

Lucy A. Bates,<sup>1</sup> Phyllis C. Lee,<sup>2,3</sup>  
Norah Njiraini,<sup>2</sup> Joyce H. Poole,<sup>2</sup>  
Katito Sayialel,<sup>2</sup> Soila Sayialel,<sup>2</sup>  
Cynthia J. Moss<sup>2</sup> and Richard W. Byrne<sup>1,4</sup>

## *Do Elephants Show Empathy?*

**Abstract:** *Elephants show a rich social organization and display a number of unusual traits. In this paper, we analyse reports collected over a thirty-five year period, describing behaviour that has the potential to reveal signs of empathic understanding. These include coalition formation, the offering of protection and comfort to others, retrieving and ‘babysitting’ calves, aiding individuals that would otherwise have difficulty in moving, and removing foreign objects attached to others. These records demonstrate that an elephant is capable of diagnosing animacy and goal directedness, and is able to understand the physical competence, emotional state and intentions of others, when they differ from its own. We argue that an empathic understanding of others is the simplest explanation of these abilities, and discuss reasons why elephants appear to show empathy more than other non-primate species.*

Empathy is defined as the ability to share someone else’s feelings or experiences by imagining what it would be like to be in their situation (*Cambridge English Dictionary*), often referred to as ‘putting oneself into another’s shoes’. Empathy is a component of human consciousness (Thompson, 2001), and the ability to detect and respond appropriately to the emotions of others is a cornerstone of normal social function. The recent discovery of a mirror system for emotional

Correspondence:

<sup>1</sup> School of Psychology, University of St Andrews, Fife, KY16 9JP, UK.

<sup>2</sup> Amboseli Trust for Elephants, PO Box 15135, Langata 00509, Nairobi, Kenya.

<sup>3</sup> Department of Psychology, Stirling University, Stirling, UK.

<sup>4</sup> Corresponding author: *Email: rwb@st-andrews.ac.uk*

responses in humans has provided evidence for the neurological basis of empathy (Jabbi, Swart and Keysers, 2007; Wicker *et al.*, 2003), but little is known about the evolution of this emotional mirror system and to what degree it is shared by any other species. Macaque monkeys are known to possess mirror neurons that react to the physical actions of others when they match actions in the monkey's own repertoire (Gallese *et al.*, 1996; Rizzolatti *et al.*, 1996), but the analogous emotional mirror system has not yet been identified in non-human animals.

It is important, however, for all animals to be able to detect and respond to the content and context of conspecifics' emotional displays. Inappropriate responses to another's aggressive displays, fear reactions or sexual advances would be maladaptive and potentially fatal; that animals respond appropriately in these circumstances suggests they have at least a rudimentary form of emotion recognition system. But human abilities go beyond simply reading and responding to an emotional display in the present: we can also model emotional states and desired goals that influence others' behaviour in the past and future, and use this to plan our own actions. Do any animals share these advanced abilities, and if so can they be understood as the result of empathic responses to other individuals?

Simple forms of empathy, such as emotional contagion, have been used to explain contagious yawning, scratching, and the behavioural copying shown in the play and aggression of chimpanzees and Japanese macaques (Anderson, Myowa-Yamakoshi and Matsuzawa, 2004; de Waal, 2008; Parr, Waller and Fugate, 2005). Parr *et al.* argue that 'this type of emotional awareness functions to coordinate activity among group members, facilitate social cohesion and motivate conciliatory tendencies, and is likely to play a key role in coordinating social behaviours in large-brained social primates'. However, behavioural contagion is also evident in chickens, and all these phenomena can be explained with simple models of response facilitation (Byrne, 1994; Hoppitt, Blackburn and Laland, 2007). Nevertheless, there is evidence that even a behaviour as seemingly simple as contagious yawning does relate to empathic understanding in humans, so behavioural contagion may well be a precursor to, or simplified form of, sophisticated empathic abilities (Lehmann, 1979). Chimpanzees have been suggested to show higher levels of empathy, such as in the behaviour described as 'consolation' whereby an uninvolved bystander reassures one of the individuals involved in an agonistic interaction (de Waal and Aureli, 1996).

It seems most appropriate to look for evidence of empathy in species that live in coherent, coordinated social groups, where

individuals have both opportunity and reason to model the behaviour, emotions and mental states of conspecifics. One such species is the African elephant. Elephants are long-lived, slowly developing, large brained mammals that live in closely bonded societies (Bates, Poole and Byrne, 2008; Douglas-Hamilton and Douglas-Hamilton, 1975; Moss, 1988). Female savannah elephants remain within the same family group throughout their lives, and 'allomothering' (caring for another's offspring) for female associates is common and important for calf survival (Lee, 1987a; Moss and Poole, 1983). Furthermore, elephants are known to possess complex auditory, olfactory and visual communication systems (Langbauer Jr, 2000; McComb *et al.*, 2000; Poole, 1998; Poole, 1999; Poole and Granli, 2003). Given these characteristics, it seems reasonable to predict that elephants would benefit from being able to identify the underlying emotions and desires of others. In this paper, we explore whether African savannah elephants, a species that has not shared a common ancestor with humans for at least 103 million years (Murphy *et al.*, 2001), exhibit any signs of advanced empathic ability.

Elephants' well-documented interest in the carcasses and bones of dead conspecifics might be viewed as evidence of their empathic nature, although the biological functions of these behaviours are yet to be determined (Douglas-Hamilton *et al.*, 2006; McComb, Baker and Moss, 2006). Furthermore, elephants have recently been suggested to pass mirror self-recognition tests (Plotnik, de Waal and Reiss, 2006), and Gallup (1982) has linked the capacity for empathy with the ability for mirror self-recognition. However, it should be noted that Plotnik's paper did not follow the accepted protocol for tests of self-recognition, as defined by Gallup (1970), and earlier attempts to show mirror self-recognition in elephants have failed (Povinelli, 1989), so this remains a contentious claim.

Here we present observational reports of wild elephants that appear to respond to the emotional states of others, i.e. cases where an empathetic understanding may be implicated, as recorded during a continuous thirty-five-year study of African elephants. We consider the mechanisms of each of these reported cases, in terms of how they could be modelled cognitively.

