Chapter 14
Communicative Cues Among and Between Human and Non-human Primates: Attending to Specificity in Triadic Gestural Interactions

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Abstract Humans have a sophisticated understanding of other individuals' mental states. But differences between humans and others species are already apparent when focusing on more basic social cognitive capacities. This chapter focuses on a very basic social cognitive skill: gaze following. A rich set of data supports the hypothesis that the ability to interpret others' gaze shift as an indicator that others see things in their environment seems to be widespread among primates (and other species). However, this is in contrast to another set of data that shows that non-human primates, unlike humans, seem to have difficulties interpreting others' gaze shift as indicators that they communicate about things in the environment. This chapter argues that non-human primates (and probably other species) may lack certain cognitive and motivational components, which help to identify the relevance and specificity of a triadic gestural communicative interaction.

14.1 Introduction

The ability to coordinate complex collaborative actions such as those involving making collective decisions and coordinating group member actions requires certain social cognitive and communicative skills. Human social cognition seems to be unique compared to non-human primates: Humans have developed a highly flexible form of communication, language, and also a sophisticated understanding of other individuals' mental states. But differences between humans and other species are already apparent when focusing on more basic social cognitive capacities.

This chapter focuses on very basic social communicative cues among human and non-human primates: gaze-shift following, pointing, and ostensive cues (e.g. eye contact, tone of voice, etc.). A rich set of data supports the hypothesis that the ability to interpret others' gaze shift as an indicator that others see things in their environment seems to be widespread among primates (and other species) (for an overview, see

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Rosati and Hare 2009). However, this is in contrast to another set of data that shows that non-human primates, unlike humans, seem to have difficulties interpreting others' gaze shift as indicators that they communicate about things in the environment (for an overview, see Call and Tomasello 2005). Human children from an early age seem to be able and highly motivated to interpret gaze shifts as communicative acts performed by others in order to inform them about certain entities in their environment. In contrast to that, even our closest living relatives, the chimpanzees, have problems when it comes to interpreting communicative gaze shifts provided by others, for instance to help them find something interesting such as a piece of desirable food.

14.2 Following Gaze to See What Others See

A very basic social cognitive skill is gaze following. Humans demonstrate very early in life that faces, especially the eyes, are an important visual stimulus that as newborns they attend to specifically (Morton and Johnson 1991; Johnson et al. 2005). By the age of 6–9 months, infants begin to sense the gaze direction of others (Scaife and Bruner 1975) and follow the gaze of others to visible targets (D'Entremont et al. 1997; Csibra and Volein 2008; Flom and Pick 2003). By the age of 9–12 months, infants spontaneously follow others' gaze direction to specific targets that are not directly in view (Corkum and Moore 1995; Carpenter et al. 1998). Gaze following seems to be widespread in the animal kingdom as well.

Different primate species have been observed to follow the gaze of a human experimenter or a conspecific to an outside entity (Bräuer et al. 2005; Burkart and Heschl 2006; Emery et al. 1997; Goossens et al. 2008; Povinelli and Eddy 1996; Tomasello et al. 1998, 1999). In the classic paradigm, a human experimenter sits opposite a subject and at a predetermined moment looks up as if she has seen something interesting above the subject. Several primate species (including all great ape species) respond to this behaviour by also looking up. They do so significantly more often than in a control condition in which the human stares at the opposite side of the room (Bräuer et al. 2005). This provides good evidence that another individual's gaze direction is taken as a meaningful cue and potentially as information about some outside entity. Chimpanzees and several monkey species also follow the gaze direction of their conspecifics. Tomasello et al. (1998) tested chimpanzees and various monkey species for their ability to follow the gaze of their group members. An experimenter, situated above the group, attracted the attention of one individual by presenting food to her. Once this individual had shifted her gaze towards the food, it was recorded whether a nearby subject that had not seen the food would respond with co-orientation to the conspecific's gaze shift. All species tested in this setting followed the gaze direction of their conspecific. This finding supported earlier findings from a computerized task in which Emery and colleagues showed that rhesus macaques were able to locate an object according to the gaze direction of a conspecific depicted on a TV monitor (Emery et al. 1997; see also Deaner and Platt 2003).

