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SHORT COMMUNICATION

Novel behaviour shown by an Asian elephant in the context of allomothering

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Abstract In the absence of large sample sizes, logistic difficulties, and, more importantly, knowledge about appropriate hypotheses to test cognition in elephants, reliable anecdotal observations from field studies are increasingly being realized as valuable in this context. I report here a novel behaviour shown by a subadult female in the context of allomothering. The observation was made as part of a long-term study of social organization and behaviour in free-ranging Asian elephants in southern India. A subadult, nulliparous female, Genette, while allomothering a calf, was confronted by the calf persistently trying to suck at Genette's mammary glands. This was presumably uncomfortable for Genette, as evidenced by her reactions of avoiding, kicking, and nudging the calf away. She, however, started offering her trunk tip to the calf to suck, and this behaviour was seen repeatedly, with the calf actively sucking on it as if drinking milk. I discuss how this trunk-sucking behaviour differs from related behaviours previously seen in elephants and how this might be a case of problem solving.

Keywords Asian elephant · Allomothering · Trunk sucking · Comfort allosuckling · Problem solving · Innovation

Introduction

Elephants are known as intelligent creatures, but little work has been carried out on their cognitive abilities (see Plotnik et al. 2009; Byrne and Bates 2011). Discrimination between visual patterns (Rensch 1957) and mirror self-recognition in a single captive Asian elephant (Plotnik et al. 2006) have been shown, but causal understanding has been debated about (see Williams 1950; Nissani 2006; Byrne and Bates 2011). Reliable "anecdotes" from field studies can be very important for building up knowledge about cognitive capacities (Kummer and Goodall 1985). In the absence of knowledge about what appropriate hypotheses to test in elephants, which do not rely on sight as much as primates do, such "anecdotes" will allow for more informed hypotheses to be tested in the future (Bates and Byrne 2007). Innovations, which are novel, learnt behaviours (even if learnt due to an accident) that do not occur just from social learning (Ramsey et al. 2007), are thought to be a measure of cognitive ability and, by providing solutions to problems, can influence a species' ecology and evolution (Kummer and Goodall 1985). Field studies are especially valuable when trying to record innovations, which are usually rare. While hundreds of innovations have been recorded in primates, which include the discovery of information, novel behaviours, and existing behaviours in novel contexts (see Kummer and Goodall 1985; Reader and Laland 2001; Ramsey et al. 2007), few reports exist about innovations by elephants. As early as in 1966, Gordon reported the case of an elephant fashioning a tool to plug a water source. Foerder et al. (2011) reported the case of an elephant that showed insightful problem solving by moving an object that it could stand on to access food. But such reports are few and far between, possibly because of the dearth of studies. Here, I describe a novel, innovative behaviour that was observed in the context of allomothering by a subadult female, during a long-term field study on Asian elephants. Allomothers in elephants are non-mother females who are in close proximity to calves and protect, assist, and comfort them (Lee 1987).

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Methods

I had set up a programme of long-term monitoring of an Asian elephant population in the Nagarhole–Bandipur National Parks and Tiger Reserves area in southern India in March 2009, in order to understand the relative roles of ecological factors and individual relationships in shaping Asian elephant social organization and behaviour. The Nagarhole–Bandipur area is part of a contiguous stretch of several thousand square kilometres of forest, and the Asian elephant occurs at a density of ~2 elephants/km^2 here (unpublished data from our project). In the dry season, areas near the backwaters of the Beechanahalli (Kabini) dam offer an abundant supply of water and grass, which results in elephants and other herbivores congregating there. Behavioural observations can be carried out easily in the backwaters area because of good visibility. Elephants were individually identified through photographs and sketches (Vidya et al., in preparation), and a total of 650 elephants have been identified.

Field work was usually carried out from 6:30 or 7:00 am to 6:00 or 6:30 pm (depending on the season) by driving along pre-selected routes. Upon encountering elephants, photos and GPS location were taken, and elephants were age and sex classified (calf, <1 year old; juvenile, 1 to <5 years old; subadult, 5 to <15 years old; adult, ≥15 years old) and identified. Data on associations between individuals were collected in order to understand the social structure of female groups. Females were said to be associating with one another when they were in close proximity (usually <50 m) and showed coordinated movement, especially to or away from a water source. Association indices ($AI=N_{AB}/(N_A+N_B-N_{AB})$, where N_A and N_B are the total number of sightings of individuals A and B, respectively, and N_{AB} is the number of sightings of both individuals seen together) between individuals were calculated using MATLAB 7 (The MathWorks, Inc, 1984–2011, www.mathworks.com). Behavioural data were obtained through ad libitum sampling and focal group sampling (see Altmann 1974).

