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Object Manipulation and Play Behaviour in Bottlenose Dolphins (*Tursiops truncatus*) under Human Care

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Cetaceans are well-known to display various play activities: numerous scientific papers have documented this phenomenon in wild populations and for delphinids under human care. The present study describes analyses of bottlenose dolphin (*Tursiops truncatus*) interactions with man-made objects introduced to their habitat as part of an environmental enrichment program. At Parc Asterix Delphinarium (France), 9 bottlenose dolphins were presented with 21 different objects. During 17 hours and using object-focal follows, we studied the dolphins' behaviors directed toward the objects, according to the objects physical properties (i.e. complexity and buoyancy). We also documented the body parts the animals used to manipulate the objects. The results show that young dolphins displayed more playful actions towards the introduced objects than their older conspecifics. In general, subjects preferred the objects classified as simple and floating, they displayed a larger variety of behaviours, they spent more time and were more creative with them than with other types of objects. Finally, there was significantly more contact and "manipulation" with the dolphin head area than with the fins, fluke or other body parts. By analyzing the dolphins' behaviors and actions they directed towards the introduced objects, the present study discusses meanings dolphins might give to their surroundings and the relevance of play behavior to their welfare.

Many terrestrial mammals limit play to a short period of time in their life, whereas aquatic mammals appear to exhibit play during their whole life. Bel'kovich, Ivanova, Kozarovitsky, Novikova, and Kharitonov (1991) define play as situations in which dolphin activity is occurring that is not directed toward the satisfaction of hunger, migration, or any other utilitarian needs. Bateson (2014, p. 100) points out six defining features of play: "play is "fun", play is the antithesis of "serious" behavior, play generates novelty, play sequences are "performed repeatedly (they may also be incomplete or exaggerated relative to non-playful behavior in adults)", play is an indicator of well-being, and finally, play is playful (it "is accompanied by a particular positive mood state in which the individual is more inclined to behave in a spontaneous and flexible way"). Burghardt (2005) defines play according to five major features, four of which are slightly different from Bateson's: play is "not fully functional," play is autotelic, play is performed repeatedly and it is displayed when there is no immediate threat to the animal's fitness. Wild cetaceans and captive delphinids have been noted to display various play activities (Pace, 2000; Paulos, Trone, & Kuczaj, 2010). Some play activities are more spectacular than others, where animals engage in a variety of energetic aerial behaviors (e.g., breaching behavior in bowhead [*Balaena mysticetus*] and right whales [*Eubalaena australis*] calves', Thomas & Taber, 1984; Würsig, Dorsey, Richardson, & Wells, 1989).

Bottlenose dolphins (*Tursiops truncatus*) are highly sociable, large-brained mammals (Marino, 2002) that live a complex social life within a fission-fusion society (Connor, Wells, Mann, & Read, 2000). Previous research has shown the importance of touch (i.e., the tactile sense) in dolphins' social life: they have been observed touching and rubbing in intraspecific interactions (Dudzinski, Gregg, Ribic, & Kuczaj, 2009; Sakai, Hishii, Takeda, & Kohshima, 2006). Jones and Kuczaj (2014) and Kuczaj and Eskelinen (2014) completed a contemporary review of the scientific literature on dolphin play and concluded that play is a crucial activity in dolphins, providing opportunities to practice various activities such as predatory and reproductive

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behaviors. Play might also improve animals' general locomotor skills. Delphinids of all ages display play behaviors, which can involve modification and/or imitation of a behavior, or repetition of the player's own activity. Moreover, play in cetaceans encompasses many activities: solitary or social activity, locomotory actions, predatory activity and object play (see Hill & Ramirez, 2014, for a review). Numerous examples of play with objects (animate and inanimate) can be found in the literature (see Greene, Melillo-Sweeting, & Dudzinski, 2011; Kuczaj & Makecha, 2008; Paulos et al., 2010; see Table 1). It is important to note that authors make a distinction between play and tool use (i.e., foraging with an object, Patterson & Mann, 2011). Also, delphinids display object manipulation either directly or through use of the environment (i.e., water flow, Yamamoto, Furuta, Taki, & Morisaka, 2014).

Table 1
Dolphins' Playful Interactions with Natural and Man-Made Objects and Use with Various Body Parts

Species	Object	Body parts	Authors
Bottlenose dolphins *Tursiops truncatus*	kelp	melon, pectoral fin, tail fluke	Würsig & Würsig, 1979
Bottlenose dolphins *Tursiops sp.*	seagrass, fish	Mouth (i.e., "play snacking")	Mann & Smuts, 1999
Bottlenose dolphins *Tursiops truncatus*	rock	melon, tail fluke	Greene et al., 2011
Dusky dolphins *Lagenorhynchus obscurus*	kelp	melon, pectoral fin, tail fluke	Würsig, 2002; Würsig & Würsig, 1980
Rough-toothed dolphins *Steno bredanensis*	seaweed, seagrass sea turtle	"any body part"	Kuczaj & Yeater, 2007 (p. 143) Ritter, 2002
Hector's dolphins *Cephalorhynchus hectori*	seagrass	-	Slooten & Dawson, 1994
Amazon river dolphin *Inia geoffrensis*	sticks, branches, clumps of grass	rostrum, mouth	Martin et al., 2008
Atlantic Spotted dolphins *Stenella frontalis*	seaweed, fish, ray, soft coral, sea cucumber, rocks	mouth, rostrum, neck, pectoral fins, dorsal fin, fluke	Greene et al., 2011; Miles & Herzing, 2003
Tucuxi dolphin *Sotalia fluviatilis*	seaweed, rocks	mouth, tail fluke	Spinelli et al., 2002
Bottlenose dolphins *Tursiops truncatus*	fish food	rostrum, tail fluke	Bel'kovich et al., 1991
Bottlenose dolphins *Tursiops truncatus*	fish food	No body part but water flow of their pool	Yamamoto et al., 2014
Bottlenose dolphin *Tursiops sp.*	sponge	rostrum	Smolker et al., 1997
Bottlenose dolphins *Tursiops aduncus*	conch shell	rostrum	Allen et al., 2010.
Indo-Pacific humpback dolphin *Sousa chinensis*	sponge	rostrum	Parra, 2007

(continued)

Table 1 (continued)

Species	Object	Body parts	Authors
Bottlenose dolphin *Tursiops truncatus*	feathers	"various parts of their bodies"	Kuczaj et al., 2006 (p. 225)
Pilot whale *Globicephala melas*	bird	-	Heubeck, 2001
Dusky dolphin *Lagenorhynchus obscurus*	octopus	mouth, rostrum, caudal peduncle	Orbach & Kirchner, 2014 *(playfulness of the interaction to be clarified)*
Rough-toothed dolphins *Steno bredanensis*	plastic	melon, pectoral fins, tail fluke	Kuczaj & Highfill, 2005; Kuczaj & Yeater, 2007
Tucuxi dolphin *Sotalia fluviatilis*	plastic bags	mouth, tail fluke	Spinelli et al., 2002
Bottlenose dolphins *Tursiops truncatus*	tape, bandages, gauze, rope, plastic foam, scarves,	mouth, pectoral fins, fluke	Bel'kovich et al., 1970; Kuczaj et al., 2006
Bottlenose dolphins *Tursiops truncatus*	pieces of wood	-	Bel'kovich et al., 1970 (*in* Paulos et al., 2010, p. 708)
Bottlenose dolphins *Tursiops truncatus*	coins	-	Caldwell & Caldwell, 1972 (*in* Paulos et al., 2010, p. 708)
Bottlenose dolphins *Tursiops aduncus*	pool cleaning equipment	-	Tayler & Saayman, 1973 (*in* Paulos et al., 2010, p. 708)
Bottlenose dolphins *Tursiops truncatus*	sunglasses	mouth, fluke	Kuczaj et al., 2006 (p. 231)
Bottlenose dolphins *Tursiops truncatus*	balls, knotted ropes, buoys, buckets, basketballs, water-filled balls, foam mattresses, Frisbees, heavy duty cloth, water hoses, plastic hoops, foam sticks, collection of plastic and/or rubber objects	mouth, rostrum, melon, pectoral fins, tail fluke	Bel'kovich et al., 1970; Delfour & Beyer, 2011; Greene et al., 2011; Kuczaj et al., 2006, 2008 ; Norris & Dohl, 1980
Atlantic spotted dolphins *Stenella frontalis*	ropes, scarves	mouth, rostrum, pectoral fins, tail fluke	Herzing et al., 2012.