Recent research suggests that the gaze-following behaviour of great apes is based on some understanding of others' perspective. Different primate species seem to have some understanding of others' line of sight and others' visual perspective (Bräuer et al. 2005; Burkart and Heschl 2006; Povinelli and Eddy 1996; Tomasello et al. 1999). If an individual interprets gaze as an indicator of another individual's line of sight, the gaze-follower should not just automatically shift its head but should, if necessary, relocate to a position where it can see what the other animal is looking at. All great ape species follow the gaze direction of a human experimenter around a barrier situated between the target of the gaze and the ape. Bräuer et al. (2005) compared all great ape species for their ability to track a human experimenter's line of sight. In that study, the apes watched a human look behind different types of barriers. To track the human's gaze direction and be able to see what the human was looking at, the subjects had to move to a different corner of the room. Subjects indeed moved more often in this experimental condition compared to a control condition in which the human looked in another direction (Bräuer et al. 2005).

Okamoto-Barth et al. (2007) investigated whether the great apes' gaze following around obstacles is based on an understanding that the other individual is seeing something different, or alternatively that their movement is based on a simpler mechanism such as the motivation to simply co-orient with others – a mechanism conceptualized as operating geometrically in space (Okamoto-Barth et al. 2007). The authors therefore conducted a study in which a human experimenter gazed in the direction of a target object and the line of sight was either blocked by an opaque barrier or by a barrier with a large window in it, such that the experimenter could potentially see what was behind it. If the subjects understand something about the human experimenter's visual perspective in that situation, they would expect the target of the human's attention to be behind the barrier if the barrier had a window or in front of the barrier if the barrier was opaque. Chimpanzees and bonobos looked behind the barrier more frequently when it had a window and they looked in front of the barrier when it was opaque. This suggests that chimpanzees and bonobos take the perspective of the experimenter when following the gaze and deduce that the experimenter is seeing something (Okamoto-Barth et al. 2007).

Taken together, this evidence suggests that non-human primate species use the gaze direction of others flexibly as a cue to scan the environment for something interesting. There is also evidence that in some species this behaviour seems to be based on an understanding of others' line of sight and visual perspective and not just on some kind of automatic reflex (see also Hare et al. 2000, 2001; Kaminski et al. 2008; Melis et al. 2006a; Santos et al. 2006).

14.3 Following Gaze to See What Others Communicate About

Gaze following in primates also presents us with a conundrum, however, because a slight alteration in the procedure leads to a significant drop in the subjects' performance. Take, for example, the situation in which the experimenter sits opposite the subject and whose gaze is directed to one specific target object from

a number of potential objects, all visible to the subject. If the experimenter tries to inform the subject through gaze about the location of hidden food from a number of potential targets, for example, all primate species tested (including chimpanzees) seem to ignore the experimenter's gaze. The paradigm used in this case is the so-called object-choice paradigm (Anderson et al. 1995). Here, a human experimenter hides food in one of several locations out of view of the subject. The human then provides the subject with information about where to find the hidden food by indicating its location, either by pointing (often accompanied by gaze alternation) or by just gazing at the correct cup. Different primate species, including chimpanzees, coming from different labs and tested by different experimenters seem to ignore these communicative gestures while making their choice as they choose randomly between the cups (Anderson et al. 1995, 1996; Call et al. 1998; Herrmann et al. 2007; Itakura et al. 1999; Povinelli et al. 1997; Tomasello et al. 1997). Furthermore, the subjects' performance is not enhanced by interaction with a conspecific. Itakura et al. (1999) trained a chimpanzee to reliably indicate the location of hidden food to other group members. In this setting, the chimpanzee subjects ignored the conspecific's pointing gesture just as they ignored the human experimenter's (Itakura et al. 1999).