We accept that this approach is controversial for two reasons. Firstly, the application of cognitive models is contentious. In principle, the acquisition of all non-innate behaviours can be explained as classical or instrumental conditioning (Skinner, 1953), just as all such behaviours can also be understood cognitively (Byrne and Bates, 2006; Tomasello and Call, 1997). It is often suggested that if

behaviour can be explained as conditioning there is no need to apply cognitive terminology. Conditioning explanations are purportedly more ‘parsimonious’ because they do not attribute any mental processes: indeed, it is often falsely imagined that using cognitive models to describe behavioural complexity implies greater ‘intelligence’ than reliance on associative explanations. Unfortunately, conditioning accounts of complex behaviours are typically derived in a post-hoc, and therefore unfalsifiable, fashion (Byrne and Bates, 2006). We favour cognitive terminology in this paper purely because it allows predictive models to be developed that can subsequently be tested and potentially falsified. The application of cognitive models does not in itself imply anything about our expectation of the level of cognitive skill to be found in elephants.

Secondly, this approach is controversial for its use of observational records of behaviour, often collected *ad libitum*, instead of controlled experimental trials. Several experimental paradigms have been developed to test mental-state and emotional-state recognition in primates (Hare *et al.*, 2000; Hare, Call and Tomasello, 2001; Parr, 2001), but adapting these tests to non-primate species often proves difficult and lacks ecological validity. Whilst few experimental tests of captive elephant behaviour have succeeded in engaging the potential subjects, there is a wealth of knowledge of wild elephant behaviour available from long-term study sites. For this reason, we base our study on observational field records taken from the longest running African savannah elephant study site, in Amboseli National Park, Kenya. This approach allows us to consider elephants’ empathic skills within their particular ecological context: the problems faced by the elephants here are real and relevant to their success.

## Methods

### *Study site and population*

The Amboseli ecosystem of southern Kenya is a semi-arid savannah. The Amboseli elephant population has been studied continuously for over thirty-five years by members of the Amboseli Trust for Elephants (ATE), set up by Cynthia Moss and Harvey Croze in 1972 (see [www.elephanttrust.org](http://www.elephanttrust.org)). During this time, over 2200 elephants have been identified and named (Moss, 2001) and at December 2006 the population stood at 1434 living elephants, divided into fifty-eight family units, with approximately 300 independent males. All the elephants in the population are habituated to the ATE project vehicles, allowing observation of behaviour at close range.

### *Data collection*

Since 1975, three long-term researchers — Cynthia Moss (CM), Joyce Poole (JP) and Phyllis Lee (PL), and three permanent research staff — Norah Njiraini (NN), Soila Sayialel (SS) and Katito Sayialel (KS), have provided the bulk of ATE elephant data collection, totalling approximately 480 months of daily elephant observations between them. Data collected during this time has included focal sampling of mothers and infants (CM, PL), focal sampling of males (JP), focal behaviour sampling of a family group (JP), scan sampling of infant activity (PL), and *ad libitum* recording of interactions between elephants (all). Additionally, research staff census family units using the Park in order to maintain accurate demographic records of the Amboseli elephant population. In all records cited, two-letter codes (e.g. AA, EB) signify the names of family groups, whereas names or numbers (e.g. Echo, M27) signify individuals.

### *Data analysis*

Bates and Byrne (2007) have argued that analysis of observational records, where each single record may be called an anecdote, can be a useful scientific tool if approached systematically. Firstly, only written reports, recorded at the time of occurrence by experienced observers, should be included in any such analysis. Reports used should conform to a strict, pre-determined definition of the behaviour of interest. Reports can then be separated according to the details of the behaviour observed, and any categories where only single records exist must be discounted as un-interpretable (McGrew, 2004). Categories of behaviour that provide multiple independent observations of the event can then be examined to determine the minimum cognitive apparatus necessary to allow such behaviour. This approach generates testable and falsifiable hypotheses regarding the underlying cognitive mechanisms of behaviour.

The original data-sheets and notes used to record all elephant observations were made available to LB and RB. We extracted 255 reports of behaviour that potentially illustrated empathic responses to distressing situations, according to the following working definition: 'A voluntary, active response to another individual's current or imminent distress or danger, that actually or potentially reduces that distress or danger.'

Six records described events that were recorded only once, and so were deemed un-interpretable and were excluded from further analysis. The remaining 249 records were assigned to one of the categories detailed below, according to the type of socio-ecological problem addressed by the behaviour.

*Coalitions* — In aggressive or hazardous situations, two or more individuals (a and b) may work simultaneously and in a cohesive manner against another individual or individuals (x).

*Protection* — When a young or injured individual is in a potentially dangerous situation, but is unable to defend itself sufficiently, it may receive protection from another elephant. Such ‘protection’ is distinct from coalition behaviour, as here the individual being protected is unable to protect itself, usually because it is too small or too sick.

*Comfort* — Interactions were deemed ‘comforting’ rather than protective if the recipient was distressed but not in any actual danger. A wide range of routine behaviour performed towards young calves by older female elephants have been described as maternal or allomaternal comfort (Lee, 1987a). Females may comfort calves in various ways: by touching or cradling an immature animal with the trunk; touching an immature with the body, or allowing the immature to lean on or touch oneself; and by tolerating comfort suckling, whereby a calf attempts to suckle from an adolescent or adult female that is not its mother. Previously, allosuckling (suckling another’s calf) has been discussed with respect to nutrition (Lee, 1987a), but as that is not our focus we include all tolerated allosuckling attempts, irrespective of whether the female is lactating.

*Babysitting* — When a calf is separated from its mother for a prolonged period, one or more other females may show interest in and/or direct care towards the calf. This is termed babysitting, and is often seen when a calf has been orphaned or has strayed from its family. This category essentially draws on the protective and comforting behaviours of females in the specific situation of a calf that has been separated from its mother for at least several hours.

*Retrievals* — When a calf has been temporarily separated from its family group, older females from the family may act to return the calf to its natal group. In the category of retrieval, we include fetching individuals that have wandered away from their group, been left behind or been kidnapped.

