What Chimpanzees Know about Seeing, Revisited: An Explanation of the Third Kind

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Abstract and Keywords

Chimpanzees follow the gaze of conspecifics and humans — follow it past distractors and behind barriers, ‘check back’ with humans when gaze following does not yield interesting sights, use gestures appropriately depending on the visual access of their recipient, and select different pieces of food depending on whether their competitor has visual access to them. Taken together, these findings make a strong case for the hypothesis that chimpanzees have some understanding of what other individuals can and cannot see. However, chimpanzees do not seem nearly so skillful in the Gesture Choice and Object Choice experimental paradigms. Neither behavioral conditioning nor theory of mind explanations can account for these results satisfactorily. Instead this chapter proposes the idea that chimpanzees have the cognitive skills to
recall, represent, categorize, and reason about the behavior and perception of others, but not their intentional or mental states, because they do not know that others have such states since they cannot make a link to their own. Human beings began their own evolutionary trajectory with these same skills, but then at some point in their evolution (probably quite recently) they began to understand that their own experience could serve as some kind of model for that of other persons. This allowed for even better prediction and control of the behavior of others and better communication and cooperation with them as well, and so it was an adaptation with immediate adaptive consequences that ensured its survival.

Keywords: non-human primates, gaze-following, theory of mind, intentionality, chimpanzee

Joint attention is not just two individuals looking at the same thing at the same time. Joint attention requires that each of the individuals knows that the other is attending to the same thing as they are attending to; that is what makes it a joint, rather than merely a simultaneous, activity (Tomasello, 1995). To engage in joint attention, therefore, an individual must at the very least be able to understand that another individual may see or attend to something. Whereas that assumption is mainly uncontroversial in human infants over 12 to 18 months of age, there is currently some controversy about whether chimpanzees—as the closest primate relatives of human beings—know that others can see or attend to things. This is the question that we shall address in this paper.

Evidence That Chimpanzees do not Understand Seeing

Chimpanzees perform surprisingly poorly in two experimental paradigms that involve an understanding of seeing. In the first they must understand that a communicative partner needs visual access to their gesture in order to respond to it appropriately. In the second they must understand that the gaze and gesture of others can help them to locate hidden food in a foraging task. We discuss each of these in turn.
First, Tomasello et al. (1985, 1989, 1994, 1997b) identified around three dozen gestures that young chimpanzees use to communicate with group mates in various contexts. For instance, they raise their arms to initiate play, extend their arms to beg for food, slap the ground or clap their hands to call attention to themselves, and touch their mother's side to request travel to a different location. These gestures fall within three basic sensory modalities: visual, auditory, and tactile. Thus, visual gestures rely solely on visual information (e.g. hand-beg, see Fig. 3.1); auditory gestures rely mainly on sound production (e.g. hand-clap, see Fig. 3.1); and tactile gestures depend mainly on establishing physical contact with the recipient (e.g. arm-on, see Fig. 3.1). Tomasello et al. (1994, 1997b) found that chimpanzees use gestures from the three sensory modalities differentially, depending on the spatial orientation of the recipient. In particular, young chimpanzees use gestures that are mainly auditory or tactile when their recipient is in all kinds of spatial orientations with respect to them, but they use visual gestures only when their recipient is facing toward them and therefore able to see them (see Fig. 3.1). One possible conclusion from these data is that chimpanzees know that if their visually based gestures are to work, others must see them.

FIGURE 3.1. Percentage of gestures used by young chimpanzees in each of three sensory modalities (visual: hand-beg; auditory: hand-clap; tactile: arm-on) as a function of whether the recipient is looking at them.
But it is also possible that something simpler is at work, and indeed this is the conclusion of Povinelli and co-workers. In a series of fifteen experiments Povinelli and Eddy (1996a) tested seven 4- and 5-year-old chimpanzees' understanding of how humans must be bodily oriented for successful communication to take place (see also Povinelli et al., 1999). They trained each of these seven juveniles to approach a Plexiglas barrier and extend their hand toward one of two human experimenters (each with a hole in the Plexiglas in front of them) to request food—with only the first gesture being responded to. In the critical test trials, one human stood behind each hole, and food was available on a table between them. The subjects thus had to choose which of these two humans to beg from. We will call this the Gesture Choice experimental paradigm (see Fig. 3.2).