Note. In white: natural object play and in grey: man-made object play. – means information not available.

Environmental enrichment refers to improvement in animals' physical and/or social surrounding; it has been defined as any technique designed to improve biological functioning (e.g., increase lifetime reproductive success, increase fitness or overall health) of captive animals through modifications to the animals' environment (Newberry, 1995). Since environmental enrichment is currently quite popular in zoological and marine parks, an analysis of dolphins' behavior displayed while interacting with provided enrichment objects could increase our knowledge of their play behaviors. In Europe, enrichment is legally required (European legislation, STE 123) as it provides captive animals with environmental stimuli, though access to enrichment should not interfere with the five freedoms (Young, 2003). The five freedoms were originally developed from a UK Government report on livestock husbandry in 1965 by Brambell and are: (1)

freedom from hunger or thirst, (2) freedom from discomfort, (3) freedom from pain, injury or disease, (4) freedom to express (most) normal behaviour and (5) freedom from fear and distress. Enrichment is provided to improve an animal's quality of life as it increases the activity of the animal and stimulates natural behaviors that in turn, reduce boredom and may tackle stereotypic behavior (Moberg & Mench, 2000). Stereotypic behaviors are behaviors that are repetitive and seem to occur without any function and often response to an inadequate physical or social environment (Mason, 1991, see Mason and Rushen, 2008 for a more recent review). They can be indicative of a situation in which the animal lacks a certain degree of control over the environment (Fraser & Broom, 1990) and many stereotypic behaviors appear to become emancipated from their original causes over time (Cooper, Odberg & Nicol, 1996). Types of enrichment include: visual, auditory, olfactory, feeding, tactile, structural and social objects or events (Hoy, Murray, & Tribe, 2009), and human-animal interactions that challenge animals' cognitive abilities (e.g., husbandry training and positively reinforced interactions between the animals and their keepers/trainers/visitors, Laule & Desmond, 1998; Swaisgood & Shepherdson, 2005). Several examples of documented environmental enrichment can be found for terrestrial mammals (e.g., Skibiel, Trevino, & Naugher, 2007 for felidaes; Videan, Fritz, Schandt, Smith, & Howell, 2005 for chimpanzees [*Pan troglodytes*]; Fragaszy, Visalberghi, & Fedigan, 2004 for capuchin monkeys [*Cebus apella*]). However, until the early 2000s, it was challenging to find documented environmental enrichment research programs for marine mammals (walrus [*Odobenus rosmarus*], Kastelein, Jennings, & Postma, 2007; polar bears [*Ursus maritimus*], Renner & Kelly, 2006; and bottlenose dolphins, Clark, 2013; Delfour & Beyer, 2011; Greene et al., 2011; Paulos et al., 2010).

In dolphinaria, few studies have described and analysed dolphins' manipulative behaviors or assessed the effectiveness of environmental enrichment. Delfour and Beyer (2011) showed that some dolphins interact with objects while others do not. Therefore, Delfour and Beyer insisted that enrichment could not be proven effective until animals' playful interactions with provided objects and/or events had been scientifically demonstrated. This study was also the first to use an etho-phenomenological framework to understand dolphins' *umwelt*. The present study aimed to investigate how bottlenose dolphins manipulate human-made objects by assessing their behavior during sessions with environmental enrichment, in order to reveal possible meanings the objects might have for the dolphins (Delfour, 2010; Delfour & Beyer, 2011). We also documented which body parts dolphins used to manipulate the provided objects. Bottlenose dolphins have been observed tossing jellyfish and food fish with their rostrum and tail (Bel'kovich, Ivanova, Kozarovitsky, Novikova, & Kharitonov, 1991), and carrying various objects mainly with their fins and sometimes with their melon or in their mouth (Herzing, 1997; Kuczaj & Yeater, 2006; Parra, 2007). During affiliative and tactile intraspecific interactions, dolphins use their flippers, head and other body parts (Bel'kovich et al., 1991; Dudzinski et al., 2009; Paulos, Dudzinski, & Kuczaj, 2008; Sakai et al., 2006). We were interested in analysing how dolphins use their body to engage in interactions with man-made objects in order to better understand what meanings dolphins give to their surroundings, and in our case to the objects put in their habitat. This scientific framework is known as an etho-phenomenological approach and considers the behaviors of the animal subject. Phenomenology, a philosophical current, studies the appearances of things, things as they appear in our experience, or the ways we experience things, thus the meanings things have in our experience (Delfour, 2006, p. 518). By choosing the phenomenological approach, we aimed to study the dolphins' own perspective on their environment and reject mechanist models. The dolphin body's experiences determine the way each individual builds up the world, and they *ipso facto* constitute different perspectives of this world (see von Uexküll's concept of Umwelt in von Uexküll, 1956).

In summary, the aims of this study were to understand what actions bottlenose dolphins directed toward their surroundings and more precisely how they interacted with and manipulated objects, varying in complexity and buoyancy, introduced into their environment, in order to suggest potential meanings the objects might hold for the dolphins. By analyzing the dolphins' body use while manipulating objects, knowledge is gained on how dolphins access the world using their body. Addressing all of the above-mentioned questions would enable us to further understand the dolphins' umwelt and discuss environmental enrichment in terms of animal welfare.

Method

Study Subjects and Housing

The study was conducted in 2012 at the dolphinarium of Park Asterix (Plailly, France). At the time of this study, the facility was inhabited by nine Atlantic bottlenose dolphins (*Tursiops truncatus*), four females aged 39, 31, 17, 12 years and five males aged 29, 7, 1 and 1 years (2 dolphins were 1 year old; see Table 2). Subjects were housed in an outdoor pool (approximately 3,240 m^3 and depth that varied from 2.5 m at the shallowest point to 4.5 m at its deepest) conjoined to two indoor pools (550 m^3 in total with a depth of 2.5 m) and had free access between the pools during the study. Dolphins were fed their regular, normal diet. No special events occurred during the study period.

Table 2
Classification of Bottlenose Dolphins at Parc Asterix

Name	Sex	D.O.B
Beauty	Female	Approx. 1973
Guama	Male	Approx. 1982
Femke	Female	Approx. 1980
Aya	Female	04/07/1996
Baily	Female	25/07/1999
Balasi	Male	17/08/2004
Galeo	Male	09/08/2009
Aicko	Male	14/08/2010
Ekinox	Male	20/09/2010

Study Objects and Modality of Presentation

Every day, between training sessions, environmental enrichment was provided to the dolphins. Five objects were placed in the main pool and one in the connected indoor pools, allowing the dolphins to freely interact with them. A "toy list" (i.e., an object list) was constructed on a monthly basis, which determined which objects were put into the pools each day. The list was recreated for this study and objects were selected at random for observation, ensuring no objects were recorded twice in a row and objects were placed in random locations upon each usage to prevent biasing results (Martin & Bateson, 1993).

A variety of objects were used: floating, sinking, complex and simple. The dolphins were familiarized with all objects for at least 1 year. Simple was defined as an object that consisted of one part and was made of one material, while complex was defined as an object that consisted of two or more parts and may have been made of more than one material. Floating objects were those that remained on the water surface but could be pulled underneath by the dolphin, and a sinking object would remain at the bottom of the pool but could also be moved by the dolphin (Table 3). Dolphins had the opportunity to interact freely with the objects placed in their pools without extrinsic human reinforcement (e.g., whistles, food, vocal encouragement). Also, no neophobic behavior was observed during preliminary observations.