*Assisting mobility* — When an individual has fallen over, become stuck in mud, water or other difficult terrain, or is unable to proceed forward for any other reason, other elephants may assist so that the stuck individual can resume travelling. Acts used to assist mobility include picking up, pushing and pulling, using the trunk, tusks or feet.

*Removing foreign objects* — When an elephant has a foreign object such as a veterinary dart or spear protruding from its body, another individual or individuals may touch or attempt to remove the object.

Having categorized each record, we then attempted to determine the minimum necessary cognitive attributions made by the elephant before it performed the behaviour that aided the distressed individual (see Table 1).

*Table 1: Empathic attributions potentially made by elephants*

<b>Attribution of:</b>	<b>Understanding that:</b>	<b>Example</b>
Animacy	Some entities can spontaneously generate behaviour	Recognize that immobility of elephants is anomalous
Goal directedness	Behaviour can be directed at specific ends	Expect a recurring behaviour to normally lead to the same outcome, e.g. a male chasing an oestrus female will mount her
Emotion	Others have emotions and that these can be different to one's own	Recognize another animal's distress
Physical competence	Others have abilities and vulnerability and that these can be different to one's own	Realizing that a calf cannot cross a cattle grid
Perspective	Others perceive things and that their perspective can be different to one's own	Recognize that another individual cannot perceive a danger from its location
Intentions	Others can have wants and needs that can be different from one's own	Realizing that another's aims have been thwarted, e.g. that a calf is trying to get out of a river but is stuck
Knowledge-belief	Others have beliefs and knowledge that can be different to one's own	Predicting another's behaviour by computations of their ignorance or false beliefs e.g. working out that one's calf might not know to avoid a poisonous fruit

## **Results**

### *Coalitions (seventeen cases)*

The coalitions were always aimed at adults, and were always formed by two or more adults grouping together to threaten or chase away one

or more other, unrelated adults. Coalitions were formed to instigate a threat (nine times) but also in retaliation to threats from the adversary (eight times). Four coalitions were formed by males helping other males of a similar age. Thirteen coalitions were formed by adult females, always with related females (mother-daughter pairs in seven cases, close matrilineal relatives — siblings, aunts and nieces, cousins — in five cases, and a more distant matrilineal relative in one case). No mixed-sex coalitions were recorded, and most were targeted against same-sex adversaries (thirteen cases). All coalitions recorded were successful, in that the target of the coalition moved away from the area.

*Cognitive processes underlying coalitions* — Coalitions are commonly discussed in ethological literature, but are rarely considered as potentially empathic. In all cases included here, only one of the coalition partners (a) was originally engaging in the agonistic behaviour with the adversary (x): the partner who joined (b) could have remained uninvolved, but after they joined the interaction, the single adversary (x) moved away. The joining of (a) and (b) in a coalition effectively eliminated the potential danger to (a). The decision of (b) to act alongside (a) must ultimately be based on selfishness at the kin selection level (or reciprocal altruism between males), but a causal explanation of how (b) decides to act is also necessary. In cases where the behaviour was retaliatory, (b) may have acted because it perceived the threat from (x) as directed to itself, that is, the coalition behaviour may have been entirely coincidental. However, this explanation cannot be applied to the instigation of an attack. At a minimum, this requires an understanding of animacy of the other elephant, recognition of another's emotion (from threat and fear displays), and goal directedness of the other, whereby (b) understands that the threat behaviours of others (a) are directed at displacing another individual (x).

*Protection (twenty-nine cases)*

Most reports relate to protection of calves under one year old (twenty-seven cases). The exceptions were one for a calf of five years, and one for an adult female who had been speared and was immobile. Members of a different family were harassing the latter, and her adult daughters were observed to push the threatening individuals away. In sixteen of the cases involving calves, it was the mother who acted. Only three of these mothers were primiparous (first-time mothers); the thirteen others were experienced mothers with at least one calf born previously. In the twelve cases where an allomother acted, five were parous females

(females who have given birth at least once) and seven were young nulliparous females (females who have never given birth).

In most cases (twenty-two), the protectors acted before any harm had actually come to the individual, and so before it had actually given any obvious vocal or visual signal of distress. In the remaining seven cases, the calves were pulled away from a situation after they had been attacked or received a fright. The 'pre-emptive' reports of protection occur in five situation types:

**Chasing predators away from newborns (two cases);**

At 11.00 a.m. find the EB's . . . The baby comes over to the car and started feeling it. Just then Echo chased off a hyena and trumpeted. Immediately the calf whirled around and went back to Echo and at the same time Enid, Elspeth and Eudora came rushing over, their heads up and ears out and they joined Echo in a broad front facing the direction that the hyena went in. — CJM: 21 August 1994.

**Stopping play fights between calves (four cases);**

At 17h45, Ely and Esau start playing, chasing and trying to mount one another. They're head to head and Enid goes over to them and clearly pushes Esau away with her tusks. She does it three times and is getting in between them, breaking them up. Esau keeps going around her to get back at Ely. — CJM: 10 November 1992.

**Pushing individuals away from calves (five males, five females);**

As she moves, Echo stops, rumbles, ear flaps and looks back. Karl arrives from the east. He is sniffing towards her. Echo lifts her tusks and pushes him away from her (one day old) baby. Echo continues slowly, stopping and starting, rumbling and looking back. — CJM: 08 May 1994.

**Keeping calves away from young males and females (four cases);**

Time 12:25. At the start of the watch, Susan is mud splashing and SU9 is sitting in the mud at the edge. Two minutes into the sample, SU9 backs away from a young male. Sally then pulls SU9 closer to her, under her chin, at the approach of the young male. SU9 goes around her while Sally and the young male spar. — CJM: 27 August 1980.

**Preventing calves from moving into dangerous areas (two cases);**

At 9.30, the EB family go to the big wallow. Most of them get right in. Eventually Echo and the baby came. Echo splashed, getting mud on the baby too but backed away from the edge, looking and keeping the baby with her. — CJM: 11 May 1994.