One problem with the standard object-choice task could be that it is highly artificial. Typically, the containers and food are on the human's side of a cage or barrier, and, thus, the human does not really need the chimpanzee's help in locating the food – she could easily just lift the containers and look herself. A second issue is that chimpanzees might follow the pointing gesture and assume that the container itself is the target, rather than what might be inside. However, in a recent study, Kirchhoffer et al. (submitted) showed that chimpanzees also either ignore or do not cognitively register a human's gesture if it is directed at one of two objects that are placed within the subjects' reach and that remain visible throughout the entire test. In said study, a transparent box was placed within the subjects' reach. The box had two separate compartments at either end of the box, each containing an object. Then the human indicated which of the two objects was to be delivered by the chimpanzee by gesturing towards it and offering the subject some food in return. All chimpanzees fetched one of the two objects in most of the trials; however, all chimpanzees that were tested seemed not to take into account the human's gesture while doing so. Indeed, none of the 20 chimpanzees tested chose the target object above chance. This suggests that it is not just the potential artificiality of the object-choice paradigm that is affecting the subjects' behaviour, but presumably something more fundamental on a cognitive level (Kirchhoffer et al. submitted).

One difference between the standard gaze-following situation and cases of perceptual co-presence of the referent and the gaze cue is that in the latter, the problem cannot be solved simply by scanning the environment for anything relevant. The referent is already present, which is why, in order to be successful, the subject has to understand the referential aspect of the communicative gesture. To do so, the recipient has to visually track the gesture to a specific referent in the environment, direct the subject's attention to that referent, and then infer why the subject's attention was directed towards it.

14.4 Human Child Development

From an early age, humans seem to be especially adapted to attending to and acting upon communicative cues produced by others (Csibra and Gergely 2009; Senju and Csibra 2008). The use and production of certain communicative gestures (e.g. pointing) by 12-month-olds seem to be underpinned by an interpretation of another's intentions, desires, and some consideration of the context and common ground between both individuals. This is supported by studies showing that children as young as 12-months old use others' gestures as information about where to find a desirable object (Behne et al. 2005; Gräfenhain et al. 2009). Also, children as young as 18 months of age interpret others' pointing gestures based on what experience they have shared with them (Liebal et al. 2009; Saylor and Ganea 2007). Liebal et al. (2009) set up a situation in which children shared one activity with one adult and a second activity with another adult. Later, one of the adults pointed towards a referent, which was appropriate for either activity. The children's response to the adult's gesture depended upon which adult pointed, supporting the view that children took the pointing gesture to be relevant to a shared experience that they had just had with a specific adult some moments before, and therefore a common ground they had established with that adult (Liebal et al. 2009).

Furthermore, children at this age produce communicative gestures in order to inform others about certain entities in the environment (Liszkowski 2005; Liszkowski et al. 2006). Sometimes they do so solely with a helpful motive; in other words, without expecting anything in return for having done so (Liszkowski et al. 2008). But human communication goes beyond communicating about referents that are currently present. From an early age, children base their communicative attempts on the assumption that others can make inferences about absent referents (Liszkowski et al. 2009). Situations where the referent is currently absent are special because here, the only possible way to solve the problem is for the recipient to interpret the larger context and common ground in order to be successful (Clark 1996; Tomasello and Carpenter 2007). As shown above, this could be based on some shared experience or shared knowledge, which then helps both individuals to specify which referent the communication is about and what it has to do with that referent (Clark 1996; Liebal et al. 2009; Aureli et al. 2009; Tomasello and Carpenter 2007).

Imagine going to a friend's home that you have not seen for some time. You ask your friend to show you around because you want to know what has changed over the past few months. During your tour, you suddenly point to an empty wall without saying anything, and your friend replies, "Yes, I've sold it". He knows you are referring to a painting that was hanging there the last time you saw his home. In that moment your knowledge overlaps with your friend's and you therefore have a common ground, and also share the knowledge that you do. Therefore, communicative interactions, especially if they take place non-verbally, are based on both individuals' assumption that both can mentally orient towards a referent. Having this shared perspective helps both individuals to successfully communicate, especially in the absence of a referent (Tomasello et al. 2005; Tomasello and Carpenter 2007).