Povinelli and Eddy began by presenting subjects with one human facing towards them and one facing away from them. The chimpanzees consistently gestured toward the human who was facing toward them, thus confirming the naturalistic findings of Tomasello et al. (1994, 1997b). In a number of other experimental conditions, however, chimpanzees did not seem to distinguish between more subtle differences between the humans. For example, they did not gesture differentially to a human who wore a blindfold over his eyes (as opposed to one who wore a blindfold over his mouth), or to one who wore a bucket over his head (as opposed to one who held a bucket on his shoulder), or to one who held his hands over his eyes (as opposed to one who held his hands over his ears), or to one

**FIGURE 3.2.** Gesture Choice paradigm (Povinelli and Eddy, 1996a). One of two human experimenters present in the room is facing the ape (1). The ape requests the food from one of the experimenters by extending her arm through a hole in the Plexiglas wall (2).
who had his eyes closed (as opposed to one who had his eyes open),
or to one who was looking away (as opposed to looking at the
subject), or to one whose back was turned but who looked over his
shoulder to the subject (as opposed to one whose back was turned
and was looking away). A number of control experiments ruled out
possible artefactual explanations of these results. The investigators
concluded that although these young chimpanzees had learned one
or more cues that signal conditions conducive to communication
with humans (e.g. bodily orientation facing toward, versus away
from, the subject), overall they did not seem to understand very
well precisely how visual perception works, especially the role of
the eyes. These findings have recently been replicated by Reaux,
The second experimental paradigm that causes chimpanzees
problems is in many ways even more surprising. In a number
of different experiments from a number of different
laboratories, chimpanzees have shown a very inconsistent
ability to use the gaze direction of others to help them to
locate food hidden under one of several objects; we will call
this the Object Choice paradigm (see Fig. 3.3). For example,
Call, Hare, and Tomasello (1998) presented chimpanzees with
two opaque containers, only one of which contained food (with
chimpanzees trained to know that they could choose only one).
A human experimenter then looked continuously at the
container with food inside. Not one of six chimpanzees used
this cue to find the food. Tomasello, Call, and Gluckman
(1997a) and Call, Agnetta, and Tomasello (1999) provided
chimpanzees with several other types of visual gestural cues
in this same paradigm and also found mostly negative results
(the two individuals who sometimes tested above chance were
both raised by (p.48)
Humans—see next section. Povinelli, Bierschwale, and Cech (1999) found that some young chimpanzees could learn to use gaze-direction cues in a similar experimental situation, but they also showed in various ways that this was for them only a learned behavioural cue, not an indicator of the visual experience of others; for example, when the experimenter turned his head in the correct direction of the baited container but looked to the ceiling and not at the baited container, chimpanzees chose the correct container just as often as if the experimenter looked directly at it. Itakura et al. (1999) used a trained chimpanzee conspecific to give the gaze-direction cue, but still found negative results.

With one exception, the only positive results in this paradigm (other than with human-raised chimpanzees) have come when the experimenter actually approaches the correct container and actively inspects it, as if actually foraging for food (Itakura et al., 1999), or if he makes chimpanzee body movements or vocalizations or noises in combination with gaze as cues (Call et al., 1999; Povinelli and Eddy, 1996b). In several different studies, even after an individual chimpanzee subject has learned to be successful by using some other cue (e.g. the ‘approach and forage’ cue), when that same subject is later given the ‘gaze only’ cue, they return to chance performance (Call et al., 1998, 1999). The one exception is the study of Itakura and Tanaka (1998) in which two chimpanzees (one of whom was human-raised) performed reasonably well in this task. It is also interesting and important to note that domestic dogs do much better in all versions of this task than do
chimpanzees (Miklósi et al., 1998; Hare, Call, and Tomasello, 1998; Hare and Tomasello, 1999). (And of course domestic dogs have extensive contact with humans throughout their lives; see next section for a discussion of the role of experience with humans as a factor in this task.)

Povinelli (1999) relates his history of growing scepticism as he tested his chimpanzees in the Gesture Choice and Object Choice experimental paradigms in many different studies over a several-year period, and we ourselves must admit to being amazed at how poorly the chimpanzees in our laboratory continue to do in the Object Choice paradigm, returning to random performance on the ‘gaze only’ cue even after they have been successful on a cue that combines gaze with some other behaviour. The overall conclusion from these two experimental paradigms would thus seem to be: although chimpanzees show sensitivity to the bodily orientation of other individuals in communicating with them—in the sense that they do not attempt to use a visually based gesture to an individual who is facing away from them—most of them do not seem to understand that (1) visual perception depends on visual access for the eyes, or (2) the visual perception of others may be used as a cue to find hidden food whose location the looker, but not the chimpanzee subject, knows.