Results

The innovation observed was in the context of allomothering by a subadult female, Genette, towards Dana's calf. Dana was first seen on 23 Apr 2009 (and estimated to be about 25 years old) with her juvenile male tusker Denzel (estimated to be about 5 years old). Genette (estimated to be 10 years old) was first seen on 1 Jun 2009 as part of a larger group that included Dana, but Genette was primarily seen to associate with Genevieve (adult female ~25 years old) and Genevieve's 2-year-old juvenile female. Dana gave birth to a female calf (Dana_2012_F) around 23 Mar 2012 (date correct to within 10 days, calf first seen on 30 Mar 2012). The association index between Dana and Denzel was 0.938 for the 6 months before the calf was born and was 0.045 for about 2 months (till the end of May) soon after the calf was born. During the latter period, Genette joined Dana and her calf (very rarely was any other elephant seen to associate with this trio), and her association index with Dana was 0.933 (15 sightings of the three animals together), although she had not been sighted with Dana during the previous 6 months. From 3 Jun 2012 onwards, for the next month, Dana and her calf were seen separately or with others but not with Genette, and Genette was found again with Genevieve and her juvenile female.

The novel behaviour was first observed on 9 Apr 2012 and, subsequently, on 10 Apr 2012. Dana, her calf, and Genette were spotted at 12:01 hours at Rajamankere backwaters, DB Kuppe Range, Nagarhole National Park, but went out of sight shortly afterwards. They were seen again from 14:33–17:07 hours. At 14:36, Dana's calf was seen to search between Dana's hind legs for her mammary glands, a behaviour often seen in the first month after birth (Nair 1989). At 14:37, the calf was at Dana's mammary glands, but 6 s later, she was trying to reach for Genette's nipple. Genette was nulliparous, and her mammary glands were not even slightly enlarged. Genette nudged the calf away to the side using her trunk and forelegs, but the calf was persistent, and Genette placed her trunk tip (finger at the end of the trunk) inside the calf's mouth (after 6 s), which the calf sucked on as if drinking milk. On 9 Apr 2012, out of 33 attempts by the calf to suck at Genette's nipples that could be observed clearly, Genette offered her trunk 28 times to the calf. She seemed harassed by the calf's persistence and nudged away, kicked the calf (Fig. 1), or, occasionally, walked away, all five times when she did not offer her trunk, and during 17 of the 28 times before offering her trunk tip. Whenever the calf had access to Genette's trunk tip, she made sucking motions with her mouth as when drinking milk from Dana. On 10 Apr 2012 (14:57–15:38), both attempts by the calf to feed from Genette that I could clearly observe resulted in Genette offering her trunk tip and the calf sucking on it (Fig. 2). There was no correlation

Fig. 1 Genette kicking Dana_2012_F when the latter reached for Genette's nipple. Standing next to Genette is Dana

Fig. 2 Dana_2012_F sucking on Genette's trunk tip. Standing beside Genette is Dana

between response time (time between the calf reaching for the mammary glands and having the trunk tip placed in its mouth) and the attempt number (Spearman $R=0.026$, $P=0.893$, $N=29$ attempts). In all cases on both the days, sucking by the calf was terminated by Genette withdrawing her trunk tip (Electronic Supplementary Material 1, 2). The average duration of sucking by the calf was 5.8 s (±1.17 95 % CI) on 9 Apr 2012 and 36.5 s (±2.94) on 10 Apr 2012. Suckling duration of the calf by Dana was 1.5 min, similar to the 1–2-min suckling durations reported in Asian elephant calves previously (Gadgil and Nair 1984; Nair 1989).

Genette had been seen with Dana and her calf on 4 days before 9 Apr 2012, but the trunk-sucking behaviour was not observed then nor was the calf seen to try to suck from Genette, although Genette was allomothering the calf in terms of assisting her and directing her towards Dana. Unfortunately, Genette, Dana, and her calf could not be spotted for the next 10 days after the novel behaviour was seen and were found across the river in Bandipur after that. Undisturbed behavioural observations on them were not possible subsequently because of the presence of other elephants closer to the vehicle and/or dominance directed by other elephants towards Dana's group until 26 Apr 2012, when the novel behaviour was no longer seen, possibly because of the cost to Genette in terms of feeding. On 26 Apr 2012, of the nine attempts by the calf to suck at Genette's nipple that were seen, Genette allowed the calf to suck at her nipple while she continued to feed in seven of the attempts. She continued to try to kick the calf or walk away about half the times, but did not offer her trunk. The calf was also taller now and was more easily able to access her nipple.