*Cognitive processes underlying protection* — The twenty-three cases of 'pre-emptive' protection suggest that the protector is empathic in the sense of predicting the distress that the calf will feel if the current

situation is not stopped. As the calves were not necessarily experiencing any distress, the protector could not always be responding simply to the direct perception of pain signals or distress responses by the calf. Instead, they must at least have been using their past experiences with such interactions, e.g. they have learned that boisterous young males are dangerous to young infants, or play fighting with larger calves can cause distress. They must have recognized the situation as conforming to that type, and taken action to prevent the distress from occurring. Therefore, these cases provide evidence that the actor could attribute animacy, goal directedness and emotional attribution to another individual.

### *Comfort (129 records)*

Lee (1987a) showed that mothers and allomothers frequently touch young calves and maintain close proximity to them, although the rate of touching and degree of closeness declines as the calf ages. In this analysis, thirty-five records of reassuring immatures were extracted, with each always directed to calves under two years old. In 61% of cases ( $n=21$ ) the calves were newborns or less than one month old (76% less than twelve months old), and in 42% ( $n=15$ ) the comfort-reassurance behaviour was preceded by the calf giving a distress vocalization. In one case where no vocalization was recorded, the calves (twins) were noted as standing with 'heads up' in an alarm posture, and in 9% ( $n=3$ ) of cases the calves initiated the physical contact themselves, by touching their bodies against an allomothers. In 45% ( $n=16$ ) of cases, calves received comfort without showing any obvious external behavioural cues.

Comfort allosuckling by calves was recorded on ninety-two occasions. Only one of these records describes comfort suckling by an immature older than two years (a six year old male was allowed to comfort suckle from an adolescent female in his family). In all but one case, the calf and older female were from the same family or bond group. In forty-seven of the ninety-two cases, it was a parous female who allowed another's calf to suckle from her. Adolescents under the age of thirteen were only recorded to allosuckle calves on fifteen occasions. Two negative examples, where allosuckling attempts were refused, concerned adult females who had calves of their own and thus would have been lactating. One of these was from the same family as the refused calf, and the other was not.

*Cognitive processes underlying comfort behaviours* — The frequency of comfort behaviour suggests that elephants are very sensitive to the

emotional needs of calves. In approximately half of the cases, comfort occurred when a calf was obviously distressed, with the distress most often conveyed by auditory emotional communication signals. In these cases, the mother or allomother has to recognize the emotional signals of the calf and respond appropriately by offering comfort. In principle, comfort might be offered because of an understanding of wants and needs, in the absence of any expression of emotion. But in these cases, the most parsimonious explanation is that the mother was responding to the emotions of the calf.

Where comfort was shown to calves without any obvious external behavioural cues from the calf, it is harder to determine the ontogeny of the mother's behaviour. However, we suggest that seeking physical contact with calves may require no stimuli other than the appearance and subsequent recognition of the young calf, and is most likely an innate behavioural response of females towards elephant calves. Attraction to young calves is thought to serve an important evolutionary function in elephant families, increasing calf survival and enhancing the stability of the group (Lee, 1987a).

Comfort suckling was always initiated by calves, and so required little action on the part of the older female. In the two cases where allosuckling was refused, the female evidently discriminated the calf as not her own. In both reports the calf's actions are described as 'tried to suckle' suggesting it had at least raised its trunk towards the female's breast. Recognition of the goal towards which the calf's actions were directed, or attribution of goal directedness, is implied by the active refusal of the adult.

#### *Babysitting (twenty-one cases)*

On six occasions, an unknown calf was seen with an un-related family whose members showed some care of the calf. The calf did not survive for more than a few weeks in any of these cases, although the precise time taken for the calf to die depended upon its age and condition when it was orphaned or otherwise separated from its mother. All other cases of babysitting occurred within the calf's natal family. Six refer to orphaned calves; in four of these the calf only survived one to two months after its mother's death. The other two calves are currently still alive, after five and three years respectively. In nine cases the separation was temporary, and the calf was safely reunited with its mother after being cared for by babysitting family members.

*Cognitive processes underlying babysitting* — Babysitting is most obviously explained as an over-extension of a female's natural

tendency to care for calves: occasionally females make the 'mistake' of targeting care at non-kin calves. Babysitting can be considered a natural consequence of comforting and allomothering calves, and so probably relies on the same cognitive attributions of animacy and, on occasion, emotion, to the calf. The physical presence or absence of the mothers may not be a critical variable: calves are allomothered in both cases. However, babysitting is more common when calves are at a distance from the mother (Lee, 1987a). Rarely, babysitting may ensure a calf's survival even after its mother's death, although in cases where the calf has yet to be weaned, survival almost never results.

### *Retrievals (22 cases)*

All individuals who had to be retrieved were under five years old. Nine calves were retrieved from unrelated females or families, six were alone or left behind before being reunited with their families, five were pulled away from the ATE observation vehicle, and two were retrieved from males to whom they had wandered too close. They were all retrieved either by the mother acting alone, or by the mother and another female family member. In nine cases the female retrieved the calf following 'lost call' vocalizations by the calf, but in the other cases no vocalizations were noted. Of the nine who were with unrelated females, six most likely occurred because the calf wandered over to the unrelated females, who then began to allomother them. But on three occasions it appears that females from dominant families actively attempted to remove a newborn calf from the subordinate family and/or resisted the retrieval by the mother, as described below:

At 10.10, Freda and others move rapidly to the place where the EB's are resting and supplant them. Then they kidnap Ely (Echo's newborn calf), and he calls and cries out. Enid stays but Echo has run off and tries to grab him back. The FB's stick with Ely and at one point he is kicked and knocked down. — CJM: 24 March 1990.

*Cognitive processes underlying retrievals* — Again, this behaviour can be viewed as an extension of the allomothering 'caretaking' tendencies of female elephants. Retrievals are usually led by the mother, so she must differentiate her calf from any others present and respond to its absence. Retrieval behaviour sometimes relies on an attribution of emotion to the calf, at least when the mother is responding to vocal distress signals, and potentially involves an attribution of goal directness to the adult females who 'kidnap' calves.