Evidence that Chimpanzees Understand Seeing

We have recently been engaged in another series of studies that give a much more positive picture of what chimpanzees understand about seeing. First, Tomasello, Call, and Hare (1998) conducted a very simple study, using chimpanzees in a semi-natural captive group (and four other primate species in captive groups). The basic idea was that a human experimenter waited until a pair of chimpanzees was spatially arranged so that one was facing toward him in the observation tower (the looker) and another was looking at that individual, with its back to the experimenter (the subject). He then held up a piece of desirable food, inducing the looker to look up at him (see Fig. 3.4). He then observed how the subject responded to the looker's looking behaviour. In control trials the experimenter displayed the food in an identical manner,
but when the subject was alone. The results were very strong. Subjects reliably followed the gaze of conspecifics, looking at the food about 80 per cent of the time in experimental trials, as compared to about 20 per cent of the time in control trials (and this was found for the other primate species as well; see also Emery et al., 1997).

It is interesting and important that chimpanzees also follow the gaze direction of human beings. They do this on the basis of eye direction alone, independent of head direction (Povinelli and Eddy 1996c), and they do this even when the target is located above or behind them (Call et al., 1998; Itakura, 1996; Povinelli and Eddy, 1997). Call et al. (1998) also found that when a chimpanzee tracked the gaze of another individual to a location and found nothing interesting there, they quite often looked back to the individual's face and tracked their gaze direction a second time—‘checking back’ in this way being a much-used criterion in assessing human infants' understanding of the visual experience of others (Bates, 1979).

One possible explanation for simple gaze-following behaviour is that individuals learn, through experience, that when they look in the direction toward which another individual is visually oriented, they often find something interesting or important. The cognitive process might thus be: turn in the direction in which others are oriented, and then search randomly until you find something interesting. This is what Povinelli (1999) calls the ‘low-level’ explanation, since it is based on an individual learning what amounts to a conditioned
discriminative cue: when another individual turns in a direction, you will quite often be rewarded for looking in that direction yourself. The 'high-level' explanation may be variously characterized, but in a loose formulation it consists simply in understanding that the other one is having a visual experience (perhaps similar to one's own).

Following a suggestive finding of Povinelli and Eddy (1996c), Tomasello, Hare and Agnetta (1999) effectively disproved the lower-level explanation of chimpanzee gaze following with two experiments. In the first experiment a chimpanzee watched as a human experimenter looked around various types of barriers (see Fig. 3.5). If chimpanzees simply look in the direction of others and then search randomly, as claimed by the low-level explanation, then they should either look at the barrier (if they find it interesting) or else look for something else in that direction. They did not do this, however. Instead, the chimpanzees actually moved themselves to new locations so that they could look around each of the barriers—seemingly to see what was behind it, where the experimenter (E) was looking (they did this much more than in a control condition in which E looked in another direction—so it was not just natural curiosity about what was behind the barrier). In the second experiment chimpanzees watched as a human experimenter looked to the top and back of their cage. As they turned to follow the human's gaze, a distractor object was presented. Again in this case, if chimpanzees simply look in the direction of others and then search randomly, as claimed by the low-level explanation, then they should look at the distractor (if they find it interesting) or something else in that direction. What they did, however, was to follow E's gaze all the way to the back of the cage, and they did this even though they
clearly noticed the distractor. Together, these two studies effectively disconfirm the low-level model of chimpanzee gaze-following, supporting instead the hypothesis that chimpanzees follow the gaze direction of other animate beings geometrically to specific locations in much the same way as human infants (Butterworth and Jarrett, 1991). These studies are of only limited helpfulness in assessing the degree to which chimpanzees interpret the gaze of others intentionally or mentalistically.

In none of these studies of gaze-following did chimpanzees have to use the information they gained by following the gaze of others. It is thus possible that the reason they do so well in tasks of simple gaze-following, but so poorly in the Object Choice paradigm is that this latter paradigm requires not just following gaze but then using that information to make a foraging choice. However, in a recent series of studies, Hare et al. (2000) have shown that in the right situation chimpanzees can use the gaze direction of others, in this case...
a conspecific, (p.52) to make an effective foraging choice. They do this, however, not when that conspecific is attempting to inform them co-operatively of a hidden food’s location, but rather when the conspecific is attempting to compete with them for food.

