

INDIVIDUAL DIFFERENCES IN MATERNAL BEHAVIOUR PROFILE IN BOTTLENOSE DOLPHIN: PRESENCE OF CRUCIAL FACTORS?

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INTRODUCTION Individual differences in behaviour, found in virtually all species, are potentially important in the adaptive sense. Because parental care is a costly component of reproduction, individual differences in it may have important evolutionary implications. Furthermore, it has been recently described that temperament disposition and experience affect mothering style in many mammal species. This study analyzed whether individual differences in pattern of maternal care are related to distinctive features involving experience, environment and social context in bottlenose dolphin (*Tursiops truncatus*).

MATERIALS AND METHODS Since 1993, a behavioural research program on maternal care in bottlenose dolphin has been conducted for definite time periods in two different Italian Delphinaria placed in Rimini and Cattolica. During the observational phases, each facility housed two females (a nulliparous one and a multiparous one) with their calves and, at the Rimini's Delphinarium, two males (Table 1). A specific ethogram with a 32 behavioural elements, organized into three main categories ("Locomotor and Postural Behaviours", "Female/Female Interaction" and "Mother/Calf Interaction") was used for the data collection (Table 2). Selected displays including swim activities, general interactions and physical contacts were analyzed for the purpose of this study.

Individual-follow (continuous sampling) method (Mann, 1999) was applied to systematically monitor the behaviour of each female over one year after parturition (Cattolica's Delphinarium: June 1993 – July 1994; Rimini's Delphinarium: May 1995 - June 1996 and June 1997 – July 1998). Observation times were randomized among 3-hr periods and balanced for equal representation within a month and at different times of day (observational phase: from 08:00am to 08:00 pm). A total number of 466 hours of observation was recorded. Frequency and duration values were first analysed by means of Observer 3.0 software (Noldus, 1997) and then statistically investigated with ANOVA and χ^2 Test.

RESULTS Both nulliparous females (Beta and Isa) had the opportunity to observe the parturition of the other female present in the pool before to gave birth to their own calves, probably gaining specific maternal skill. No major differences in the three main behavioural categories were found between the four mothers (all χ^2 Tests no significant), even if individuals housed in the same environment showed a higher degree of similarity in their values (Fig.1).

However, the monthly trend of "swim in association" as well as "mother/calf interaction" revealed significant differences both between animals in the same pool and within structures (all ANOVAs $p < 0,05$), underlining the possible influence of primiparity and the potential weight of an enriched social context at the Rimini's Delphinarium. In particular:

- Both multiparous females (Alfa and Candy) allowed the primiparous ones to spend a considerable amount of time with them, especially during the first three months of the calves' life; possibly, this phase corresponded to a crucial period for the "education" of the future mothers and represented a useful social tool for the mother-calf pairs. On the other hand, primiparous females (Beta and Isa) seemed to be less associated with the expert mothers, remaining principally with their own calves for the entire year of the study (ANOVA not significant, $p > 0,05$; Fig. 2).
- The Rimini's environment, with the presence of individuals other than females, appeared to be more complex, often stimulating - in the mother/calf pairs - the emergence of individual behavioural responses to reliant conditions (Fig. 3).

CONCLUSIONS This study revealed a complex pattern of relationship between environment, maternal behaviour and individual behavioural profiles. A number of different papers reported that individual differences in bottlenose dolphins can occur in both spatial and social behaviour. The open questions are how individual differences in a situation are related to those in other situations and what their ecological consequences may be.

ACKNOWLEDGMENTS We thank Rimini's and Cattolica's Delphinarium owners and trainers for the logistic support, and all the students who took part into the project.

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Table 1. Subjects and social context in the Rimini and Cattolica Delphinaria

a) RIMINI DELPHINARIUM			
BEHAVIOUR	SEX	BIRTH DATE	PROVENIENCE
ALFA (multiparous)	F	1979	Gulf of Mexico
BETA (primiparous)	F	1981	Gulf of Mexico
SPEEDY	M	1970	Adriatic Sea
SOLE	M	03 May 1993	Born in captivity (Alfa x Speedy)
LUNA	F	12 May 1995	Born in captivity (Alfa x Speedy)
BLUE	F	26 June 1997	Born in captivity (Beta x Speedy)

b) CATTOLICA DELPHINARIUM			
BEHAVIOUR	SEX	BIRTH DATE	PROVENIENCE
CANDY (multiparous)	F	1978	Texas
ISA (primiparous)	F	1986	Cuba
TABO	M	15 June 1993	Born in captivity (Candy)
GOLIA	M	06 July 1993	Born in captivity (Isa)