14.5 Chimpanzees

Chimpanzees' failure to use human-like pointing is even more puzzling given that chimpanzees produce pointing accompanied by gaze alternation regularly when requesting something from a human partner (Leavens and Hopkins 1998; Leavens et al. 1996). There are only very few observed instances in which great apes pointed for conspecifics in the wild (Véa and Sabater-Pi 1998; Inoue-Nakamura and Matsuzawa 1997), but for humans, great apes point in order to indicate the location of food, for example. They do so with strong persistence; that is, they will not stop pointing at a referent until the human hands it over, even if offered alternatives (Leavens et al. 2005; Leavens and Hopkins 1998). This indicates that their gesture is directed at a specific referent and is not just a random begging gesture. There is also anecdotal evidence that chimpanzees will guide a human over a great distance by pointing towards a location where a desirable reward is hidden. These observations are especially impressive, as the chimpanzees in this situation show tremendous persistence and change the direction of their pointing in a flexible way as soon as the human veers in the wrong direction. However, unlike children, chimpanzees do not seem to produce gestures readily in order to help others find objects in which they themselves currently have no interest (Bullinger et al. in press; see also Zimmermann et al. 2009). In the study by Bullinger et al. (in press), the authors compared chimpanzees' and children's motivation to point towards an object in which the subjects themselves were interested or an object in which only the adult was interested. Unlike the children, the chimpanzees' level of pointing dropped dramatically after the context changed from a more selfish (the chimpanzee gets a desired object) to a more helpful (the human gets a desired object) context. Therefore, rather than informing others about certain entities, chimpanzees seem to produce gestures mainly to request self-desired objects.

This insight has led to the hypothesis that chimpanzees use gestures more as imperatives, and suggests that they are directed at humans to make them do something such as make them hand over food that they desire rather than inform the human recipients about a certain entity in the environment (Tomasello 2008; Bullinger et al. in press). Directing the recipient imperatively in order to make the recipient do things is substantially different from drawing the recipient's attention towards something in order to make the recipient know things about the environment (Tomasello et al. 2005). Communicating imperatively does not necessarily require an understanding of others' mental states. Instead, the recipient is more used as a social tool, and the gestures are used in order to request a certain action from the recipient such as to move into a certain direction. Informing individuals about things in the environment is substantially different, as by communicating the sender's aim is to provide or share information (Zimmermann et al. in press). This requires an ability to be motivated beyond the obtaining of direct-reward objects, as well as the cognitive ability to detect when a recipient is ignorant about certain aspects of the environment, plus the understanding and motivation to provide this information (Tomasello 2008).

That chimpanzees regard communication as a tool for changing others' behaviour rather than as a means to make others mentally orient towards a referent would also explain why chimpanzees fail to produce gestures in the absence of a referent. Liszkowski et al. (2009) compared chimpanzees and 12-month-old children in an identical setting. These test subjects watched two individuals, a giver and a requester, communicating with each other. The giver had two types of objects (desired or undesired), which the giver would offer to the requester upon request. During the demonstration phase, the requester would sometimes produce specific or unspecific requests. Specific requests consisted of the requester looking at the giver, nodding, clapping hands, and saying something like, "I want a ball", upon which the giver would offer the desired object. Unspecific requests consisted of the requester looking around, frowning, raising hands, and saying, "Give me something", upon which the giver would offer the undesired object. Desired and undesired objects were placed on or below a table – but always on the same side of the table. Therefore, even if the referent (e.g. the desired object) was gone, pointing towards the empty location where it used to be would produce the desired effect and the giver would hand over the desired object.