The basic set-up was as follows. In each of five experiments a subordinate and a dominant individual were placed in rooms on opposite sides of a third room. Each had a guillotine door leading into the third room which, when cracked at the bottom, allowed them to observe two pieces of food at various locations within that room—and to see the other individual looking under her door (see Fig. 3.6). After the food had been placed, the doors for both individuals were opened and they were allowed to enter the third room. The basic problem for the subordinate in this situation is that the dominant will take all of the food that it can see, and indeed in all the studies in which dominants had good visual and physical access to the two pieces of food, they took them both on most occasions (i.e. they went for one piece while staring at, and so intimidating, the subordinate from taking the other piece). However, in some cases we arranged things so that the subordinate could see a piece of food that the dominant could not see, for example, by placing it on the subordinate’s side of a small barrier. The question in these cases was thus whether the subordinate knew that the dominant could not see a particular piece of food, and so it was safe for them to go for it.
The basic finding was that the subordinates did indeed go for the food that only they could see much more often than they went for the food that both they and the dominant could see. In some cases, the subordinate may have been monitoring the behaviour of the dominant, but in other cases this possibility was ruled out by giving subordinates a small head start and forcing them to make their choice (to go to the food that both competitors could see, or to go to the food that only they could see) before the dominant was released into the area. Moreover, we also ran two other control conditions. In one, the dominant’s door was lowered before the two competitors were let into the room (and again the subordinate got a small head start), so that the subordinate could not see which piece the dominant was looking at under the door (i.e. it is possible that in the first studies the subordinate saw that the dominant was looking at the out-in-the-open food and so went for the other piece). The results were clear. Subordinates preferentially targeted the hidden piece. In the other control study, we followed the same basic procedure as before (one piece of food in the open, one on the subordinate’s side of a barrier) but in this case we used a transparent barrier that did...
not prevent the dominant from seeing the food behind it. In this case, chimpanzees chose equally between the two pieces of food, seeming to know that the transparent barrier was not serving to block the dominant’s visual access (and so her ‘control’ of the food) at all. The findings of these studies thus suggest that chimpanzees know what conspecifics can and cannot see and, further, that they use this knowledge to maximize their food intake in competitive situations.

The experiments previously described dealt with chimpanzees competing over food when all the relevant information was available at the time of choice. In the next series of experiments (Hare, Call, and Tomasello, 2001), we investigated whether chimpanzees were also able to take into account past information, such as whether the dominant had seen the baiting. For these experiments we used two barriers and one piece of food, and manipulated what the dominant saw. In experimental trials dominants had not seen the food hidden, or food they had seen hidden was moved to a different location when they were not watching (whereas in control trials they saw the food being hidden or moved). Subordinates, on the other hand, always saw the entire baiting procedure and could monitor the visual access of their dominant competitor as well. Subordinates preferentially retrieved and approached the food that dominants had not seen hidden or moved, which suggested that subordinates were sensitive to what dominants had or had not seen during baiting. In an additional experiment, we switched the dominant who had witnessed the baiting for another dominant who had not witnessed the baiting and compared it with a situation in which the dominant was not switched. Results indicated that subordinates retrieved more food when the dominant had been switched than when it was not switched, thus demonstrating their ability to keep track of precisely who had witnessed what. This result also ruled out the possibility that subordinates were using just the sequence of door opening and closing to decide which food to take.

More importantly, this whole second series of experiments ruled out the possibility suggested by Povinelli (2002) that subordinates are attracted to the food behind a barrier because in general they prefer to forage around
barsriers rather than grab food that is in the open. In other words, subordinates prefer the hidden food, Povinelli argued, not because they understand anything about the visual access of others, but simply because that's their natural foraging tendency. The foraging preference hypothesis, however, fails to account for the results of this second series of experiments, because subordinates are confronted with two barriers in all trials, and the only thing that changes across trials is whether the dominant animal has seen where the food is hidden. According to the foraging tendency hypothesis, subordinates should treat all trials with food behind the barrier equally, but they did not. They preferentially approached and took those pieces that the dominant animal had not seen hidden.

This series of experiments on chimpanzee gaze-following in more naturalistic and food competition situations thus reveals that in some situations chimpanzees know much more about seeing than is apparent in the Gesture Choice and Object Choice experimental paradigms. Discrepancies among the findings in the different situations could conceivably be due to methodological issues not related to chimpanzees' understanding of seeing per se, but this is extremely unlikely, since in all of the different studies the findings are extremely robust and replicable across variations of task design, laboratories, and subjects. So the theoretical challenge is to explain the apparently reliable yet different chimpanzee behaviours that emerge in the different observational settings, and to do so in a way that is revealing about the nature of chimpanzee social cognition.