Behavioral Observations

Data were collected over a four-week period between 11:45-13:00 hrs from the underwater viewing gallery, where the observation area was closed to the public. The observations were recorded using a video camera. Object-focal follows were directed toward the objects placed in the pool (Altmann, 1974), they lasted five minutes; the available time frame allowed for each object to be observed twice. Continuous recording was used to look at which dolphin interacted with the object and with which body parts (eight sections) to interact with the object (Figure 1). A behavioral repertoire was specifically built for this study with the following behavioral items: to push, to carry, to throw, to flip, to rest, to rub and to touch.

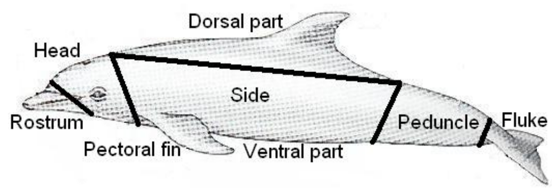
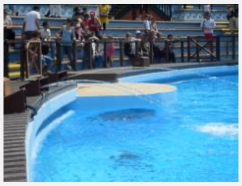


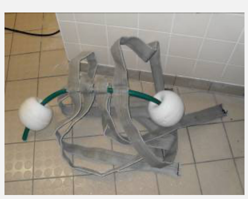
Figure 1. **Guidelines to determine which body sections were used by the dolphins.**

Table 3
Toy Identification

Classification	Photo ID	Description ID
Simple-Float		
4		Plastic Frisbee (72C x 23W x 2D cm)
13		Polyform / rubber cylindrical buoys (69L x 14W x 49C cm)
27		Outdoor water hoses
22		Cylindrical foam sticks with gaffer tape around edge (115L x 6W x 20C cm)
34		Foam mattress (200L x 100W x 8D cm)
40		Plastic hoop (82L x 82W x 260C cm)

(continued)

Table 1 continued

Classification	Photo ID	Description ID
Simple-Sink		
15		Rubber pipe (109L x 6W x 19C cm)
46		Plastic ball with detached plastic pieces inside (35L x 35W x 108C cm)
10		Heavy duty material cloth (82L x 17W x 1D cm)
Complex Float		
1		Plastic pieces and rope line (62L x 7W x 23C cm)
31		Foam sticks tied with rope (95L x 54W x 11D cm)
45		Rubber Hose pipe with two Plastic Ball attachments along with 8 pieces of heavy duty cloth attachments. (95L x 96W cm)

(continued)

Table 1 continued

Classification	Photo ID	Description ID
44		Plastic hose pipe attached with plastic bowl (59L x 39W x 25D cm)
37		Collection of 6 rubber pipes plus 6 plastic bottles attached via rope (74L x 29W cm)
26		Collection of plastic objects tied on a rope and rubber line (150L x 23W x 72C cm)
Complex Sink		
29		Plastic circular plate with 5 attachments of rubber pipes filled with rope (132L x 73W x 236C cm)
35		Rubber mattress tied with rope, filled with plastic pieces (78L x 48W x 17D cm)
12		Rubber / poly form buoy with 8 legs (52L x 22W x 65C cm)
32		Plastic bowl attach to rubber pipe and heavy duty cloth (82L x 31W x 70C cm)

(continued)

Table 1 continued

Classification	Photo ID	Description ID
41		Collection of 8 firemen hoses attached (153L x 44W cm)
33		Four variable sizes of rubber pipes attached together (70L x 18W cm)

Note. * L = length, W = width, C = circumference, D = depth.

Statistical Analysis

Statistical analysis for significance was carried out using the program IBM SPSS Statistics 19. A one-way ANOVA was conducted on the duration of interactions. A Spearman's test between the number of objects interacted with and the total number of interactions was undertaken. Our data consisted of time of interaction with objects, measured in seconds. Classical Chi-square tests were systematically computed using contingency tables (durations of interaction with objects). We also conducted exploratory factor analyses (simple correspondence analysis) and the selection of the factor model was based on the average eigenvalues (eigenvalues were included if they represented more than the average share of variance). Main contributions to the variance of each eigenvalue were selected if they represented more than the average of variance.

Results

Objects Manipulated by Dolphins

Seven out of 21 objects were frequently manipulated by the animals: 5 simple-floating objects (04, 13, 40, 34 and 22; see Table 3), one simple-sinking object (46) and one complex-floating object (01); while three objects were never used (two complex-floating objects [37 and 26] and one complex-sinking object [12]). Dolphins spent a total of 4,541 seconds (or 76 minutes) interacting with simple objects compared to a total of 529 seconds (9 minutes) with complex objects. They spent significantly more time manipulating the simple and floating objects, both in terms of rate of interactions, $\chi^2(3) = 20.12$, $p < 0.001$, and proportion of total observation time spent in the interactions, $\chi^2(3) = 19.72$, $p < 0.001$.

Individual Variations in the Manipulation of Objects and Nature of Displayed Behaviors

During the four-week period consisting of 17 hours of observations, 436 separate interactions between dolphins and enrichment objects were observed, totalling 79.10 min (i.e., 7.8% total time of observation). One dolphin (the only adult male) was never observed manipulating objects. The average time spent interacting with objects varied significantly across the different dolphins ranging from 2 s (Femke) to 300 s (Beauty). Number of interactions per dolphin also varied from 2 (Beauty) to 118 (Ekinox). The mean number of interactions with objects showed great inter-individual variability (Figure 2). Thus, Beauty's behavior appeared to be very different from her conspecifics; she engaged in only two very long lasting interactions with objects. While some dolphins were noted to play with 10 different objects others interacted with none. The one-way ANOVA conducted on duration of interaction revealed a significant difference between dolphins, whether we included Beauty, $F(7, 378) = 40.7$, $p < 0.0001$, $\eta^2_p = 0.43$, or not, $F(6, 377) = 5.97$, $p < 0.0001$, $\eta^2_p = 0.09$.

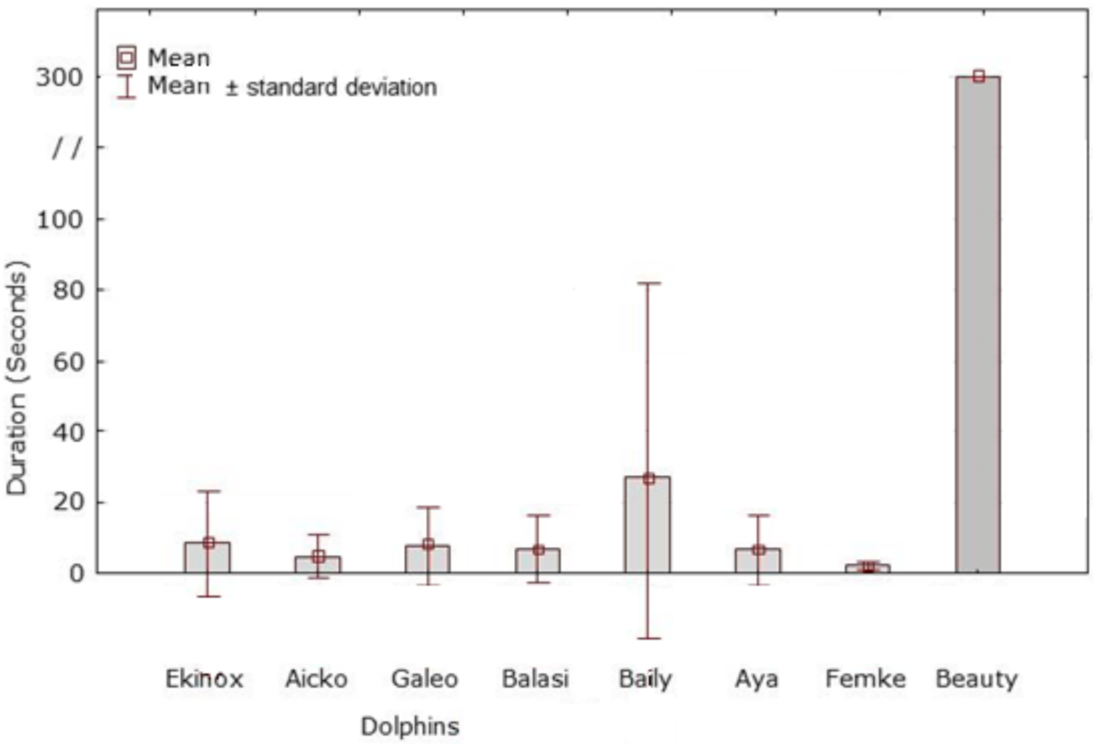


Figure 2. **Mean time (and standard deviation) spent interacting with objects per dolphin.**

Younger dolphins tended to interact with objects more than older dolphins: the number of objects interacted with, Spearman's $\rho = 0.82$, $N = 9$, $p < 0.01$, and the total number of interactions, Spearman's $\rho = 0.85$, $N = 9$, $p < 0.01$, were significantly correlated with age, but the total duration of interactions was not, Spearman's $\rho = 0.44$, $N = 9$, $p > 0.05$.