Table 2. ETHOGRAM

	BEHAVIOUR	DESCRIPTION & REFERENCE
LOCOMOTORY & POSTURAL BEHAVIOURS	Swim	The usual mode of swimming or normal swimming posture (Renjun <i>et al.</i> , 1994)
	Exploratory behaviour	Scanning horizontal/perpendicular to the bottom (Herzing, 1996)
	Loop	Looping near surface (Martinez & Klinghammer, 1995)
	Pool rub	Dolphin is rubbing side/ventral, back area on bottom (Herzing, 1996)
	Stand	Dolphin is lying motionless (Herzing, 1996)
	Rest	The animals floated at the surface of the water without any body movements, the blowhole only was exposed to the air, the breathing frequency was reduced and the small eyes appeared to be closed (Renjun <i>et al.</i> , 1994)
	Arch	Bends head and peduncle towards back or belly (von Streit & von Fersen, 1996)
	Flexion	The tail, and also the head, moved ventrally (the tail approached an angle of 45 degrees from the horizontal); the body form an arch and the muscle appeared taut. Then the animal relaxed and the tail was raised dorsally (Tavolga & Essapian, 1957)
	Open mouth	The mouth is opened either partially or fully for some time; the tongue may be extended (Martinez & Klinghammer, 1995)
	Shaking flipper	Shaking the flippers (von Streit & von Fersen, 1996)
	Somersault	Tail ventrally/dorsally over head in a somersault [*Anonymous at Monkey Mia (Australia), 1990]
	Roll	The body is rotated through 360° on the longitudinal axis to either side of the dolphin (Renjun <i>et al.</i> , 1994)
	Jaw clap	An animal clap his jaws together forcefully to produce a sharp loud sound, as form of intimidation or displeasure (Tavolga & Essapian, 1957)

FEMALE/FEMALE INTERACTION	Contact	Any behaviour which involved physical contact between two animals; a "bout" of interaction began when one dolphin touched the other and continued until they moved greater than one body length apart (Nelson & Lien, 1994)
	Rub	Strenuous action in which one dolphin swimming at a fast pace advanced upon another and rubbed part of his body vigorously against his; vigorous contact of the two bodies along their length (Tavolga & Essapian, 1957)
	Chase	In varied form, but characteristically when chasing is in progress the animals swim inverted at high speed just below the surface (Saayman <i>et al.</i> , 1973)
	Bite	Open-jawed sparring and mock threats between two opposing animals and rake marks were sometimes left on the head and torso; flukes, peduncle and dorsal fin were target areas (Saayman <i>et al.</i> , 1973)
	Tail hit	A dolphin strikes another violently with its flukes / peduncle [*Anonymous at Monkey Mia (Australia), 1990]
MOTHER/CALF INTERACTION	Beack-genital propulsion	One dolphin uses its rostrum to nudge the genital area of another dolphin who is lying stationary on its side (Shane, 1990)
	Clasp	Taking between flippers [*Anonymous at Monkey Mia (Australia), 1990]
	Hold down	Dolphin, or group of dolphins, holds another down on bottom (Herzing, 1996)
	Contact	Any behaviour which involved physical contact between two animals; a "bout" of interaction began when one dolphin touched the other and continued until they moved greater than one body length apart (Nelson & Lien, 1994)
	Rub	Strenuous action in which one dolphin swimming at a fast pace advanced upon another and rubbed part of his body vigorously against his; vigorous contact of the two bodies along their length (Tavolga & Essapian, 1957)
	Bond	Actor dolphin rests its pectoral on the flank of another, behind the other's pec and below or just posterior to his dorsal fin [*Anonymous at Monkey Mia (Australia), 1990]
	Chase	In varied form, but characteristically when chasing is in progress the animals swim inverted at high speed just below the surface (Saayman <i>et al.</i> , 1973)
	Bite	Open-jawed sparring and mock threats between two opposing animals and rake marks were sometimes left on the head and torso; flukes, peduncle and dorsal fin were target areas (Saayman <i>et al.</i> , 1973)
	Push	Pushing with the beak, the side or ventral part another animal (Pilleri, 1986)
	Unsuccessful suckling	When there isn't cessation of infant body movements (Peddemors <i>et al.</i> , 1992)
	Suckling	When the calf insert its lower jaw into the mother's uro-genital groove and the upper jaw is in contact with the lateral skin of the mammary gland, it suffens its neck as if bracing, with a cessation of tail flexing (Peddemors <i>et al.</i> , 1992)
	Bumping	The calf swims in close proximity to the mammary glands often touching the glands with a part of its body (Peddemors <i>et al.</i> , 1992)
Nurturant behaviour	Mother appears to reprimand her calf for transgression and remove him from impending danger (Cockcroft & Sauer, 1990)	