So What do Chimpanzees Really Understand about Seeing?

The current review has shown that chimpanzees follow the gaze of conspecifics and humans, follow it past distractors and behind barriers, 'check back' with humans when gaze-following does not yield interesting sights, use gestures appropriately depending on the visual access of their recipient, and select different pieces of food depending on whether their competitor has visual access to them. Taken together, these findings make a strong case for the hypothesis that chimpanzees have some understanding of what other
individuals can and cannot see. However, chimpanzees do not seem nearly so skilful in the Gesture Choice and Object Choice experimental paradigms. If these positive and negative findings are both reliable—and we believe that they are—one theoretical possibility is that chimpanzees' successful performance in the positive tasks is artificially high, in the sense that they are using some cue other than gaze direction. But the variety of lines of evidence and methods used (including both naturalistic and several different kinds of experimental observations), as well as the robustness of the findings in general, argues against this hypothesis.

Much more likely is the hypothesis that chimpanzees' poor performance in some task situations reflects the context-sensitive nature of their understanding of the gaze behaviour of others; that is to say, in some situations they simply do not understand the gaze behaviour of others, or they have a difficult time translating their understanding into action. We believe that this second hypothesis is the correct one, which means that we must look a bit more carefully at the two experimental paradigms in which chimpanzees do not perform skillfully on a consistent basis.

**The Gesture Choice and Object Choice Paradigms**

As emphasized by Tomasello (1996), the failures of the chimpanzees in the Gesture Choice paradigm may all be explained as failures to understand not visual perception in general, but rather the role of the eyes in particular in visual perception. Recall that just as in their naturalistic behaviour (as observed by Tomasello et al. 1994, 1997b), the chimpanzees in Povinelli and Eddy's (1996a) experiments were quite reliable in gesturing to the individual who was facing them as opposed to the one whose back was turned. What they could not deal with were situations in which they needed to know that the eyes are the organs of visual perception (e.g. in choosing between two people facing them, one with a blindfold), as opposed to situations in which they could use some more generic understanding that the front part of the body enables perception. It is salutary in this context to imagine how human beings would perform in a task in which they needed to know exactly which part of the eye—iris, pupil, or eyeball as a whole—is responsible for visual perception. If
they failed in this task, it would not mean that they do not understand visual perception, but only that they do not know the precise mechanism through which it works. And so we believe quite simply that the Povinelli and Eddy findings tell us that chimpanzees do not understand the role of the eyes in visual perception—and that is all they tell us.

The Object Choice paradigm reveals something different—and potentially much more telling—about chimpanzees' skills of social cognition. Given that chimpanzees in this task quite often follow the gaze of the human experimenter but then do not choose the container being gazed at, one interpretation is that they can follow the gaze of others but do not know what this gaze means—its possible information value beyond leading them to a spatial location. That is to say, chimpanzees follow gaze to a location, but when they do not see food or anything else interesting at that location, they forget about the gaze and simply choose among containers randomly (Call et al., 1998). Based on this kind of analysis, Tomasello et al. (1997b) hypothesized that chimpanzees' troubles in the Object Choice paradigm were due to the fact that they do not understand communicative intentions; they do not understand that in gazing at a container the human intends that they take his gaze as a communicative signal relevant to their searching activity (see also Tomasello, 1999). On this account, whatever chimpanzees may or may not understand about the intentions of others—a currently controversial topic—they do not understand embedded intentions such as those involved in communication: he intends something as regards my intentional (or attentional) state.

