was destroyed by Hurricane Katrina. Eight of the dolphins were in a pool at MarineLife during the storm and were consequently washed out into the Mississippi Sound. Fortunately, two weeks after the storm, all eight dolphins were found swimming together in an area close to where MarineLife once stood, and were subsequently relocated to temporary housing. The remaining dolphins had been evacuated in anticipation of the storm to nearby marine facilities. Ultimately, 15 of the 16 dolphins were permanently relocated to open-ocean pens at the Atlantis Resort, the Bahamas. Then, approximately 14 months after Hurricane Katrina and 9 months after the dolphins had been relocated to Atlantis, a second set of personality ratings were completed.

For this assessment, Atlantis trainers completed the same personality measure. It is important to note that the Atlantis trainers had never worked with these dolphins or the MarineLife trainers, nor had they read the results of the first assessment. Despite this, the personality traits of 12 of the 15 dolphins remained consistent from assessment 1 to assessment 2. This finding was significant considering the major changes these dolphins endured over the course of the 14 month span between the two assessments. These included major changes to their physical and social environments. This study provided the first empirical evidence that dolphins may have something akin to true personality, at least insofar as human ratings of dolphin personality is concerned. However, there is still much to learn about dolphin personality. We are currently examining dolphin personality in individuals from both wild and captive populations. Our ultimate goal is to better relate personality characteristics to observed behavior, which would help to provide a comprehensive theoretical framework concerning the adaptive value of the individual differences that constitute personality.

### **Conclusions**

The study of individual differences in dolphins and the ways in which such differences relate to dolphin personality is in its infancy, but continued study in these areas is important for a number of reasons. Additional information on dolphin individual differences and personality will increase our understanding of dolphin behavior and its ontogeny. Such information is important for theories of dolphin behavior, and could also be used to help provide better care and more enriching environments for captive animals. Knowing the idiosyncrasies of individual animals enables human caretakers to better predict the behavior of group members (Vazire & Gosling, 2004). Zoos and aquaria could more effectively manage dolphin social groups and maintain their welfare by considering the specific characteristics of individuals.

Knowledge of personality types can also aid in animal management techniques, such as breeding and reintroduction programs. For instance, personality and behavioral assessments can be used to predict the ability of individual captive cheetahs to successfully reproduce (Wielebnowski, 1999). Specifically, Wielebnowski suggested that individuals scoring high on the trait “tense-fearful” would have more trouble coping with the captive environment and, therefore, be less successful in producing and rearing offspring. Placing tense-fearful individuals in more isolated areas or providing them with more hiding places to alleviate tense or fearful behaviors could increase reproductive success. Although the role of personality in dolphin reproduction, rehabilitation, and release is unknown, this is a topic that clearly warrants additional investigation.

Future research should also examine the relationship between genetics and individual differences in both wild and captive populations. Some preliminary research on this link can be found in the aforementioned study on beach hunting in Shark Bay (Sargeant et al., 2005). Samples of genetic material were collected from four beach hunters in order to assess mitochondrial haplotypes. Three of these four

beach hunters possessed the same haplotype (*D*). This finding supports the possibility of a genetic link to individual differences in foraging strategies, and certainly is consistent with the notion that genetically determined personality traits may play a role in the acquisition of at least some foraging strategies.

Understanding the extent to which dolphin personality differences is heritable and the role of experience in the ontogeny of dolphin personality could be extremely beneficial to efforts to conserve dolphin species. Individual differences within a single population can be adaptive (Wilson, 1998), particularly when the environment is subject to change. Anthropogenic events pose potential threats to wild dolphin well-being, and are likely to increase as the population of humans continues to climb exponentially. Therefore, dolphin conservation will be closely linked to how well the species can respond to change. Perhaps the presence of different personality types within a dolphin population will contribute to its ability to survive. For example, if a dolphin population is confronted with changes to food resources, a bold, neophilic individual may be able to more quickly locate new resources and perhaps even alert its conspecifics to this new food source. Thus, the existence of individual differences in a population may help ensure that the population survives (Dall, Houston, & McNamara, 2004).

Although all dolphins are not the same, not all differences are important. A large part of the task facing scholars interested in individual differences and personality concerns the need to distinguish important individual differences and trivial ones. In addition, it is necessary to distinguish individual differences that reflect a dolphin's behavioral flexibility from those that result from a dolphin's personality (Kuczaj & Makecha, 2008). Data from both wild and captive populations will be needed to make these sorts of distinctions, and we hope that the personalities of individual researchers do not get in the way of collaboration that will facilitate continued advances in our understanding of the roles of individual differences and personality in dolphin behavior.

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