Discussion

To my knowledge, this is the first report of an elephant substituting her trunk tip for her nipple. This was problem solving because Genette was disturbed by the calf trying to suck her nipple, as evidenced by her reactions of nudging and kicking the calf and trying to walk away. Trunk-to-mouth behaviour has been frequently observed in elephants, in which an animal places its trunk in its own mouth or another individual's mouth. The former has been seen in young calves (Douglas-Hamilton and Douglas-Hamilton 1975; Moss 1988; Kowalski et al. 2010, personal observation) and is thought to be comforting to the individuals, analogous to thumb-sucking behaviour in humans (Bolwig 1965; Douglas-Hamilton and Douglas-Hamilton 1975). The latter probably allows for information transfer about food, in reassuring an individual that is distressed (Adams and Berg 1980, personal observation), as part of greeting ceremonies (Moss and Poole 1983), or to reduce further aggression (Garai 1992). In a study by Adams and Berg (1980), in which frequent trunk-to-mouth behaviour had been recorded, the individuals studied were female African elephants 5–15 years old (subadults by the classification in my study). The study by Garai (1992) included a calf that received trunk-to-mouth contact by adult females, which seemed to serve the function of inspection by the females, but did not involve the calf sucking on the trunk tip. I do not know of any report in which this behaviour has been co-opted to serve the purpose of comfort allosuckling.

Elephant females, including nulliparous females, are known to comfort calves through allomothering (Dublin 1983), which may include touch and, infrequently, suckling of others' calves (Gadgil and Nair 1984; Lee 1987; Nair 1989; Rapaport and Haight 1987). During a study on African savannah elephants in Amboseli, it was found that lactating females generally did not tolerate allosuckling and were aggressive in their rejections of the calves, while nulliparous females were tolerant of allosuckling, and such bouts were often terminated by the calves (Lee 1987, 44 successful allosuckling bouts out of a total of 1,865 suckling bouts observed over 2 years). The function of allonursing, therefore, may be to pacify an infant (primate or elephant) rather than to supply milk (Jay 1963; Lee 1987; Baldovino and Di Bitetti 2008). Such comfort allosuckling was rarely shown by subadults below 13 years of age in African savannah elephants (15 occasions during >30 years of the Amboseli Elephant Project, Bates et al. 2008). The observed behaviour of Genette allowing the calf to suck on her trunk tip provides support to the hypothesis that allonursing serves the function of comforting the infant.

Although our data do not demonstrate it, the observed behaviour is consistent with the notion that elephants have a theory of mind and empathy. Theory of mind (Premack and Woodruff 1978) has been previously attributed to elephants (see Hart et al. 2008) because they have successfully demonstrated mirror self-recognition (Plotnik et al. 2006) and assistance towards conspecifics in distress (Douglas-Hamilton and Douglas-Hamilton 1975; Moss 1988; Douglas-Hamilton et al. 2006). We also find empathy here (see Bates et al. 2008), in the form of "targeted helping" (see de Waal 2008). Although one does not know whether it was through insight or inadvertent, the novel behaviour solved a problem, because Genette

was successful in not allowing Dana's calf to actually suck her nipples during the first 2 days of my observing the behaviour. The alternative seemed suitable because the calf did not withdraw its mouth during any of the instances, and it was Genette who withdrew her trunk every time. It was probably too good an alternative because the calf persistently followed Genette around and sucked on her trunk although Dana, who was lactating, was nearby. This prevented Genette from feeding normally and could possibly have led to her not offering her trunk subsequently.

If Genette's behaviour of offering her trunk tip to the calf was performed for the first time the day I saw it, there was learning by Genette also about the effectiveness of the behaviour because she allowed the calf to suck on her trunk the second day for longer periods of time. Dana's calf was not observed to try to suck from Genette's nipple or trunk during the preceding week. Offering trunk sucking had also not been shown by Genette when she was allomothering Genevieve's juvenile during the previous years or by other adult or subadult females in our study. It, therefore, classifies as an innovation (Kummer and Goodall 1985; Reader and Laland 2001). We do not know of any other innovation reported in elephants in the context of allomothering. Even in primates, about half the innovations recorded have been in the context of foraging, and only about 2 % of the innovations have been in the context of infant care (Reader and Laland 2001).

Studies of natural object and relational concepts in animals often ignore how animals discriminate between classes and whether there are constraints in doing so (Thompson 1995). My observations suggest that the tactile sense, especially involving the trunk, may be appropriate in testing such concepts in elephants. Foerder et al. (2011) reported the case of an elephant that showed insightful problem solving by moving an object that it could stand on to access food. Thus, tasks relating to the use of the trunk may be useful in examining cognition in elephants (Foerder et al. 2011; Plotnik et al. 2011).

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