*Assisting mobility (28 cases)*

All but one of the immobile individuals were under two years old when helped. The exception concerns a mother leading her two-year-old and six-year-old daughters to a cattle-grid where there was a break in the electric fence that was separating them from her. The mother had to break through the electric fence, using her tusks to snap the wire, and then enter the enclosure to lead her calves to the safe place to exit (NN: 10 September 2006). The following day, the same individuals were again stuck in the enclosure. The youngest could not be encouraged to cross the cattle grid for fifteen minutes, eventually running over it only when the mother walked back on to it herself, facing the calf, and reversed slowly (NN: 11 September 2006).

Four records describe leading a calf to terrain that was easier for it to negotiate, such as a less steep part of a riverbank or over a cattle grid. Nine records refer to events where a calf had fallen over or could not get up and was helped to stand, usually by the mother but in one case by an unrelated adult male. In all cases, the calf was helped to its feet by the adult using its trunk to lift it, and gently sliding the foot underneath the calf.

The remaining fifteen records refer to calves who had fallen into ditches or who could not climb in or out of mud wallows, rivers or other water channels. The calf was pushed (three times) or pulled (nine times) out, or an adult dug the sides of the bank with her tusks, which decreased the incline (three times). In thirteen cases, the calf was helped by the mother, in the other six cases the calf was helped by other female family members. The passage below describes the action of one such allomother:

IB's are crossing Snipe River. Infant struggles to climb out of bank after its mother. An adult female is standing right next to it, and moves closer as the infant struggles, it does not push it out with its trunk, but it digs its tusks into the mud behind the calf's front right leg which acts to provide some anchorage for the calf, who then scrambles up. — LB and NN: 21 September 2005.

*Cognitive processes underlying mobility assistance* — In all cases described here, elephants must have made attributions of animacy and physical competence to the individual that was immobile. Attributing emotion is also highly likely in some circumstances, such as the eleven cases observed where a calf gave a distress bellow vocalization (seven when it was stuck in a water channel or ditch, and four when it had fallen over), although emotion attribution is also possible when

no vocalizations were given, for example from visual signals of distress or frustration.

Hart, Hart and Pinter-Wollman (2008) discuss elephants helping disabled conspecifics as evidence that elephants attribute mental states: they consider helping implies attributing a mental state of ‘disablement’, an example of ‘targeted empathic helping’. We suggest that mental state attribution may not be necessary to understand these data; an understanding of the *physical* state of the stuck individual is often sufficient, with no need to understand intentions or knowledge. However, two scenarios included in our database do require an attribution of intention by the helper to the calf.

Firstly, the three cases when calves were *pushed* out of a water channel, such as in the example described above, seem to require an understanding of the calf’s intention. In these cases, the adult responded to the signs of frustration or distress in the calf, but the act of helping it increased the physical distance between calf and adult. In contrast, *pulling* calves out of a channel does not necessarily require understanding the calf’s intention to climb out of the bank. The mother or allomother was already out of the channel, and — as with retrievals — upon seeing its distress at the physical separation, she acted to bring the calf near to her. Similarly, digging the sides of a bank to allow a calf an easier ascent does not require an attribution of intent as in all cases the adult’s behaviour could be argued to be self-ish, whereby the females dug the bank to also ease their own climb, although in most cases the adult could easily step out of the bank.

The second scenario that required an attribution of intention describes a female leading a mother and calf to a shallower bank:

At 11.10ish Ella gives a ‘lets go’ rumble as she moves further down the swamp . . . At 11.19 Ella goes into the swamp. All the group are in the swamp except Elspeth and her calf, born 2000, and Eudora (Elspeth’s mother). At 11.25 Eudora appears to ‘lead’ Elspeth and the calf to a good place to enter the swamp — the only place where there is no mud. — JP: 3 June 2000.

In this case, Eudora had no need to enter the swamp at the point to which she led her daughter and granddaughter, her behaviour was adjusted specifically to the problem faced by the calf.

#### *Removing foreign objects (three cases)*

Only three records contribute to this category, although there are additional verbal reports that have not been included here as they do not conform to the criteria set out in Bates and Byrne (2007). One

describes an adult (M324) pulling a tranquillizing dart out of another male (M319) that had been darted by a vet prior to treatment for a spear wound.

After [M319] was darted, another male — M324 — approached M319 and kept on touching the dart. M324 then pulled the dart out and dropped it on the ground, and kept touching where the dart was. M324 was then pushing M319, then when M319 went down, M324 left. — SS: 4 September 2006.

The actor, M324, dropped the dart as soon as he had pulled it out, suggesting he was not interested in the dart itself, but rather in removing it from the other elephant.

The second observation in this category describes a six-year-old male investigating a spear that was penetrating the back of another juvenile (Matrix, born 2000). The spear had entered just above the hip on the left hand side of the elephant, and came out about four inches further back, one inch below the spine, and was lodged in the wound. Matrix did not appear to be limping when walking, and was keeping pace with her mother Marjorie.

Matrix is swishing her tail onto the wounds almost constantly, and both the entry and exit wounds are oozing puss, but we can't see any blood. At 10.35 Matrix mud splashes with Marjorie, and initially directed all sprayings to the wound area . . . 11.07 Matrix is dusting the wound. She does not throw dust anywhere else on her body, just on the wound. 11.12 Winona's male calf (born 2000) moves out of the swamp near to Matrix. He is standing just behind her. He touches the spear (the exit side) with his trunk three times. As he did this Matrix stopped feeding and stood still. 11.15 The 2000 male moved off, and Matrix stepped forward and continued feeding. No vocalisations were heard. — LB and KS: 24 February 2006.

Matrix or Marjorie were not seen to investigate the wound with their trunks at any point, and there was apparently no attempt by the juvenile male to pull the spear out of Matrix. Verbal reports of other incidents suggest that sometimes elephants do attempt to pull out spears that protrude from other's bodies, however.

The final report in this category describes an experienced matriarch removing rubbish from her calf's mouth.