Two further facts are relevant to an interpretation of chimpanzee behaviour in the Object Choice paradigm. First, in the recent studies of Hare et al. (2000, 2001) reviewed above, chimpanzees were skilful at determining what the other individual could see in a competitive situation and then using this information to make a foraging choice—in this case going for the one that the other individual was not looking at or could not see. It would thus seem odd that in the Object Choice paradigm they do not then use the gaze of the other as a cue for which container they should choose—even if they do
not understand communicative intentions *per se*—taking it simply as information. Said another way, in the competitive situation the individual simply sees the food, checks to see if the other can also see it, and if the other cannot see it, goes for it. The question is why they cannot then do something similar in the Object Choice paradigm, but in this case go for the food the other *is* looking at. But again the problem might revolve around communication versus competition. The situation in which another individual is trying to inform them about the location of food is clearly not the one chimpanzees normally experience, since they spend their whole lives competing with group mates for food. This is especially true when it is a monopolizable food item that the other individual could clearly take if it wished (Hauser and Wrangham, 1987). So the subject in this paradigm does not take the gaze of the other as an informative cue—'she is looking at something interesting so that must be where the food is'—because no individual would behave like that in the presence of food she could take for herself. So subjects in this experimental paradigm just do not know or care why the other is looking at one container and not another, because such behaviour does not suggest the presence of food—whereas in the same set-up foraging behaviour itself (as in Itakura et al., 1999) does suggest food, and so is an effective cue. The basic idea is thus that the Object Choice paradigm is difficult because it involves either (i) understanding communicative intentions, or (ii) taking gaze behaviour in a co-operative, rather than a competitive, spirit.

The second important fact is that some individuals are at least somewhat skilful in this task. Several of the subjects in Povinelli et al.'s studies learned to use gaze cues; two subjects in the study of Itakura and Tanaka (1998) were skilful; and two subjects in Call et al. (2000) were skilful. Although it cannot account for all of the variation observed, one effective factor is very likely the amount and kind of experience these individuals have had with humans. The two skilful subjects of Call et al. (2000) had both been raised in infancy by humans, and one of the (p.57) subjects of Itakura and Tanaka (1998) was human-raised as well. The other skilful subject in their study had also had much human experience, but not
significantly more than some other subjects who never became skilful, so human experience is clearly not the whole story; there are very likely individual differences due to other sources as well. But to the extent that experience with humans is important, we would hypothesize that the key factor is that humans regularly attempt to communicate with and direct the attention of the other individuals with whom they interact. More specifically, chimpanzees who grow up with humans experience many attempts by others to direct their attention and behaviour, and after they respond in some way, they get feedback about their response. That is, humans respond to the chimpanzees' responses with praise and happiness when the chimpanzee succeeds in doing what the human intended her to do, but with something less positive when they do not respond in this way. By contrast, individuals who grow up with conspecifics do not have these learning opportunities, as chimpanzees rarely if ever try to direct the attention of conspecifics to outside objects.

There is much evidence for this interpretation in the direct comparison of enculturated (human-raised) and non-enculturated apes on a variety of social and communicative behaviours (see Call and Tomasello, 1996, for a review). Some especially relevant findings are that enculturated apes look more at humans than conspecifics in joint attentional interactions and in gestural communication with humans (Call and Tomasello, 1994; Carpenter et al., 1995; Gómez, 1996). (On some accounts, to be effective, the process of human enculturation must begin at an early age: Rumbaugh and Savage-Rumbaugh, 1992). So it is not unreasonable to suggest that extensive experience in social and communicative interactions with humans from an early age is a reason for the superior performance of many, if not most, of the individual chimpanzees who are skilful in this task. It is also relevant in this regard to recall that domestic dogs—who have been bred phylogenetically and raised ontogenetically to be at tuned to human beings—are actually much better in the Object Choice task than are chimpanzees.

So our hypothesis is that chimpanzees in some situations do understand what other individuals can and cannot see. They do not understand, however, the role of the eyes in the
process, and they do not understand when another individual is using gaze (or other gestures or cues) in an attempt to direct their attention—unless they have had relatively extensive previous experience in communicating with humans.

**An Explanation of the Third Kind**

Even if chimpanzees do indeed understand what other individuals can and cannot see in some situations, there are still multiple possibilities for the nature of this understanding, some more mentalistic than others. For example, the cognitively strongest hypothesis is that chimpanzees understand the visual perception and experience of others in much the same way as do humans. That is, an individual understands not only that others see things that she does not currently see (e.g. due to occlusion), but also that (i) others can *attend* to different aspects of things within a single visual field; (ii) others can have different perspectives on the same object she is now perceiving (e.g. from a different angle); and (iii) others' visual experience is *similar to her own* (i.e. she can simulate the visual experience of others by imagining how she would see it if she were in the other's place). By contrast, the cognitively weakest hypothesis is that chimpanzees' understanding of visual perception and experience of others is based on learned behavioural contingencies (or blind rules), accompanied by no understanding of the other's visual experience at all.