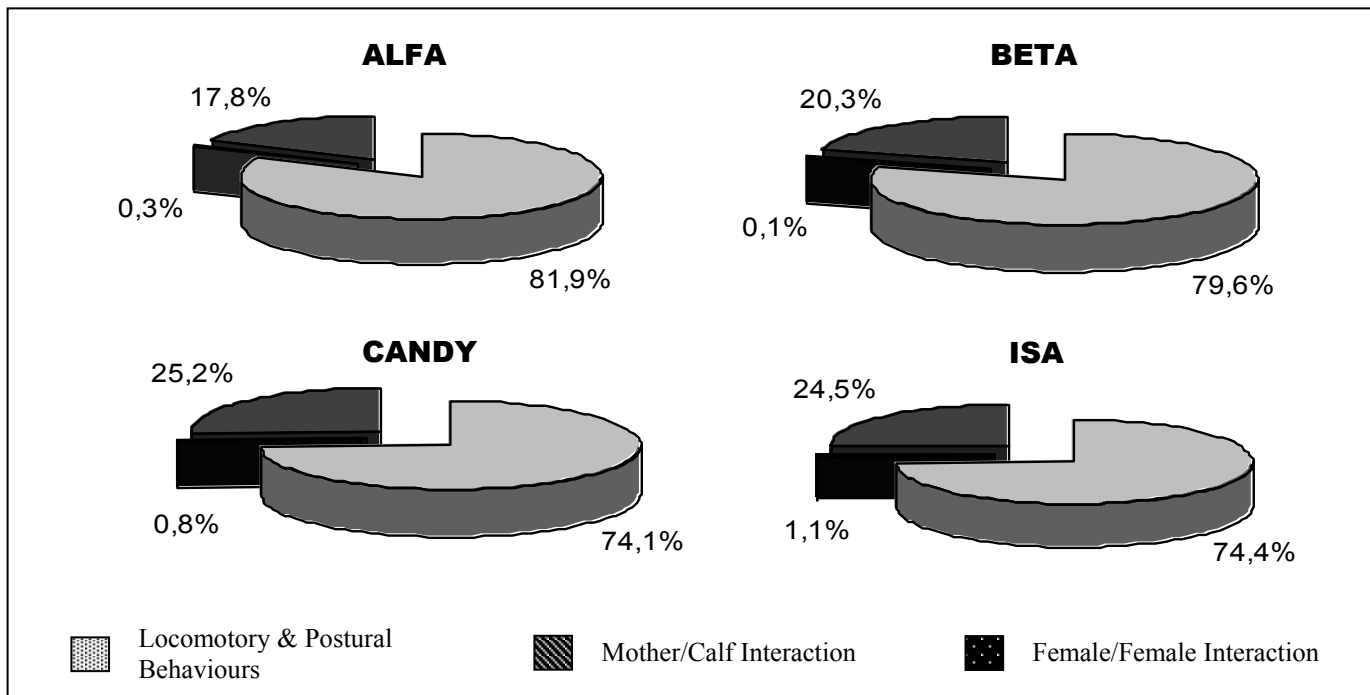


Fig. 1. BEHAVIOURAL CATEGORIES Frequency Distribution

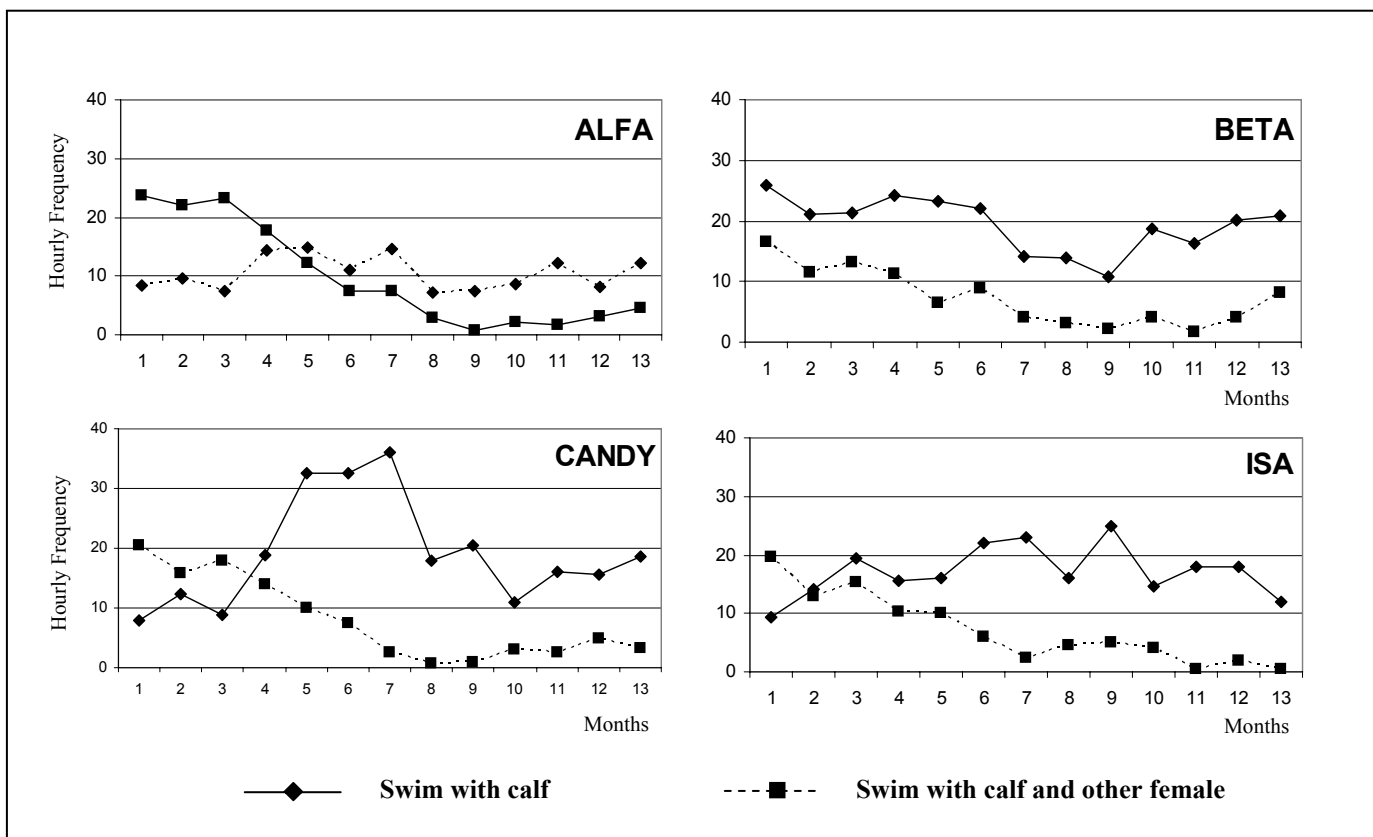