When the children were placed in the role of the requester, they made specific requests towards the correct location, irrespective of whether the referent was present but hidden behind the barrier or genuinely absent, meaning that the requester had to point to an empty location. The chimpanzees, on the other hand, made specific requests towards the desired object if it was hidden behind a barrier, but not if it was absent and the table was empty. Thus, it appears that unlike human children, the chimpanzees needed some perceptible referent in order to elicit requesting behaviour. This supports the hypothesis that chimpanzees do not regard and use communication as a means to make the giver mentally orient towards a referent.

From the evidence supporting the view that chimpanzees produce gestures imperatively leads to the hypothesis that they also interpret gestures imperatively and as a request to do things. This context of imperative motivation and interpretation helps explain why they may struggle with the cooperative, helpful nature of the pointing gesture in communicative interactions. An understanding of the pointing gesture in the object-choice paradigm presupposes a more general understanding of others' helpful motives and their motivation to help or inform us about things that they assume are relevant to our purposes (Moll and Tomasello 2007; Tomasello 2008). Chimpanzees may simply lack an understanding of others' cooperative motives, which is why they fail to use a human's pointing gestures in a food-finding situation (Tomasello 2008).

However, Kirchhoffer et al. (submitted) showed that chimpanzees also seem to have difficulties using requests in return for an edible reward. The human in the study did not inform the chimpanzees helpfully, but instead indicated by pointing at which object she wanted in return for the edible reward. The pointing gesture was therefore clearly underlined by an imperative rather than informative motive. Still, none of the chimpanzees used this imperative pointing gesture in order to gain a direct reward. This is difficult to reconcile with the view that it is the cooperative

motive of the pointing gesture alone that chimpanzees have difficulties with. An alternative hypothesis could be that chimpanzees simply do not register the gesture, because acting upon it requires a motivation to act cooperatively, which chimpanzees may lack.

Interestingly, chimpanzees do not hesitate in fetching an object upon request if it is the only possible referent in view, even if there is no direct benefit for them doing so (Yamamoto et al. 2009; see also Melis et al. in press for similar evidence). In the Yamamoto et al. study, two chimpanzees sat in adjacent rooms. Both individuals needed a tool located in the other individual's room to retrieve food located in their own room. Both individuals helped each other by handing over the necessary tool requested by the other individual. The same was true if only one individual needed a tool that was placed in the other individual's room and the giver had no direct benefit from handing it over to the requester. Even though the chimpanzees rarely provided the tool voluntarily, they would not hesitate in handing it over upon a specific request produced by the requester such as poking an arm through a hole (Yamamoto et al. 2009). This demonstrates that chimpanzees are generally motivated to act cooperatively upon receiving a communicative request from another individual (see also Melis et al. 2006b; Warneken et al. 2007 for evidence that chimpanzees are generally motivated to act cooperatively and even helpfully).

These findings are difficult to reconcile with the assumption that a general lack of cooperative motivation is the reason for chimpanzees' failure to respond to human-given communicative gestures. Chimpanzees seem to incur difficulties only in those situations where there is more than one possible referent in view or no referent at all. One major difference between a situation with only one perceptible object present vs. two perceptible objects is that the recipient of the gesture will not be successful simply by scanning the environment for just any object, but must attend to the specificity of the gesture or infer the referent from the context such as based on some common ground. If there is no common ground upon which to interpret the context, attending to the specificity of the gesture is the most parsimonious solution.

Imagine you are sitting opposite a stranger and you suddenly find yourself distracted by something behind you. You turn to look, and upon turning back the stranger points and makes a request using no words other than, "Give me". Imagine that you, the recipient, have no further way of requesting additional information. Because the other individual is a stranger, you have absolutely no common ground such as shared past experiences. The only way to solve the problem is by scanning the environment for anything relevant. If there is more than one possible referent, you, the recipient, must invest time and effort figuring out which referent is being requested by closely attending to the specificity of the gesture (e.g. the requester's gaze or pointed finger). If there is only one possible referent, it is likely that the referent is the one in view and therefore time need not be invested attending to the specificity of the gesture. In the event that there is no referent at all in sight, the problem cannot be solved without a tremendous investment of time and effort, such as going through every possible referent in the wider area or identifying the specificity of the gesture. Therefore, finding the correct referent is significantly

hindered in the absence of common ground, which serves as a helpful tool to quickly identify the correct object.