We do not believe that either of these extreme hypotheses is correct. First, we do not believe that chimpanzees understand visual perception in the same manner as humans (especially the analogy to the self), because they show no evidence of such understanding in a variety of other studies of social cognition (see Tomasello and Call, 1997, for a review). But we also do not believe that all that is involved is some form of non-cognitive behavioural conditioning. Our mixed hypothesis is that during their normal ontogenies, as they interact with others and attempt to predict their behaviour in many situations, individuals may learn many things about the relation of their group mates' visual access to things (i.e. both to themselves and to external objects) and their subsequent behaviour. For instance, individuals may learn about the visual
access of others when occluders are present via situations in which they (i) notice and follow the gaze direction of another individual (and also notice its behaviour and emotions); (ii) see a barrier of some sort; and (iii) subsequently see the target of the other's gaze, behaviour, and emotions because the barrier moves, the target moves, or they themselves move around the barrier (Tomasello et al., 1999). The basic idea is thus that through individual experience, chimpanzees come to know important things about the relationship between the visual access of others, its likely target (either the self or stimuli in the environment), and how this relates to their behaviour in a variety of different situations. It is important to emphasize that our mixed explanation is not equivalent to a behavioural conditioning, non-cognitive explanation. Even though it involves learning, it may be construed as a cognitive form of learning which leads to real understanding and insight, as expressed in knowledge flexibly displayed in behaviour in novel situations—as in our food competition experiments.

Within this third way it can be argued that there are still different types of understanding that can be distinguished. Indeed, one may be tempted to distinguish between more psychological versus more behavioural explanations. However, we do not think that this distinction is fully satisfactory. First of all, to some extent this distinction perpetuates the bipolar view between theory of mind and learned behaviour that we tried to eliminate in the first place. More importantly, we do not think that this distinction captures the essence of our third view. One problem is that the dichotomy psychological versus behavioural is misleading, because all levels in the third view are psychological, although we prefer to call them ‘cognitive’. Calling some of them behavioural may confuse the issue, because they may be equated to the learned behavioural contingencies position. Yet, it is true that finer distinctions within this cognitive third view are possible, and indeed desirable. But those distinctions should be viewed as part of a continuum with more translucent constructs, such as the visual perception of others (i.e. seeing), at one end and more opaque constructs, such as knowledge states of others, at the other end of the continuum.
Similarly, we argue, the knowledge that individuals have about the visual perception of others affords various distinctions. One can distinguish between perceptual access (whether others can or cannot see something), perspective taking (how others perceive something from their vantage-point), or attention (what aspect of something others are focusing on; more on attention later). Currently, there is evidence suggesting that chimpanzees reach at least the first level of understanding the visual access of others, which corresponds to level 1 visual perspective taking in Flavell’s (1985) account. In other words, they know what others can or cannot see. Whether or not they also possess the ability to take the perspective of others or know what others are attending to, remains an unresolved question that awaits further research. Likewise, we still know comparatively little about other mental states, such as intentions, knowledge, or beliefs. Although there is some evidence suggesting that chimpanzees may also be sensitive to the intentions or the knowledge states of others, other interpretations have not been ruled out yet, and therefore, unlike the research about visual access in others, it is still premature to draw solid conclusions.

Thus, we do not believe that the only explanatory alternatives for complex primate social behaviours are (1) behavioural conditioning or (2) theory of mind (e.g. Byrne, 1995, 1997; Heyes, 1998). Rather, following Tomasello and Call (1997), we prefer a third alternative: namely, that individuals may have insight into social problems in the same way that they have insight into physical problems such as tool use and spatial reasoning—with this insight in all cases depending to some degree on personal experience with the objects and activities involved (see also Call, 2001). It is hypothesized that the social cognition of chimpanzees (and other primates) is based in large part on a representational understanding of the behaviour of others, which permits them to do things like remember, foresee, and communicatively manipulate the behaviour and social relationships of others. This enables primates not only to react appropriately in social situations, but more importantly, to predict and influence their group mates’ behaviour in novel situations as well. But—and this is what makes our explanation not about theory of mind—all of
this understanding, prediction, and manipulation is of the behaviour, including visual behaviour, of others; it is not of the intentional or mental states of others. We call this an explanation of the ‘third kind’ because, unlike behaviouristic learning explanations, it involves complex cognitive processes such as understanding and perhaps even reasoning, and unlike theory of mind explanations, it concerns behaviour and perception, not intentional or mental states.

