Reinterpreting the Mentality of Apes

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As a soccer player, one of us was often confronted with the challenging dilemma of taking penalty kicks. Up to about age 13, I (T. S.) could quite reliably convert the shot by simply peeking briefly to one corner of the goal, running up and then casually placing the ball in the other corner. I relied not on the accuracy or velocity of my shot, but almost entirely on fooling the keeper that I intended to shoot in the opposite direction. But then some clever keepers picked up on this simplest of tricks and tried to thwart my attempt by jumping in the opposite corner to the one I looked to. Some even tried to turn the tables by offering one side (moving closer to the other post). The battle became increasingly more challenging as I was sizing up the keeper's ability to read my intentions and do the opposite of what I thought he thought. For example, I pretend to place it right, but I think that he thinks I am only pretending to place it right – so I may chose to place it right after all. This is theory of mind in action.

Most theory-of-mind research uses verbal paradigms to assess children's reasoning about the mind. As the preceding example illustrates, however, theory of mind manifests in our nonverbal actions. Naturally, investigations into potential theory of mind in nonhuman animals must rely on such nonverbal performances. Whether our closest animal relatives share such manifestations of theory of mind has been a topic of much research and discussion in recent years. But identification of an unequivocal behavioral indicator for mind-reading has proved frustratingly difficult. Although observations of great ape behavior in natural (Whiten & Byrne, 1988) and experimental (Povinelli, Nelson, & Boysen, 1990; Premack & Woodruff, 1978) settings resulted in initial enthusiasm, in recent years, research has increasingly failed to find support for the idea that great apes appreciate mental states (e.g., Heyes, 1998, for a review).

Thus, in spite of their sophisticated social skills (Goodall, 1986), social traditions (Whiten et al., 1999) and potentially mindreading-related behaviors such as deception (Whiten & Byrne, 1988) and gaze-following (Tomasello, Hare, & Agnetta, 1999), we have to contemplate the possibility that chimpanzees may not interpret the social world in the mental terms that are so natural to mature humans in these contexts. Chimpanzees have so far failed what many believe to be the acid test for theory of mind, a (nonverbal) false-belief task (Call & Tomasello, 1999), and close experimental scrutiny has suggested a purely behavioral basis to their apparent understanding of seeing, attending, and pointing (Povinelli, 1996; Povinelli & Eddy, 1996; Povinelli & Prince, 1998).

THE REINTERPRETATION HYPOTHESIS

To explain this apparent disparity between apes' social expertise and the failure to find empirical evidence for theory of mind, Povinelli and colleagues have proposed the reinterpretation hypothesis (Povinelli, Bering, & Giambrone, 2000; Povinelli & Giambrone, in press; Povinelli & Prince, 1998). According to this account, great apes are thought to display remarkably similar social behaviours to humans not because they share with humans the capacity for theory of mind, but because humans share with great apes sophisticated mechanisms for social behavior that function without second-order intentionality. Theory of mind may have evolved uniquely in the human species. Moreover, it may not have resulted in radically new behavioral patterns (hence the difficulty in identifying clear behavioral indicators of theory of mind). Povinelli and colleagues question the logic of what they call the argument by analogy, which runs as follows: we display behavior X and great apes display behavior X; we believe that our behavior X is usually caused by second-order mental states, thus great apes' behavior X is caused by the same second-order mental states (i.e., a theory of mind). The authors question whether we are correct in asserting that our behavior X is in fact usually caused by second-order mental states (even if sometimes it is). Perhaps the behavior can be generated by other mechanisms and we may only reinterpret that behavior in

mentalistic terms after the fact. Consequently, the inference by analogy loses a lot of force. Great apes may have mechanisms that can generate behaviour often associated with theory of mind in humans, but their behavior may not be produced by theory of mind and they may indeed be unable to reinterpret it in such terms.