The fact that chimpanzees may lack the cognitive abilities allowing them to refer to common ground while communicating with others means that chimpanzees lack an important mechanism to help simplify the identification of a particular referent from several objects. In the absence of an understanding of common ground, chimpanzees must therefore rely solely on identifying the specificity of a gesture. This becomes even more difficult if the possible referents are in close proximity to each other. If the objects are distant from one another, deciphering the reference may be easier, as the specificity of the gesture is easier to identify.

Two studies have been conducted supporting this view: Mulcahy and Call (2009) tested chimpanzees, bonobos, and orangutans in a proximal version and a more distant version of the object-choice test (Mulcahy and Call 2009). The proximal version of the paradigm was comparable to that used in prior studies (Bräuer et al. 2006; Hare et al. 2002; Herrmann et al. 2007). The subject sat in front of two cups positioned on a table located between the experimenter and the subject. While the experimenter pointed to one cup, the subject could also see the other cup, which was in close proximity. As in prior studies, the apes failed this version of the test. The distant version differed in one important respect: The cups were placed at a large distance from one another such that the subject had to move from one room to another in order to make a choice. This meant that while attending to one cup, the other was no longer in view, which made deciphering of the reference easy, as attending to the specificity of the gesture was not necessary. Interestingly, the chimpanzees were successful in this version of the test, supporting the view that it is not the generally cooperative nature of the communicative interaction that is the problem but rather the interpretation of the specificity of the gesture.

The second paradigm corroborating this view is a study by Barth et al. (2006). In this study, the authors also compared two setups of the object-choice paradigm. Both setups had in common that the cups were positioned in close proximity to one another so that they were both in view the entire time the chimpanzees made their choice. But the two setups differed in one important respect. In one setup, the chimpanzees were already in the room, sitting in front of the two cups before the experimenter performed her gesture towards one of them. As the chimpanzees were already attending to both cups when the experimenter gazed at the target cup, the required attention to the specificity of the gesture seemed to be missed, and the chimpanzees chose randomly between both cups. In the alternative setup, the chimpanzees entered the room while the experimenter was already gazing at one of the cups; thus, the first thing the chimpanzees saw was the human gazing in a particular direction, which potentially drew their attention immediately to the specific referent. Chimpanzees probably performed well in this version of the task because when the chimpanzees made their choice, the specificity of the gesture was unambiguous: While entering the room, the chimpanzees most likely saw the gesture before they saw the two cups (Barth et al. 2005).

14.6 Ostensive Signals

Humans have evolved non-costly signals, so-called ostensive cues (e.g. eye contact, high-pitched voice, etc.), which help to indicate that the ensuing interaction is communication directed at the other individual and that the interaction is relevant (Sperber and Wilson 1986; Csibra and Gergely 2009). Human children are sensitive to ostensive cues from a very early age. One example is the special pattern of infant-directed speech (so-called motherese), which can make it manifest that the child is being addressed. It has been observed that newborns prefer infant-directed over adult-directed speech (Cooper and Aslin 1990; Csibra and Gergely 2009). At the age of 9 months, children tend to follow the gaze of others only when they are preceded by an ostensive signal (e.g. eye contact). This suggests that already at this early age, children form in their social environment an expectation of referential communication when following others' gaze direction (Senju et al. 2008; Senju and Csibra 2008).

Chimpanzees, as well as other primates, do not seem to produce or use ostensive signals during their communicative interactions, even though there is evidence that chimpanzees are sensitive to eye contact and also use others' eyes as an important stimulus in communicative interactions with humans (Hostetter et al. 2007; Itakura et al. 1999; Kaminski et al. 2004). There is, as yet, no evidence suggesting that ostensive cues are used in order to manifest relevance or specificity during communicative interactions with conspecifics. Therefore, chimpanzees may lack another important mechanism that, in the absence of a common ground, could help to manifest the relevance of specificity. This may also be why, for chimpanzees, it may simply not be relevant to attend to the specificity of gestures in certain situations, especially if the possible referents are in close proximity and therefore deciphering the reference of the gesture made even more difficult or impossible.