Sex also played a role in the amount of interaction with objects observed. Although, males interacted significantly more often with objects, 319 interactions compared to 117 by females, $\chi^2(1) = 93.60$, $p < 0.01$. Females spent significantly longer on average with each object than did males, 23.66 s vs 7.22 s for males; $t(386) = 4.86$, $p < 0.01$. The most frequently displayed behaviors were pushing objects (i.e., 2 out of 3 displayed behaviors) followed by touching objects (i.e., 1 out of 8 displayed behaviors; Figure 3).

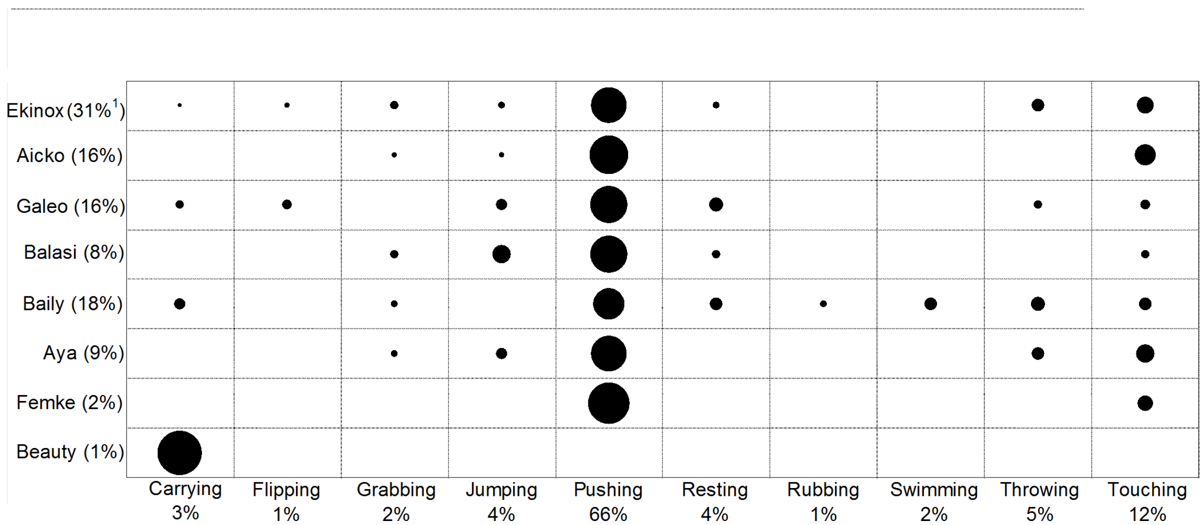


Figure 3. **Individual variations in the manipulation of objects**. Percentage of total time per dolphin spent in displaying various behaviours with objects. [1]*Individual percentage of time spent displaying the various behaviors.*

Behaviors Displayed with Various Objects

Contingency analysis revealed that both variables (i.e., toys and dolphins' displayed behaviors) were statistically linked, $X^2(136) = 5909$, $p < 0.0001$, Cramer's $V^2 = 0.17$. We conducted a correspondence analysis on the dolphins' behaviors X objects contingency table (Figure 4). We selected a two-factor model that explained 79% of the common variance. The first factor represented half of the variance (51%) with the second factor explaining 28% of the variance. The first factor arose from an opposition between carrying and pushing, respectively, associated with objects 1 and 13 (plastic and rope line and rubber cylindrical buoys) and with object 4 (plastic Frisbee). The second factor emerged from touching behavior (82% of the second eigenvalue) associated with the simple object 34 (foam mattress) and the complex objects 29, 32, and 41. Simple objects (04, 22, 13, 40, 15, and 27) and complex objects (46, 01, and 44) elicited various behaviors: to push, to rub, to throw, to flip, to rest on, to carry, and to jump on objects.

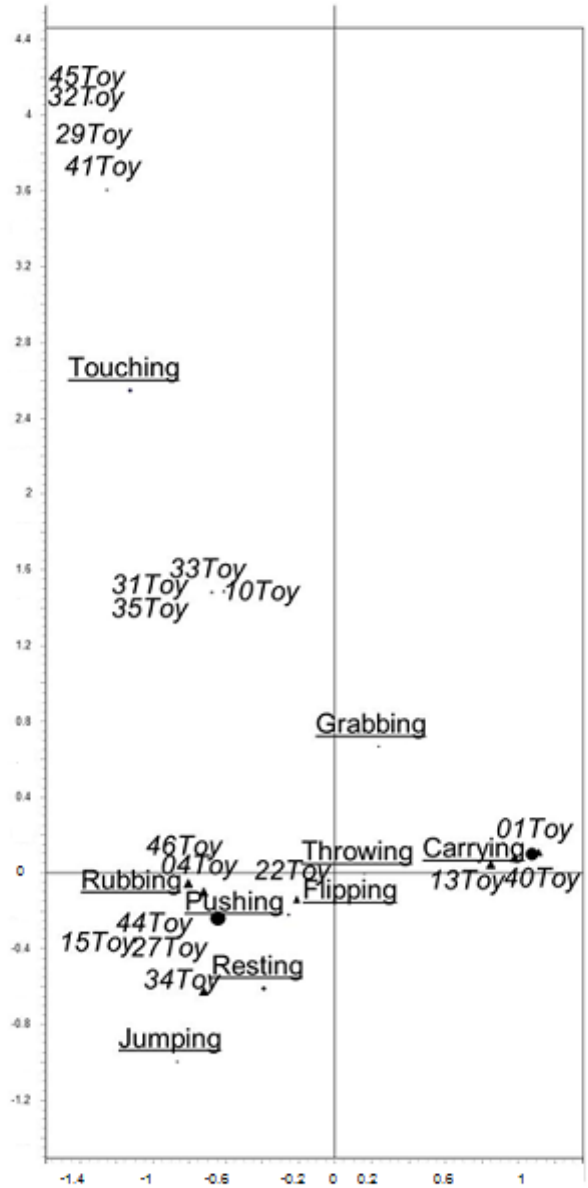


Figure 4. **Projection of the toys and the dolphins' displayed behaviors on the factorial plane Axis 1 X Axis 2.** Representation of the graphical output resulting from the Principal Component Analysis on the dolphins' behaviors X objects contingency table. Each point represents one object according to its coordinates for each variable. The first factor (an opposition between carrying and pushing behaviors) represented half of the variance (51%) and the second factor (related to touching behaviour, 82% of the second eigenvalue) explaines 28% of the variance.

Body Parts Used During Manipulative Behaviors

The contingency analysis revealed that both variables were statistically linked, $\chi^2(63) = 4.36$, $p < 0.0001$, Cramer's $V^2 = 0.13$. We conducted a correspondence analysis on the dolphin body parts X behaviors contingency table. We selected a three factors model that explained 88.5% of the common variance. The first factor represented 44.5% of the variance with the remaining two factors explaining, respectively, 30.5% and 14% of the variance. The first factor arose from an opposition between fin and side (Figure 4) respectively associated with carrying, and resting and pushing. The second factor emerged from an opposition between the head frequently associated with swimming and fin and side both associated with resting (Figure 5). Lastly, the third factor was based only on the ventral body part associated with jumping.