To give a concrete example, in our food competition experiments, the subordinate individual can see the dominant individual, and she can see the two pieces of food. She has learned from past experience that when there is an opaque barrier between another individual and an object, that individual does not behave towards that object in any way (showing no fear, attraction, or other emotional or behavioural response). To make her choice of which food to go for, she takes into account this knowledge and formulates a strategy accordingly. In this case, she approaches and takes the hidden piece of food. The most complex expression of knowledge of this type would involve the subordinate in attempting to actually manipulate the situation so as to make it favourable for her. In the current case, we would need to imagine a situation in which the subordinate had the ability to control the position of the barrier, so that it was either in place (blocking the dominant’s view) or not before the trial began. An insightful social strategy—comparable in many ways to the anecdotal reports of primate deception (Whiten and Byrne, 1988)—would be for the chimpanzee to choose to place the barrier in its effective position before the trial began. We do not know of any experimental studies demonstrating the use of precisely this kind of strategy, but the main point in the current context is that the individual could formulate such an intelligent social strategy by reasoning about the behaviour and perception of the other individual, not its mental states.

And What about Attention?

If we claim that chimpanzees understand something about seeing in terms of the visual behaviour of others, but not the intentional or mental states of others, what does this imply about their understanding of the attention of others? Many authors basically equate an understanding that another sees
something with an understanding that they are attending to something. We think that is a mistake. Attention is an intentional phenomenon in the sense that it involves the individual intentionally focusing on one aspect of their current experience to the exclusion of others. A person may see an apple and then choose to focus their attention either on its shape, its colour, its edibility, or any of an infinite number of aspects. To understand another individual’s visual attention is to understand that they have made an intentional choice about what to include and what to exclude in their visual experience. This way of looking at attention links it inseparably to an understanding of intentionality in general (Gibson and Rader, 1979; Tomasello, 1995).

On this definition of attention, we do not know of any studies indicating that chimpanzees have any understanding of the attention of others. Admittedly, it is difficult to see how one would investigate this question directly without using language or some other symbolic system that embodies different communicative perspectives (p.61) on things, and indeed it is possible that some enculturated apes may have learned to appreciate the attention of others as a result of their ‘linguistic’ interactions with them. But in the normal course of events, in their natural habitats, chimpanzees and other primates do not experience others attempting to manipulate their intentions or attention, and they do not understand or attempt to manipulate the intentions or attention of others either. So joint attention in the normal, human-based meaning of the expression, is simply not an issue.

Without going into detail, we should also mention at this point that one hypothesis is that human infants understand intentional and mental states such as attention from about 1 year of age, because they are able to make some kind of correspondence between their own experience and that of others (Tomasello, 1995, 1999). The reason why this ability does not emerge until around 1 year of age is that it is not until then that infants themselves control their own intentional behaviour and attention sufficiently to differentiate ends from means, and so to experience their own intentional and mental
states as something separate from their behavioural expressions. In this basically simulation view, chimpanzees can learn a lot about the behaviour and perception of others, but they will always be looking at others from the 'outside in', because, without an identification of self and other, they will not be able to use the simulation processes (putting themselves in the 'cognitive shoes' of the other) on which adult human social cognition depends.

Conclusion

Our explanation of the third kind is difficult, because human beings have a difficult time imagining that other organisms can observe the behaviour of conspecifics or humans and not understand and describe that behaviour in intentional terms. What does it mean that a chimpanzee understands seeing if that does not mean on analogy to her own visual experience? What does it mean to understand perception but not attention? We do not currently know how to answer these questions at any deep level. But what we will say at this point is simply that it is an empirical fact that chimpanzees' behaviour in many socially complex situations is decidedly mixed. They behave very intelligently in some ways—seeming to understand and reason about others—but they still do not seem to understand some social interactions in the way that humans do. Our hypothesis is simply that they have the cognitive skills to recall, represent, categorize, and reason about the behaviour and perception of others, but not about their intentional or mental states—because they do not know that others have such states, since they cannot make a link with their own. Chimpanzees—and perhaps in a different way autistic children—are showing us the most intelligent way an individual can understand and interact with conspecifics in the absence of using one's own intentional and mental states as a model for those of others.

(p.62) Human beings began their own evolutionary trajectory with these same skills, of course, but then at some point in their evolution (probably quite recently) they began to understand that their own experience could serve as some kind of model for that of other persons. This allowed for even better prediction and control of the behaviour of others, and
better communication and co-operation with them as well, and so it was an adaptation with immediate beneficial consequences that ensured its survival. Its implications for the ontogeny of human social cognition and behaviour—and indeed the crucial role of this adaptation in the evolution of human culture—is only now being fully recognized.

References

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