Interestingly, chimpanzees are generally more successful in reading a human's communicative gestures if the context in which the gesture is given is shifted from a cooperative one to a competitive one. When the context is competitive, chimpanzees successfully use human-given gestures, even in situations where the possible referents are in close proximity. In a study by Herrmann and Tomasello (2006), a human experimenter signalled the location of hidden food by extending her arm in the direction of one of two cups. Both cups were in full view of the subject while the human was pointing. If the human had established a competitive context with the chimpanzees (competing with other chimpanzees for food), the extended arm was used to indicate which location to avoid, while in the cooperative setting (engaging in a cooperate interaction with the experimenter vs. competing with other chimpanzees for food), the experimenter indicated informatively where the food was hidden. Chimpanzees were more successful in using the gesture to find the location of the hidden food in the competitive vs. cooperative context (Herrmann and Tomasello 2006; see also Hare and Tomasello 2004).

The reason for this outcome could be that chimpanzees are especially adapted for competitive interactions (Hare 2001). Chimpanzees constantly compete with conspecifics as well as neighbouring groups over resources. It has even been

hypothesized that it was this type of competition that led to certain sophisticated social cognitive skills and that in turn helped individuals to outcompete others (Humphrey 1976; Byrne and Whiten 1988). There is also evidence that chimpanzees show certain social cognitive skills such as understanding others' visual perspective in competitive paradigms (Hare et al. 2000, 2001), but not in more cooperative paradigms (Povinelli et al. 1994). This has led to the hypothesis that chimpanzees may simply find competitive contexts more relevant than cooperative ones, which could also explain why chimpanzees use human-given gestures more frequently when presented in a competitive context (Hare and Tomasello 2004). In line with the framework of our argument, this evidence supports the theory that chimpanzees simply attend to the specificity of the gesture more during competitive situations because it is of greater relevance for them, while in more cooperative contexts the specificity of the gesture is not registered because it is of less relevance.

Interestingly, multiple pieces of evidence suggest that chimpanzees and other primates that have been raised in close proximity to humans generally find it easier to use human-given pointing gestures. This is even the case within a cooperative and informative context and when the potential referents are in close proximity to each other (Itakura and Tanaka 1998; Okamoto-Barth et al. 2008). Call and Tomasello (1996) outlined different mechanisms that might possibly explain differences between enculturated and non-enculturated apes: simple exposure to human life, emulation learning of human actions, explicit training by humans, and being treated by humans as intentional beings (Call and Tomasello 1995; Tomasello and Call 2004). They favour the explanation that being treated as intentional beings may lead to a fundamental change in the social cognition of enculturated apes. However, recent evidence suggests that non-enculturated apes also have some understanding of intentions in others (Call et al. 2004; Buttelmann et al. 2008). Therefore, being treated as intentional beings may not be sufficient to explain why enculturated apes use human-given gestures. An alternative explanation could be that these individuals, through their intensive interactions with human caretakers, consider communicative interactions with humans to be more relevant than their mother-reared counterparts. Rather than learning to associate the gesture with a reward, they may attend to the specificity of the gesture more because they consider the whole interaction to be highly relevant, even if presented in a cooperative context. One could also speculate that those individuals potentially developed some sensitivity to certain ostensive signals, which in turn helps them to identify the relevance and specificity of a communicative interaction.