Consider our football example. In most ball games where an offensive player is trying to pass a defensive player, the trick is to make the opponent commit to one side or the other and delay one's own final move to such time in order to capitalize on that commitment. Now when we talk about these moves afterward, we explain that we wanted him to think X while we really were going to do Y. But do we actually go through all these intellectual-sounding notions? Standing at the penalty shot, perhaps at times we do. And we may find ourselves going in mental circles as we plot deception and counterdeception. In the heat of the action, however, there may simply be no time to formulate such explicit notions of each other's intent. Instead, we may quite automatically go through all the motions of deception and counterdeception and only afterward interpret them in mentalistic terms. We may simply *reinterpret* the causal basis of that behavior retrospectively (or perhaps, at times, even concurrently). Hence, the reinterpretation hypothesis.

Povinelli, Bering, and Giambrone (2000) suggest that "behavioural forms that primatologists are fond of calling deception, empathy, grudging, reconciliation, and even pointing, all evolved and were in full operation long before there were any organisms that could understand them in these terms." Thus, we may have learned to reinterpret our own ape behaviors in the last 5 million years. And we have (perhaps wrongly) applied this mental reinterpretation to other animals. Although chimpanzees may engage in a chase of rapid and effective side-to-side movements (e.g., de Waal, 1986; record no. 231 in Byrne & Whiten, 1990),[1] it may only be human observers who interpret these in terms of faking a left turn to create a false impression in the pursuant.

In sum, the reinterpretation hypothesis comprises the following key claims:

1. Theory-of-mind-like behavior may be caused by mechanisms other than theory of mind.
2. Great ape behavior relies on such mechanisms, that is, they do not have a theory of mind.
3. When theory of mind did evolve, it did not result in a host of novel behaviors, but merely fine-tuned the existing behavioural mechanisms.

WHEN IS BEHAVIOR CAUSED BY THEORY OF MIND?

The reinterpretation hypothesis appeals to the introspectively plausible proposition that theory-of-mind-like behaviors may often not be caused by theory of mind, but only be reinterpreted, post hoc, in mental terms. But there is an alternative explanation (as Povinelli and colleagues acknowledged in a footnote to one of their expositions; Povinelli & Giambrone, in press). In humans, rapid social behavioral patterns (as in our football example) may only operate *after* they have earlier been consciously processed. In other words, the deception and counterdeceptions may have become automatic ("second nature") but only after a lot of practice involving explicit cognitive operations of a kind that Povinelli et al. are happy to consider true theory of mind. In general, the literature on human skill development is replete with examples where behaviors that were once governed by slow conscious processes become automatic with practice (e.g., Speelman & Maybery, 1998). Driving a car is at first a difficult, effortful, and conscious process but develops into automatic control with practice-freeing the mind to engage in other activities, such as having a conversation and reading advertisements that tell you what's on at the movies. Similarly, this may be true of many aspects of football where players' behavior becomes far more sophisticated, quicker and, yes, automatic as they get more experienced. It requires a lot of practice and explicit coaching to become a sophisticated player. Another classic example that does not involve physical skills of the type we kicked off with is chess. To begin, the novice has to compute each step and the likely specific responses-but the grand master can intuitively "see" whole strategies that to this extent have become automatic. Should theory-of-mind development also be regarded as skill acquisition, from effortful, explicit, controlled, and slow processing to, fast, automatic, noneffortful processing that comes with practice?

On the face of it, this seems to be a very plausible possibility. Initial understanding may develop, for example, on the basis of mental simulation: putting oneself in others' (or one's past or future selfs) shoes (e.g., Harris, 1991). Sufficient experience with this may then result in short cuts that allow for inference without explicitly mentally simulating experiences. In other words, people become *experts* and this is evident in more automatic processing and (possibly in addition) the ability to explicitly account for (reinterpret) the actions after the fact. Here we will not be able to discuss the pros and cons for the different theories of theory of mind acquisition. But it is worth noting that adult humans can engage in both instant (implicit) recognition and effortful, controlled simulation. We can quite automatically recognize that someone who was cheated is likely to seek retribution but we can also imagine what it must have been like for that person and more thoroughly appreciate that person's perspective through the simulation called empathy (cf. Suddendorf, 1994).