Echo is with Esprit (born 2005) behind the Safari Lodge. Echo picks up a plastic bag then drops it again almost immediately. Esprit, standing right next to Echo, then picks it up and starts to put it in her mouth. Echo immediately picks the bag off her, holds it in her own trunk-curl for several seconds, then drops it and moves on. Esprit moves with her. — LB and NN: 22 February 2006.

Interestingly, elephants frequently carry vegetation on their bodies, and conspecifics apparently pay little interest to these natural objects; there are no reported observations of individuals removing vegetation from another's body, although they may play with and toss around vegetation from their own bodies before discarding it. Similarly, during experimental trials of a study that involved presentation of brightly coloured cloths to the elephant groups, several different individuals picked up a white cloth in some trials, and draped it over their bodies whilst walking along. On these occasions, we never observed others attempting to remove the cloth (Bates *et al.*, 2007).

*Cognitive processes underlying removal of foreign objects* — In the cases presented here, the actors apparently recognized the dart, spear and plastic bag as foreign objects that should not be in contact with the others' bodies, and in two cases removed them. Minimally, this act could be achieved with knowledge of what is 'normal' for elephant bodies, with action taken to investigate or remove the visible objects that do not conform to this template. This explanation only works if clumps of vegetation carried on an elephant are seen as normal, which is plausible given how often researchers see this. However, it does not explain why no investigations were made of the cloths carried on others' backs or tusks during the experimental trials. Such a minimal explanation of 'norm' attribution gives no significance to the fact that male M319 was visibly ill before he was darted, and in the case of Matrix, puss was seeping from the wounds: the potential health state of the individual should be irrelevant. We would therefore have to predict that elephants would remove foreign objects from the bodies of any elephant, healthy or sick, irrespective of the nature of the foreign object. However, this prediction is apparently not supported, as it is only in cases where there is a visible injury or sickness, or the object presents a potential hazard, that another elephant has felt compelled to touch the foreign object.

It is not possible to draw strong conclusions from only three observations, but these reports suggest that elephants can distinguish dangerous from benign foreign objects, perhaps using emotional and behavioural cues from the wounded animal, and it is this recognition that prompts the action to remove them. In addition, removal may be altruistic, as the interaction with a foreign object that is associated with illness, injury, or danger in another could be potentially dangerous to the actor as well.

### Discussion

Based on the evidence presented here, as summarized in Table 2, we would argue that elephants routinely recognize *animacy* and *goal-directedness*; that is, elephants recognize certain characteristic aspects of normal elephant behaviour, and have expectations about the outcomes usually achieved by such behaviour. Furthermore, there is strong evidence that elephants are able to recognize accurately and respond appropriately to a range of *emotions* of other elephants, usually but not exclusively kin. Elephants therefore understand that other elephants are animate agents that can perform directed behaviours and experience autonomous emotions, which they can recognize.

*Table 2:* Summary of behaviours observed and the implications for cognition

Behaviour	Context	Requirement	Empathic attribution
Anticipatory coalitions	Competition with other elephants	Recognition of threat from third parties to allies	Animacy Goal directedness Emotion
Protection	Pre-empting and preventing injury/danger	Recognition of danger to others	Animacy Goal directedness Emotion
	Response to injury/danger	Recognition that another has been hurt	Animacy Emotion
Comfort	Physical reassurance	Recognition of physical distress of calf	Animacy Emotion
	Social reassurance	Recognition of emotional distress of calf	Animacy Emotion
	Refusal of allosuckling	Recognition of identity of calf	Animacy Goal directedness
Babysitting	Related calves	Recognition that calf is not with its mother	Animacy Emotion
	Unrelated calves	Recognition that calf is not with its mother	Animacy Emotion
Retrievals	Calf left alone	Remembering that calf should be present	Animacy Emotion
	Calf with individuals it wandered towards	Recognition of calf and that it should be present	Animacy Emotion
	Calf with individuals that drew it away	Recognition of calf and that it should be present	Animacy Goal directedness Emotion

Behaviour	Context	Requirement	Empathic attribution
Assisting Mobility	Leading	Recognition that calf cannot negotiate certain terrain	Animacy Physical competence
	Helping to stand	Recognition that calf cannot stand	Animacy Physical competence Emotion
	Pulling out of ditches etc.	Recognition that calf distressed because lacks ability to join mother	Animacy Physical competence Emotion
	Pushing out of ditches etc.	Recognition that calf wants to get out of ditch but lacks ability	Animacy Physical competence Intention
	Leading by a third party	Recognition that mother's efforts will be insufficient to overcome calf's physical inability	Animacy Physical competence Intention
Removing foreign objects	Darts, spears, rubbish	Recognition that object is unusual and dangerous	Animacy Emotion

It is important to realize that the 249 records discussed here almost certainly under-represent the frequency with which elephants engage in these sorts of empathic behaviour. Behaviours such as comforting and seeking physical contact with calves can be observed every few minutes in Amboseli, and others such as coalitions, protection and assisting with mobility probably also occur on a daily basis. Because they are now so familiar to observers, these actions are now rarely recorded except during focal sampling or when they occur in circumstances that are noteworthy for another reason, although they were recorded more frequently in the first ten to fifteen years of the project. Given the potentially controversial nature of this paper, we have been careful to only include reports that fully conform to the criteria laid out by Bates and Byrne (2007). This stringency reduced our sample size, but we feel it was necessary. Even with this reduced sample of observations, we were still able to uncover some evidence, from behaviour in the category of 'assisting mobility', that elephants understand the *physical competence* and *intentions* of others, where these differ from their own. We anticipate that structured observations will in the future strengthen this conclusion.

We therefore take it that elephants do indeed show certain kinds of empathy. Empathy can operate at a number of levels, from the simplest level of 'contagion', to a more sophisticated level described by de Waal (2008) as 'sympathetic concern'. The latter is illustrated in our data by instances in which elephants offer protection and comfort to the calves of others, 'babysit' them or retrieve them from harm. The highest level of empathy de Waal describes, 'empathic perspective taking', is characterized by 'targeted helping' towards needy individuals. In our data, this was shown in several cases in which calves were helped to overcome mobility problems.