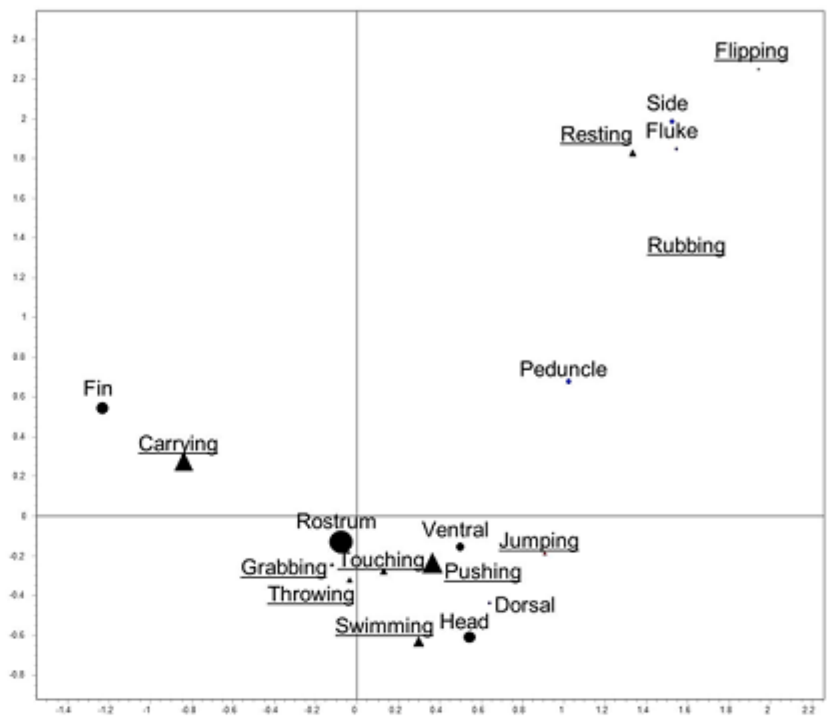


Figure 5. **Projection of the used dolphins' body parts and the displayed behaviours on the factorial plane Axis 1 X Axis 2**. Representation of the graphical output resulting from the Principal Component Analysis on the dolphin body parts X behaviours contingency table. This 3 factors model explaines 88.5% of the common variance. The first factor represents 44.5% of the variance with the remaining two factors explaining respectively 30.5% and 14% of the variance. The first factor arose from an opposition between fin and side respectively associated with carrying and, resting and pushing. The second factor emerged from an opposition between the head frequently associated with swimming and fin and side both associated with resting. Lastly the third factor was based only on the ventral body part associated with jumping

Dolphins mainly use their head and rostrum to manipulate the provided objects during long and frequent interactions (Figure 6).

There were significantly more manipulations using the head than the pectoral fins, fluke and other body parts, $\chi^2 = 379.37$, $p < 0.001$. The head and rostrum were used to push, grab, throw, touch objects and swim with objects, while the ventral part helped to jump on objects and the fluke and side were used to flip objects or to rest on objects. In summary, dolphins displayed more diverse behaviors when using the anterior part of their body (head and rostrum) than the posterior part.

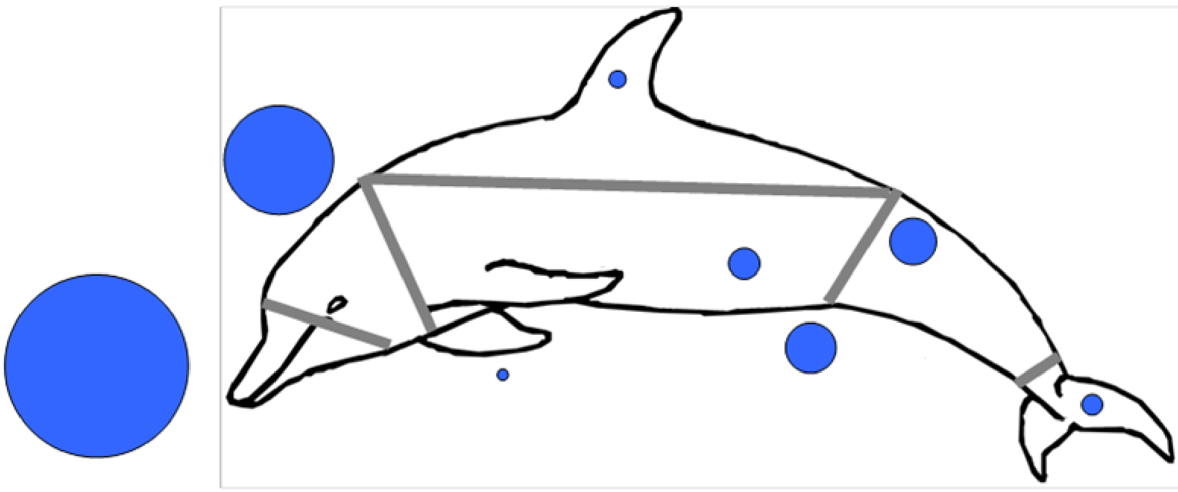


Figure 6. **Dolphin body parts recorded during manipulations of the objects and the proportion of interactions with enrichment objects observed for each body part (relative diameter).** The blue circles represent the percentage of time the animals spent interacting with provided objects using specific body parts.

Body Parts Used According to Physical Parameters of the Provided Objects

Contingency analysis revealed that both variables were statistically linked, $\chi^2(110) = 3.34$, $p < 0.0001$, Cramer's $V^2 = 0.12$. We conducted a correspondence analysis on dolphin body parts X objects in a contingency table (Figure 7). We selected a one-factor solution that explained 72% of the common variance. Unidimensionality of data arose from an opposition between the rostrums associated with objects 04 and 13 and the ventral parts sides and peduncles, associated with object 34. The dolphins used their rostrums to interact with simple floating and sinking objects (13, 15, and 10) and complex objects (45, 32, 44, 01, 35, 33, 41, and 29). They used their melons to interact with simple objects 04, 46 and 40. The dolphins mainly used their anterior body parts to be in contact with objects (rostrum then head/melon) and they interacted with various objects.

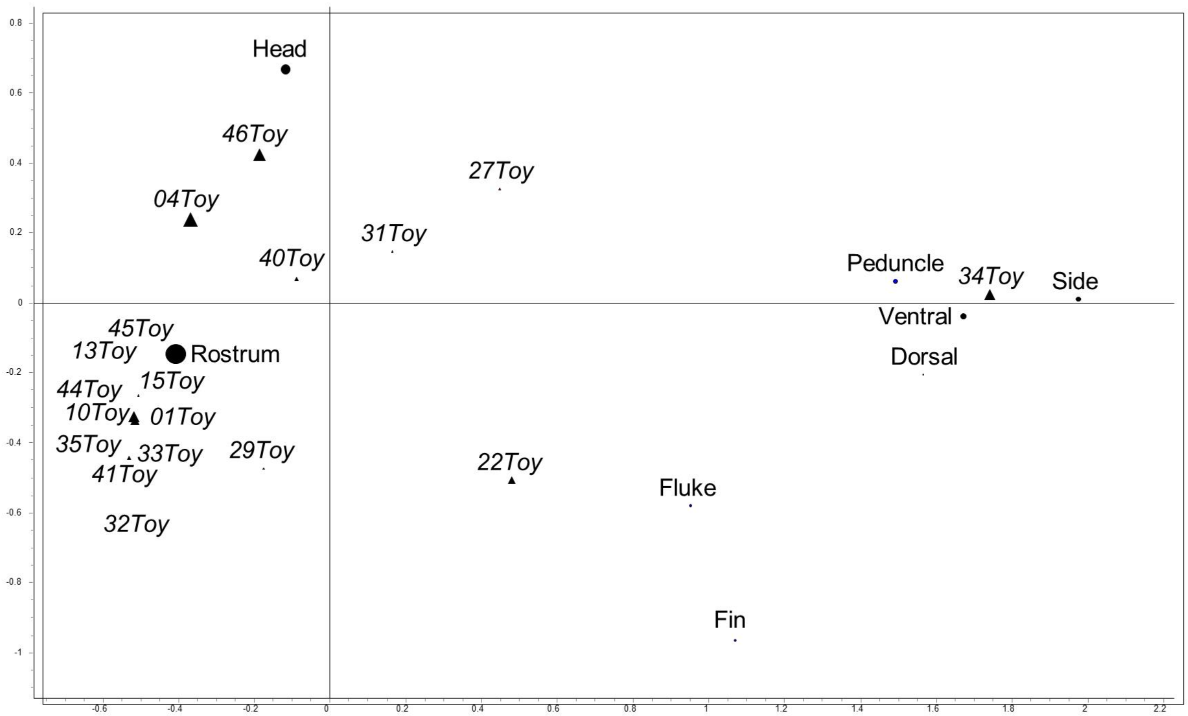


Figure 7. **Projection of the used dolphins' body parts and the toys on the factorial plane Axis 1 X Axis 2.** Representation of the graphical output resulting from the Principal Component Analysis on the dolphin body parts X objects contingency table. We selected a one factor solution that explained 72% of the common variance. Unidimensionality of data arose from an opposition between the rostrum and the side, the ventral side and peduncle, respectively associated with toys 04 and 13 on the left, and with toy 34 on the right.