Fig. 2. SWIM IN ASSOCIATION Monthly Trend

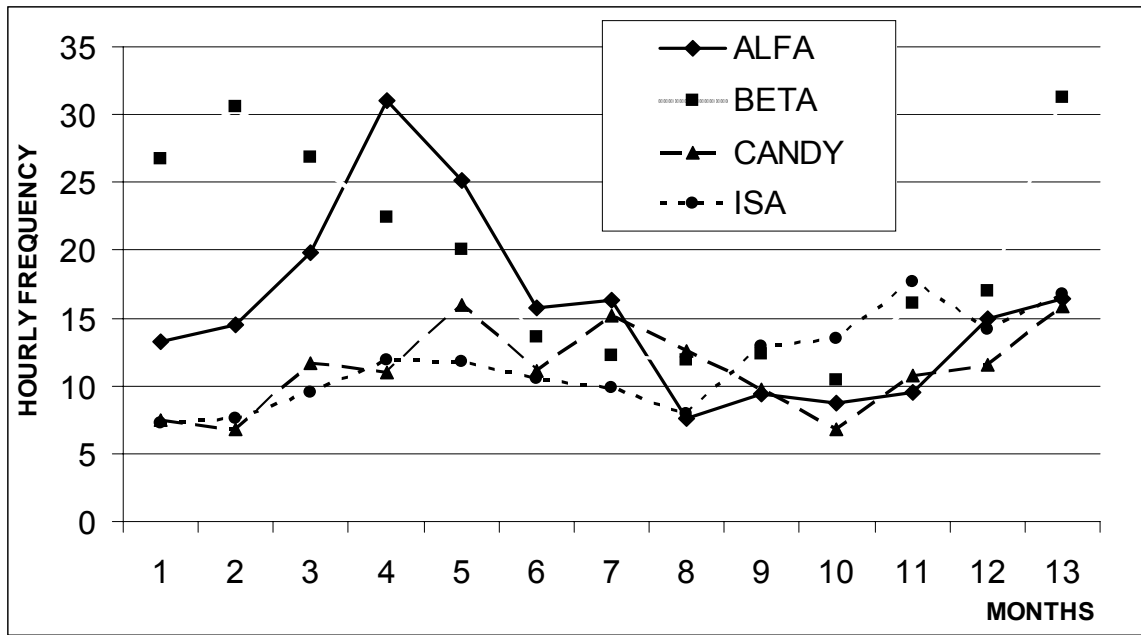


Fig. 3. "MOTHER/CALF" INTERACTION Monthly Trend