Few animal species have been suggested to show such a high level of empathy. There seem to be three possible reasons for that: a genuine lack of ability, a lack (in the animals) of much functional utility to showing such empathy, or an antipathy (in the research community) towards labelling animal behaviour as empathic. Because of the inherent difficulty in measuring animals' emotions and other mental states, animal behaviour researchers are understandably reluctant to appeal to empathy as a causal explanation: preferring alternatives that do not impute emotional state understanding, often going no further than a functional account. Intriguingly, this sparse and intellectually hygienic approach contrasts with how (often the same) researchers typically talk about their subjects' behaviour amongst themselves! Invoking advanced cognitive capacities such as empathy is often the easiest way to describe an event to someone who did not themselves observe it, but it is another matter to prove their existence to a sceptical audience.

Quite apart from these differences of interpretation, there are perhaps few species where individuals would benefit from empathic responses, whether or not they have the ability to show them. For many mammals, the only social period of life is a relatively brief period of dependence on the mother, and maternal solicitude is shown in routinely protective behaviour that can be explained by simpler means than empathy. Much the same applies to birds, although many bird species are pair bonded so both parents may supply care and protection. Only with species where several generations live socially and the group may contain both kin and non-kin with various degrees of affiliation, as with many anthropoid and some strepsirrhine primates, are researchers able in principle to detect the signs of empathic responses. In these cases, the ability to discriminate among individuals according to differences in their physical abilities, their knowledge and their needs and wants, may pay in evolutionary terms. It is, then, no surprise that it is in primates (de Waal, 1996, 2008) and in elephants that empathy has been detected. The level of empathic responsiveness of elephants seems exceptionally high, but

fair comparison is difficult. For example, the relatively slowly developing infants of most primates would still be held close to their mothers at the age when elephant calves are often the subjects of helping by other elephants.

It is obvious from the records we have discussed here that elephants are very sensitive to the distress of others, and remarkably capable of anticipating and preventing such distress. These reports mostly concern the potential distress of calves, and it is mostly relatives who react. As de Waal (2008) argued, empathy is the causal mechanism underlying directed altruism. In all animal species studied, altruism is most common along kin lines, but the high reproductive 'value' of an elephant calf to its mother and other kin (Lee, 1987b) particularly increases the adaptive value of any effective care by elephants. Nevertheless, as evidenced by a few of our records, adult elephants do sometimes help individuals who are not related to them; thus, not all empathic behaviour may be linked to kinship, and may represent a more generalized response to distress (Douglas-Hamilton *et al.*, 2006). Some of the many instances of altruism described in other animal species may also depend on empathy; but as yet it remains unclear if helping in any other species requires empathic comprehension of the distressing event. Other than elephants and primates, species likely to give convincing evidence of empathy are those, such as social carnivores, that show female philopatry (i.e. where females stay in the natal home area and adolescent males move away to breed) and altruistic and co-operative helping behaviours. For example, meerkats, which show many kinds of altruistic helping behaviour (Clutton-Brock *et al.*, 2000; Clutton-Brock *et al.*, 2002), would be interesting to consider from this perspective, but as yet no evidence of empathy has been reported.

### *Acknowledgements*

We would like to thank the Leverhulme Trust for financial support (Grant F/00 268/W). Our study of the cognition of the African elephant could not take place without the continual collaboration of the Amboseli Trust for Elephants. We thank the Office of the President, the Kenya Wildlife Service and the Amboseli Park wardens for allowing ATE to study the elephants of Amboseli National Park.

### **References**

- Anderson, J.R., Myowa-Yamakoshi, M. and Matsuzawa, T. (2004), 'Contagious yawning in chimpanzees', *Proceedings of the Royal Society (B): Biology Letters Supplement*, **271**, pp. S468–70.

- Bates, L.A. and Byrne, R.W. (2007), 'Creative or created: Using anecdotes to investigate animal cognition', *Methods*, **42**, pp. 12–21.
- Bates, L.A., Poole, J.H. and Byrne, R.W. (2008), 'Elephant cognition', *Current Biology*, **18**, pp. R544–R546.
- Bates, L.A., Sayialel, K.N., Njiraini, N., Moss, C.J., Poole, J.H. and Byrne, R.W. (2007), 'Elephants classify human ethnic groups by odor and garment color', *Current Biology*, **17** (22), pp. 1938–42.
- Byrne, R.W. (1994), 'The evolution of intelligence', in *Behaviour and Evolution*, ed. P.J.B. Slater and T.R. Halliday (Cambridge: Cambridge University Press), pp. 223–65.
- Byrne, R.W. and Bates, L.A. (2006), 'Why are animals cognitive?', *Current Biology*, **16**, pp. R445–R448.
- Clutton-Brock, T.H., Brotherton, P.N.M., O'Riain, M.J., Griffin, A.S., Gaynor, D., Sharpe, L., Kansky, R., Manser, M.B. and McIlrath, G. (2000), 'Individual contributions to babysitting in a cooperative mongoose, *Suricata suricatta*', *Proceedings of the Royal Society of London (B)*, **267**, pp. 301–5.
- Clutton-Brock, T.H., Russell, A.F., Sharpe, L.L., Young, A.J., Balmforth, Z. and McIlrath, G.M. (2002), 'Evolution and development of sex differences in cooperative behavior in meerkats', *Science*, **297** (5579), pp. 253–6.
- de Waal, F.B.M. (1996), *Good Natured: The Origins of Right and Wrong in Humans and Other Animals* (Boston MA: Harvard University Press).
- de Waal, F.B.M. (2008), 'Putting the altruism back into altruism: The evolution of empathy', *Annual Review of Psychology*, **59**, pp. 279–300.
- de Waal, F.B.M. and Aureli, F. (1996), 'Consolation, reconciliation, and a possible cognitive difference between macaque and chimpanzee', in *Reaching into Thought: The Minds of the Great Apes*, ed. A.E. Russon, K.A. Bard and S.T. Parker (Cambridge: Cambridge University Press), pp. 80–110.
- Douglas-Hamilton, I., Bhalla, S., Wittemyer, G. and Vollrath, F. (2006), 'Behavioural reactions of elephants towards a dying and deceased matriarch', *Applied Animal Behaviour Science*, **100** (1–2), pp. 87–102.
- Douglas-Hamilton, I. and Douglas-Hamilton, O. (1975), *Among the Elephants* (New York: Viking Press).
- Gallese, V., Fadiga, L., Fogassi, L. and Rizzolatti, G. (1996), 'Action recognition in the premotor cortex', *Brain*, **119**, pp. 593–609.
- Gallup, G.G., Jr (1970), 'Chimpanzees: Self-recognition', *Science*, **167**, pp. 86–7.
- Gallup, G.G., Jr (1982), 'Self-awareness and the emergence of mind in primates', *American Journal of Primatology*, **2**, pp. 237–48.
- Hare, B., Call, J., Agnetta, B. and Tomasello, M. (2000), 'Chimpanzees know what conspecifics do and do not see', *Animal Behaviour*, **59**, pp. 771–85.
- Hare, B., Call, J. and Tomasello, M. (2001), 'Do chimpanzees know what conspecifics know?', *Animal Behaviour*, **61**, pp. 139–51.
- Hart, B.L., Hart, L.A. and Pinter-Wollman, N. (2008), 'Large brains and cognition: Where do elephants fit in?', *Neuroscience and Biobehavioural Reviews*, **32** (1), pp. 86–98.
- Hoppitt, W., Blackburn, L. and Laland, K.N. (2007), 'Response facilitation in the domestic fowl', *Animal Behaviour*, **73**, pp. 229–38.
- Jabbi, M., Swart, M. and Keysers, C. (2007), 'Empathy for positive and negative emotions in the gustatory cortex', *NeuroImage*, **34** (4), pp. 1744–53.
- Langbauer Jr, W.R. (2000), 'Elephant communication', *Zoo Biology*, **19**, pp. 425–44.
- Lee, P.C. (1987a), 'Allomothering among African elephants', *Animal Behaviour*, **35** (1), pp. 278–91.