Discussion

In summary, our results show that these bottlenose dolphins displayed longer and more frequent interactions with simple floating objects *versus* complex objects and also demonstrated an inter-individual variability in the use of objects. The clear linear relationship between age of dolphin and number of interactions with objects show that age was certainly a primary factor within this study, which contributed toward individual variation in object use. Younger dolphins spent more time interacting with objects than older ones. This finding is widely spread in the scientific literature (see Bekoff, 1984 for review). Juvenile dolphins are at a highly inquisitive stage of their life and are more likely to experiment and express various behaviors with objects (Paulos et al., 2010; McCowan, Marino, Vance, Walke, & Reiss, 2000). Objects were strictly rotated providing variation and unpredictability, which can reduce boredom and habituation (Reiss, McCowan, & Marino, 1997). However, under human care, the training sessions show that object play sessions along with random play sessions with care takers also reduce inactivity, boredom, and keep the dolphins cognitively stimulated (Ramirez, 1999). Moreover, our results also revealed that males tended to play more often with objects than females. However, three out of five males were around one year old, and one male was sub-adult. The difference of age between the males and the females (all adults) could explain this result. In the wild, when object carrying is thought to be a socio-sexual display, male Amazon river dolphins (*Inia geoffrensis*) more frequently display this behavior compared to females (83% *versus* 9%; Martin, da Silva, & Rothery, 2008). Due to their young age (i.e., not sexually mature), it is improbable in our study that males use the objects as a socio-sexual display.

For the first time, we analyzed the behaviors displayed by dolphins towards provided enrichment objects according to their complexity and buoyancy, and also which body parts were used to interact with the objects. Our results show that object carrying behavior duration is prolonged compared to other observed behaviors (e.g., rubbing, touching, throwing, grabbing behaviors). Carrying objects by dolphins often refers to play (Delfour & Beyer, 2011; Kuczaj, Lacinak, Fad, Trone, Solangi, & Ramos, 2002; Kuczaj, Makecha, Trone, Paulos, & Ramos, 2006) but it could also be non-play behaviors. In the wild, it has been noted to be a display of epimiletic behavior (i.e., dolphins carry dead calves, Harzen & Santos, 1992; Palacios & Day, 1995), a foraging specialization (i.e., with tool use: dolphins hold a sponge on their rostrum, Smolker, Richards, Connor, Mann, & Berggren, 1997) or a possible socio-sexual display (i.e., Amazon river dolphins carry organic items, Martin et al., 2008). Some very rare observations of carrying objects, for instance conch shell carried by Indo-pacific bottlenose dolphins (*Tursiops aduncus*) remain quite difficult to interpret (Allen Bejder, & Krützen., 2010). In this etho-phenomenological analysis, carrying object behavior was contextually related to enjoyable moments and playful behavior. Carrying behavior was performed less frequently than pushing, touching, or throwing behaviors. Wild and under human care dolphins have been observed pushing and tossing animate and inanimate objects (Bel'kovich, Krushinskaya, & Gurevich, 1970; Delfour & Beyer, 2011; Greene et al., 2011; Kuczaj et al., 2002, 2006; Norris & Dohl, 1980). In our study, carrying behavior was mainly displayed by two females, Beauty (over 39 years old) and Baïly (12 years old) both pregnant at the time of study. The oldest female has been previously seen carrying a particular object on her forehead (Delfour & Beyer, 2011). Their reproductive status could also have had an impact on their manipulative behaviors with objects. However, little research focuses on hormones affecting play behavior (Greene et al., 2011), and the parental processes and behaviors and pre-maternal behavior remain unknown in bottlenose dolphins.

When considering body parts used to interact with provided objects, these bottlenose dolphins prefer to use their rostrum and head to manipulate them. This could be due to the nature and physical properties of the objects; however, potentially all objects could have been carried or touched with fins so this does not explain why the dolphins preferentially used their rostrum, mouth and melon, and not their fins. In the wild, dolphins also interact with organic and non-organic objects using their mouth, rostrum, and head (Allen et al., 2010; Bel'kovich et al., 1991; Greene et al., 2011; Miles & Herzing, 2003; Kuczaj & Yeater, 2007; Parra, 2007; Smolker et al., 1997; Spinelli, Nascimento, & Yamamoto, 2002). Moreover, we could argue that to put something in the mouth, the animals might feel safe with it and/or be familiar with the objects (none of them were new to the dolphins). So, the tendency we found here could be due to the fact that we were studying dolphins under human care used to playing with objects put in their pool by their trainers. It would be relevant to analyze object manipulation according to their degree of familiarity but that topic was outside the scope of the current study. The rostrum appeared to be one of the main focal points for first contact with objects. We did not record vocalizations of the animals when they manipulated the objects, so we do not know if the dolphins were producing sounds while holding objects in their mouth. Further study will then focus on information the dolphins could acquire on the nature, texture, density, palatability, and so on of the objects.

Our study revealed that dolphins preferred to interact with simple floating objects, and they displayed a larger variety of behaviors, spent more time and were more creative with them than with other types of objects. In other words, the dolphins in our study were more behaviorally productive; thus increasing the richness of their behavioral repertoire. This finding is extremely important since environmental enrichment is provided to enrich the animals' sensorial and cognitive worlds. We suggest that the dolphins' interest and preference for simple objects (easy to manipulate) could be an opportunity for them to create their own games and in a way to control their environment. It seems easier to produce an effect with a simple object that can be thrown, grabbed, pushed, touched, flipped than with a complex one that only elicits touch. Actions have to be viewed and understood as methods to produce an effect (Delfour, 2010; Delfour & Beyer, 2011). However, one parameter has not been measured here: echolocation. At the time of the study, the "best" objects to provide to this group of dolphins to have more chance to create play behaviors were simple and floating ones. However, to ensure the animals' well-being, it would also be important to monitor play activity, habituation and disinterest towards the objects in short- and long-term periods.

Some objects seem to hold very little interest for the dolphins and therefore, it is not surprising that objects are ignored. A previous study conducted at Parc Asterix showed that dolphins only manipulated 50% of the objects, and while some animals developed preferences towards particular objects, the dolphins favoured regular social interactions over objects use (Delfour & Beyer, 2011). The group constitution was slightly different (fewer young animals), hence it is important to bear in mind the effect of social grouping on variety of behaviors (Delfour & Beyer, 2011). Moreover, distinct personalities exist among this group of dolphins that could explain possible reasoning behind differential use and interactions with objects (Birgersson, Birot de la Pommeraye, & Delfour, 2014). Displayed behaviors should be congruent with the animals' personality. Age, social rank, reproductive activity and gender all contribute toward variation in object interaction but what we show here suggests these animals ascribe meaning to their environment. For the first time, we demonstrated that simple objects elicit more diverse behaviors in a group of bottlenose dolphins.