14.7 Sensitivity to Ostensive Signals in a Non-human Species: The Domestic Dog

Work with domestic dogs shows that sensitivity to ostensive cues alone can lead to a flexible use of gestural communication, even in the absence of a deeper understanding of others' psychological states (a prerequisite for the ability to form a common

ground with others). Domestic dogs are extraordinarily flexible in using different human-given communicative gestures. Interestingly, dogs' skills in this domain seem to be influenced by selection processes that occurred during domestication. This hypothesis is supported by two additional facts: First, wolves, dogs' closest living relatives, seem to be less flexible than dogs in using human gestural communication. Even if both species are raised under identical conditions and then tested at the same age, dogs outperform wolves in communication skills (Miklosi et al. 2003; Hare et al. 2002). In addition, major learning events during ontogeny alone cannot account for the dogs' behaviour. This is supported by the fact that puppies from 6 weeks of age are able to use human pointing to find food, even when required to move away from the human's hand to be successful (Riedel et al. 2008). Dogs' behaviour relative to human pointing cannot be explained exclusively by mechanisms such as local or stimulus enhancement, but seems also to be based on some understanding of the triadic nature of the interaction (Hare et al. 1998). In addition, there is evidence that dogs are extremely sensitive to certain ostensive cues such as eye contact or tone of voice (Kaminski et al. submitted). Eye contact seems to be a particularly important signal for dogs to identify when communication is relevant and directed at them (Kaminski et al. submitted; see also Viranyi et al. 2004). Domestic dogs therefore represent an interesting example of how rather simple mechanisms, such as having a certain sensitivity to ostensive cues, may help to identify the referent in triadic communicative interactions despite lacking a complex understanding of others' psychological states.

14.8 Summary and Conclusions

The expectation is that comparative communicative cue studies between humans and non-human primates such as those described in this chapter will reveal relevant information regarding the underpinnings of group cooperation in our species. For instance, in Sects. 14.2 and 14.3, we showed that there is a difference between the ability of non-human primates to interpret gaze shifts as an indicator that others see things in the environment vs. that others are communicating about things – an important cognitive nuance specific to humans. That said, it appears that the gaze-following behaviour of great apes is based on some understanding of another's perspective. Different primate species seem to have some understanding of others' line of sight and others' visual perspective, an amazingly relevant parallel to human cooperative behaviour.

In Sect. 14.4 we also showed that human children as young as 12 months can interpret communicative cues of pointing regarding the pointer's intentions, desires, and even with some consideration to the context and common ground between themselves and the individual pointing. In another six months of age, this cognitive interpretation expands to shared experiences that the child has had with the individual pointing, demonstrating an already-developed grasp of the abstract indicated by the human child's non-reliance on the referent object even being in site – a human-specific trait reinforced by imperative communication

experiments comparing human children and chimpanzees' understanding of others' mental states. (Sect. 14.5). What is not specific to humans is the general cooperative nature of communicative interaction, a behaviour trait observed extensively among chimpanzees and limited mostly to their inability to interpret the specificity of the communicative gesture rather than an unwillingness to help or cooperate.

We then talked about the comparative sensitivity of human children and chimpanzees to ostensive cues or signals such as referential speech patterns – chimpanzees neither producing nor responding to such communication except eye contact in some communicative interactions with humans (Sect. 14.6). But what we also know – again, something that could potentially explain certain motivational aspects of human group cooperative behaviour – is that the response among chimpanzees to human-initiated communicative cues is notably heightened when they are issued in a conspecific competitive setting, leading to the hypothesis that the chimpanzees' response to communicative cues (or the lack thereof) may be based more on the relevancy of said cues rather than on the chimpanzee's cognitive understanding of these cues. The last, but certainly not the least, important detail included in this section is the parallel between the levels of understanding in non-human primates (both chimpanzees and apes) of human communicative cues and their level of enculturation/exposure to humans, suggesting that there may be elements of "nurture" in the "nature vs. nurture" group cooperative traits among primates in general – human as well as non-human.

This domestication theme then segues to our final section on comparative studies between dogs and wolves and the extensive understanding that dogs demonstrate regarding human communicative cues. The outperformance dogs demonstrate over their ancestral relatives raised under identical conditions in an experimental setting points to the influences of selection processes that occurred during species domestication. These influences of selection processes, coupled with the certain sensitivity dogs have to human communicative cues, may help enlighten our understanding of triadic communicative interactions even when lacking a complex understanding of others' psychological states.

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