- Lee, P.C. (1987b), 'Nutrition, fertility and maternal investment in primates', *Journal of Zoology*, **213**, pp. 409–22.
- Lehmann, H.E. (1979), 'Yawning: A homeostatic reflex and its psychological significance', *Bull. Meninger Clin.*, **43**, pp. 123–36.
- McComb, K., Baker, L. and Moss, C. (2006), 'African elephants show high levels of interest in the skulls and ivory of their own species', *Biology Letters*, **2**, pp. 26–8.
- McComb, K., Moss, C., Sayialel, S. and Baker, L. (2000), 'Unusually extensive networks of vocal recognition in African elephants', *Animal Behaviour*, **59**, pp. 1103–9.
- McGrew, W.C. (2004), *The Cultured Chimpanzee: Reflections on Cultural Primatology* (Cambridge: Cambridge University Press).
- Moss, C. (2001), 'The demography of an African elephant (*Loxodonta africana*) population in Amboseli, Kenya', *Journal of Zoology*, **255**, pp. 145–56.
- Moss, C.J. (1988), *Elephant memories: Thirteen years in the life of an elephant family* (London: Elm Tree Books).
- Moss, C.J. and Poole, J.H. (1983), 'Relationships and social structure of African elephants', in *Primate Social Relationships: An Integrated Approach*, ed. R.A. Hinde (Oxford: Blackwell Scientific Publications), pp. 315–25.
- Murphy, W.J., Eizirik, E., O'Brien, S., Madsen, O., Scally, M., Douady, C.J., Teeling, E., Ryder, O.A., Stanhope, M.J., de Jong, W. and Springer, M.S. (2001), 'Resolution of the early placental mammal radiation using Bayesian phylogenetics', *Science*, **294**, pp. 2348–51.
- Parr, L.A. (2001), 'Cognitive and physiological markers of emotional awareness in chimpanzees (*Pan troglodytes*)', *Animal Cognition*, **4** (3–4), pp. 223–9.
- Parr, L.A., Waller, B.M. and Fugate, J. (2005), 'Emotional communication in primates: Implications for neurobiology', *Current Opinion in Neurobiology*, **15** (6), pp. 716–20.
- Plotnik, J.M., de Waal, F.B.M. and Reiss, D. (2006), 'Self-recognition in an Asian elephant', *Proceedings of the National Academy of Sciences*, **103**, pp. 17053–7.
- Poole, J. (1998), 'An exploration of the commonality between ourselves and elephants', *Etica and Animali*, **9**, pp. 85–110.
- Poole, J. (1999), 'Signals and assessment in African elephants: Evidence from playback experiments', *Animal Behaviour*, **58**, pp. 185–93.
- Poole, J.H. and Granli, P.K. (2003), 'Visual and tactile signals of African savanna elephants', [http://www.elephantvoices.org/index.php?topic=what\\_comm&topic2=what\\_comm/visual\\_tactile\\_signals.html](http://www.elephantvoices.org/index.php?topic=what_comm&topic2=what_comm/visual_tactile_signals.html).
- Povinelli, D.J. (1989), 'Failure to find self-recognition in Asian elephants (*Elephas maximus*) in contrast to their use of mirror cues to discover hidden food', *Journal of Comparative Psychology*, **103**, pp. 122–31.
- Rizzolatti, G., Fadiga, L., Fogassi, L. and Gallese, V. (1996), 'Premotor cortex and the recognition of motor actions', *Brain Research*, **3**, pp. 131–41.
- Skinner, B.F. (1953), *Science and Human Behaviour* (New York: Macmillan).
- Thompson, E. (2001), 'Empathy and consciousness', *Journal of Consciousness Studies*, **8** (5–7), pp. 1–32.
- Tomasello, M. and Call, J. (1997), *Primate Cognition* (New York: Oxford University Press).
- Wicker, B., Keysers, C., Plailly, J., Royet, J., Gallese, V. and Rizzolatti, G. (2003), 'Both of us disgusted in my insula: The common neural basis of seeing and feeling disgust', *Neuron*, **40** (3), pp. 655–64.