One could argue that there were several biases in our study: selection of objects, familiarity with the provided objects, small population sample, and fairly exploratory analyses. That said, we built an equilibrium among types of provided objects, our studied population is representative of any dolphinaria, and the descriptive statistics we used are frequently applied in these conditions. Finally, we plan to implement sound recordings and analysis in our future studies.

Understanding what body parts are used and how objects are manipulated is important when designing enrichment programmes, since environmental enrichment aims to improve the quality of life for a captive animal (Newberry, 1995). The notion that complex objects will offer dolphins greater stimulation is not supported by our results and appears to be an anthropomorphic idea on what animals with developed cognitive abilities might need. Moreover, supposed novel complex objects may also quickly lose interest, as habituation to objects is considerably common, especially if dolphins do not interact regularly with them (Delfour & Beyer, 2011; Goldblatt, 1993). Then, we suggest that further research on enrichment should focus on a possible link between the nature of proposed objects and the animals' creativity and innovation. In order to assess effectiveness of enriching animals' environment, several parameters should be included: the richness of animals' behavioral repertoire, the variety of adequate/appropriate behavior-situation relationships, the congruence between the displayed behaviors and the individuals' personality, the positive state underlying play, the context in which play is displayed (it should be playful), the display of playful play with or without objects, the possibility to monitor solitary *versus* social playful play, and the animals' excitation (the animal should have fun during play). To conduct this work, a great familiarity (i.e., degree of knowledge) with dolphins will be mandatory (Servais & Delfour, 2013). Finally, scientists have discussed why environmental enrichment should not be reduced to housing supplementation and why the supposed beneficial effects of environmental programs have to be assessed (Boissy et al., 2007). Boissy et al. (2007) presented the actual methods to enhance animals' quality of life: "by creating a situation where there is anticipation of positive reward, by offering more space to promote play, and by providing opportunities for positive contrast situations, for improving coping abilities, and for information gathering" (p. 386). It is of course imperative to validate that enrichment has the expected effect(s) without falling into what Boissy et al. (2007) call a "circularity of reasoning." To avoid this pitfall, we suggest looking for meanings that dolphins might ascribe to their environment in order to understand the worlds they live in; this is the only way we would then properly respect these animals.

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References

Altmann, J. (1974). Observational study of behavior: sampling methods. *Behaviour*, *49*, 227–266.

Allen, J., Bejder, L., & Krützen, M. (2010). Why do Indo-pacific bottlenose dolphins (*Tursiops* sp.) carry conch shells (*Turbinella* sp.) in Shark Bay, Western Australia? *Marine Mammal Science*, *27*, 449–454.

Bateson, P. (2014). Play, playfulness, creativity and innovation. *Animal Behavior and Cognition*, *1*, 99–112.

Bekoff, M. (1984). Social play behavior. *BioScience*, *34*, 228–233.

Bel'kovich, V. M., Krushinskaya, N. L., & Gurevich, V. S. (1970). The behavior of dolphins in captivity. No. 50701. Washington, DC: Joint Publications Research Service.

Bel'kovich, V. M., Ivanova, E. E., Kozarovitsky, L. B., Novikova, E. V., & Kharitonov, S.P. (1991). Dolphin play behavior in the open sea. In K. Pryor, K. & Norris, K.S. (Eds), *Dolphin societies: Discoveries and puzzles* (pp. 67–77). Los Angeles, CA: University of California Press.

Birgersson, S., Birot de la Pommeraye, S., & Delfour, F. (2014) *Dolphin personality study based on ethology and social network theory*. Germany: Lambert Academic Publishing.

Boissy, A., Manteuffel, G., Jensen, M.B., Moe, R.O., Spruijt, B., Keeling, L.J., Winckler, C., Forkman, B., Dimitrov, I., Langbein, J., Bakken, M., Veissier, I., & Aubert, A. (2007). Assessment of positive emotions in animals to improve their welfare. *Physiology & Behavior*, *92*, 375–397.

Burghardt, G.M. (2005). *The genesis of animal play: testing the limits*. Cambridge, MA: MIT Press.

Clark, F. E. (2013). Marine mammal cognition and captive care: A proposal for cognitive enrichment in zoos and aquariums. *Journal of Zoo and Aquarium Research*, *1*, 1–6.

Connor, R. C., Wells, R. S., Mann, J., & Read, A. J. (2000). The bottlenose dolphin: social relationships in a fission-fusion society. In Mann, J, Connor, R. C., Tyack, P. L. &Whitehead, H. (Eds), *Cetacean societies: field studies of dolphins and whales* (pp. 91–126). Chicago, IL: University of Chicago Press.

Cooper, J.J., Odberg, F.O., & Nicol, C.J. (1996). Limitations on the effectiveness of environmental improvement on reducing stereotypic in bank voles. *Applied Animal Behaviour Sciences*, *48*, 237–248.

Delfour, F. (2006). Marine mammals in front of the mirror, or from body experiences to self-recognition. Cognitive ethological methodology combined with a phenomenological questioning. *Journal of Aquatic Mammals*, *32*, 517–527

Delfour. F. (2010). Marine mammals enact individual worlds. *International Journal Comparative Psychology*, *23*, 792 – 810.

Delfour, F., & Beyer, H. (2011). Assessing the effectiveness of environmental enrichment in bottlenose dolphins (*Tursiops truncatus*). *Zoo Biology*, *29*, 1–14.

Dudzinski, K. M., Gregg, J. D., Ribic, C. A., & Kuczaj, S. A. (2009). A comparison of pectoral fin contact between two different wild dolphin populations. *Behavioural Processes*, *80*,182–190.

Fragaszy, D., Visalberghi, E., & Fedigan, L. (2004). *The complete capuchin: the biology of genus Cebus*. New York, NY: Cambridge University Press.

Fraser, A. F., Broom, D. M. (1990). Farm Animal Behaviour and Welfare. Bailliere, Tindell. *CABI publishing, UK* .

Goldblatt, A. (1993). Behavioural needs of captive marine mammals. *Aquatic Mammals*, *19,* 149 – 157.

Greene, W. E., Melillo-Sweeting, K., & Dudzinski, K. M. (2011). Comparing object play in captive and wild dolphins. *International Journal Comparative Psychology*, *24*, 292 – 306.

Harzen, S., & Santos, M.E.D. (1992). Three encounters with wild bottlenose dolphins (*Tursiops truncatus*) carrying dead calves. *Aquatic Mammals*, *18*, 49–55.

Herzing, D. L. (1997). Life history of free-ranging Atlantic spotted dolphin. *Marine Mammal Science*, *12*, 576–595.

Herzing, D. L., Delfour, F., & Pack, A. A. (2012). Responses of human-habituated wild atlantic spotted dolphins to play behaviors using a two-way human/dolphin interface. *International Journal of Comparative Psychology*, *25*, 137–165.

Heubeck, M., (2001) Pilot whale apparently playing with moulting common eiders. *Scottish Birds*, *221*, 62.

Hill, H., & Ramirez, D. (2014). Adults play but not like their youngs: the frequency and types of play in belugas (*Delphinapterus leucas*) in human care. *Animal behaviour and cognition*, *1*, 166–185.

Hoy, J., Murray, P. J., & Tribe, A. (2009). Thirty years later: enrichment practices for captive mammals. *Zoo Biology*, *28*, 1–14.

Jones, B. L., & Kuczaj, S. A. (2014). Beluga (*Delphinapterus leucas*) novel bubble helix play behaviour. *Animal Behaviour and Cognition*, *1*, 206–214.

Kastelein, R. A., Jennings, N., & Postma, J. (2007). Feeding enrichment methods for Pacific walrus calves. *Zoo Biology*, *26*, 175–186.

Kucza,j S. A. II, & Eskelinen, H. C. (2014). Why do dolphins play? *Animal behaviour and Cognition*, *1*, 113–127.

Kuczaj, S. A., Lacinak, C. T., Fad, O., Trone, M., Solangi, M., & Ramos, R. (2002). Keeping environmental enrichment enriching. *International Journal Comparative Psychology*, *15*, 127–137

Kuczaj, S. A., Makecha, R., Trone, M., Paulos, R. D., & Ramos, J. A. (2006). Role of peers in cultural innovation and cultural transmission: Evidence from the play of dolphin calves. *International Journal Comparative Psychology, 19*, 223–240.

Kuczaj, S. A., & Makecha, R. (2008). The role of play in the evolution and ontogeny of contextually flexible communication. In Oller, K. & Griebel, U. (Eds.), *Evolution of communicative flexibility* (253–278). Cambridge, MA: MIT Press.

Kuczaj, S. A. II, & Yeater, D. B. (2006). Dolphin imitation: Who, what, when, and why? *Aquatic Mammals, 32*, 413–*422*.

Laule, G., & Desmond, T. (1998). Positive reinforcement training as an enrichment strategy. In D. J. Shepherdson, J. D. Mellen, & M. Hutchins (Eds.), *Second nature: environmental enrichment for captive animals* (pp. 302–313). Washington, DC: Smithsonian Institution Press.

Mann J., & Smuts, B. (1999). Behavioral development in wild bottlenose dolphin newborns (*Tursiops sp.*). *Behaviour*, *136*, 529–566.

Marino, L. (2002). Convergence of complex cognitive abilities in cetaceans and primates. *Brain Behavior and Evolution*, *59*, 21–32.

Martin, P., & Bateson, P. (1993). *Measuring behavior: an introductory guide*. Cambridge: Cambridge University Press.

Martin, A. R., da Silva, V. M. F., & Rothery, P. (2008). Object carrying as socio-sexual display in an aquatic mammal. *Biology Letters*, *4*, 243–245.

Mason, G. J. (1991). Stereotypies: a critical review. *Animal Behavior*, *41*, 1015–1037.

Mason G., & Rushen, J. (Eds.). (2008). *Stereotypic animal behaviour: fundamentals and applications to welfare*. Wallingford, UK: CAB international.

McCowan, B., Marino, L., Vance, E., Walke, L., & Reiss, D. (2000). Bubble ring play of bottlenose dolphin (*Tursiops truncatus*): Implications for cognition. *Journal Comparative Psychology*, *114*, 98 – 106.
Miles, J. A., & Herzing, D. L. (2003). Underwater analysis of the behavioural development of free-ranging Atlantic spotted dolphin (*Stenella frontalis*) calves (birth to 4 years of age). *Aquatic Mammals*, *29*, 363–377.
Moberg G. P., & Mench J. A. (2000). *Biology of animal stress: Basic principles and implications for animal welfare*. Oxon: CABI Publishing.
Newberry, R. C. (1995). Environmental enrichment: increasing the biological relevance of captive environments. *Applied Animal Behaviour Science*, *44*, 229–243.
Norris, K. S., & Dohl, T. P. (1980). The structure and functions of cetacean schools. In L. M. Herman (Ed), *Cetacean behavior: Mechanisms and functions* (pp. 211–261). Malabar, FL: Krieger Publishing Company.
Orbach, D. N, & Kirchner T. (2014). Armed escorts: Dusky dolphin (*Lagenorhynchus obscurus*) interactions with octopuses (*Pinnoctopus cordiformis*) in New Zealand. *Aquatic Mammals*, *40*, 285–292.
Pace, D. S. (2000). Fluke – made bubble rings as toys in bottlenose dolphin calves (*Tursiops truncatus*). *Aquatic Mammals*, *26*, 57–64.
Palacios, D. M., & Day, D. (1995). A Risso's dolphin (*Grampus griseus*) carrying a dead calf. *Marine Mammal Science*, *11*, 593–594.
Parra, G. J. (2007). Observations of an Indo-Pacific humpback dolphin carrying a sponge: object play or tool use? *Mammalia*, *71*, 147 – 149.
Patterson, E. M., & Mann J. (2011). The ecological conditions that favor tool use and innovation in wild Bottlenose dolphins (*Tursiops sp*.). *PLoS ONE*, 1371. doi:10.1371/journal.pone.0022243
Paulos, R. D., Dudzinski, K., & Kuczaj S. (2008). The role of touch in select social interactions of Atlantic spotted dolphin (*Stenella frontalis*) and Indo-Pacific bottlenose dolphin (*Tursiops aduncus*). *Ethology*, *26*, 153–164.
Paulos, R. D., Trone, M., & Kuczaj S. (2010). Play in wild and captive cetaceans. *International Journal Comparative Psychology*, *23*, 701–722.
Ramirez, K. (1999). *Animal training: successful animal management through positive reinforcement*. Chicago, IL: Shedd Aquarium.
Renner, M., & Kelly, A. L. (2006). Behavioral decisions for managing social distance and aggression in captive polar bears (*Ursus maritimus*). *Journal Applied Animal Welfare Science*, *9*, 233–239.
Reiss, D., McCowan, B., & Marino, L. (1997). Communicative and other cognitive characteristics of bottlenose dolphins. *Trends in Cognitive. Sciences*, *1*, 140–145.
Ritter, F. (2002). Behavioural observations of rough-toothed dolphins (*Steno bredanensis*) off La Gomera, Canary islands (1995–2000), with special reference to their interactions with humans. *Aquatic Mammals, 28*, 46–59.
Sakai, M., Hishii, T., Takeda, S., & Kohshima S. (2006). Flipper rubbing behaviors in wild bottlenose dolphins (*Tursiops aduncus*). *Marine Mammal Sciences*, *22*, 966–978.
Servais, V., & Delfour, F. (2013). Comment étudier la communication entre dauphins captifs et soigneurs?. *Interactions et Intercompréhension: une approche comparative* (pp. 141–156).
Skibiel, A. L., Trevino, H. S., & Naugher K. (2007). Comparison of several types of enrichment for captive felids. *Zoo Biology*, *26*, 371–381.
Smolker, R. A., Richards, A., Connor, R. C., Mann, J., & Berggren P. (1997). Sponge carrying by dolphins (Delphinidae, *Tursiops sp*): a foraging specialization involving tool use? *Ethology*, *103*, 454 – 465.
Spinelli, L. H. P., Nascimento, L. F., & Yamamoto, M. E. (2002). Identificação e descrição da brincadeira em uma espécie pouco estudada, o boto cinza (*Sotalia fluviatilis*), em seu ambiente natural. *Estudos de Psicologia*, *7*, 165–171.
Swaisgood, R. R., & Shepherdson D. J. (2005). Scientific approaches to enrichment and stereotypies in Zoo animals: what's been done and where should we go next? *Zoo Biology*, *24*, 499–518.
Thomas, P. O., & Taber, S. M. (1984). Mother-infant interaction and behavioral development in southern right whales, Eubalaena australis. *Behaviour*, *88*, 42–60.
Videan, E. N., Fritz, J., Schandt, M. L., Smith, H. F., & Howell S. (2005). Controllability in environmental enrichment for captive Chimpanzees (*Pan troglodytes*). *Journal Applied Animal Welfare Science, 8*, 117–130.
von Uexküll, J. (1956). *Mondes animaux et monde humain: Théorie de la signification.* Paris, France: Gonthier.
Würsig, B., & Würsig, M. (1979). Behavior and ecology of the bottlenose dolphin, *Tursiops truncatus*, in the South Atlantic. *Fishery Bulletin*, *77*, 399–412.

Wursig, B., & Wursig, M. (1980). Behavior and ecology of the dusky dolphin, *Lagenorhynchus obscurus*, in the South Atlantic. *Fishery bulletin*, *77*, 871–890.

Würsig, B., Dorsey, E. M., Richardson, W. J., & Wells, R. S. (1989). Feeding, aerial and play behaviour of the bowhead whale, *Balaena mysticetus*, summering in the Beaufort Sea. *Aquatic Mammals*, *15*, 27–37.

Yamamoto, C, Furuta, K, Taki, M, & Morisaka, T. (2014). Captive bottlenose dolphins (*Tursiops truncatus*) spontaneously using water flow to manipulate objects. *Plos One, 9*, 1–5.

Young, R. J. (2003). *Environmental Enrichment for Captive Animals*. Oxford, UK: Blackwell Publishing.

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