Thus, appeal to the introspective observation that some behavior, although associated with theory of mind, may not be *caused* directly by second-order representations may not be immediately convincing as a fundamental critique. For example, the observation that we may follow gaze of others quite automatically may not result from some low-level non-theory-of-mind mechanism, but from sufficient experience and practice with these situations, resulting in automated response mechanisms. Thus, more generally, many theory-of-mind-like behaviors may result from: (a) mechanisms that are phylogenetically older and unaffected by theory of mind; or (b) mechanisms that have developed out of theory of mind but have become automated. One potential way in which one could differentiate between these possibilities is to look at whether the mechanism in question is informationally encapsulated. If social skills were to rest on type A mechanisms, then one would not expect that explicit reflection would interfere with these ancient low-level processes. Automatized mechanisms of type B, on the other hand, should be subject to optional top-down processes. That is, one can select the behavior (e.g., football or chess move) automatically, but certain situations may cause one to pause and explicitly think about what to do. Adult theory-of-mind-type behavior appears to be accessible in this latter way, which would support our automatization hypothesis rather than a reinterpretation account. In sum, we are not aware of any empirical reason why one should favor possibility A for these behaviors in human adults.

The case for the reinterpretation hypothesis perhaps could be rescued if one could argue that relevant behaviors that great apes show emerge first in human development *before* theory of mind is evinced. Could it be that children of age 2 or 3 have no real theory of mind, just sophisticated social mechanisms (as proposed for apes) that are only later reinterpreted in mental terms?

REINTERPRETATION ONLY WHEN FALSE-BELIEFS ARE UNDERSTOOD?

Some researchers have equated having a theory of mind with passing false-belief tasks. False-belief tasks were originally conceived to establish that a subject "reasons" about the mind (Bennett, 1978; Dennett, 1978; Harman, 1978). In the case of true beliefs, reality and beliefs match, and hence, behaviors that result from cognitions that take true beliefs into account cannot easily be distinguished from behaviors that are simply responses to reality. In the false-belief task, however, subjects have to show that they understand that behavior is produced on the basis of beliefs about the world, even when these beliefs contradict what the subjects themselves believe to be true. Thus, success on the task is often said to evince an understanding of the representational nature of the mind. This ability is thought to involve *metarepresentation*, that is, representing representations *as* representations (Perner, 1991; Pylyshyn, 1978). Thus, perhaps it could be argued that younger children who systematically fail this task do not have the (metarepresentational) capacity to reinterpret behaviour in mental terms. So theory-of-mind-like behavior in these younger children maybe based on the sophisticated social mechanisms the reinterpretation hypothesis claims to function without theory of mind in apes.

The false-belief task has become a standard tool for assessing theory of mind development and a recent meta-analysis (Wellman, Cross, & Watson, 2001) of 178 studies confirmed that there is a developmental trend from chance or below-chance performance to clear

above-chance performance on such tasks from age 3 to 5. Of the many task variations, only motive (deception increases performance), salience (if protagonist's belief is clearly stated or pictured, then performance increases) and real presence (real world presence of the contradicting situation decreases performance) had a systematic effect on performance. Although several researchers have proposed early competence accounts, suggesting that unnecessary aspects of the task mask young children's capacity, the meta-analysis did not find supportive age-condition interactions, showing instead that these conditions did not change the general trajectory (that is, they have equal effects for all age groups). The authors thus argue against early competence theories and instead suggest that a conceptual change occurs between ages 3 and 5.

There has been a strong research effort looking at the reasons why children younger than $3^1/2$ fail false-belief tasks. Arguably, however, this effort has somewhat missed the point of the task. The objective of the task was not to show that 3 year olds lack a theory of mind, or to discover whether acquisition of a theory is gradual or abrupt (Suddendorf, 1998a). Passing the task is informative, failing it may be less so. The reason that commentators to Premack and Woodruff's paper, 'Does the chimpanzee have a theory of mind?' suggested the false-belief task, was that passing it unequivocally establishes that the subject took the mental representation of the protagonist into account. It shows theory of mind. In spite of findings from Wellman et al.'s (2001) meta-analysis, failure on the task may result from any number of reasons other than lack of theory of mind. Bloom and German (2000) recently pointed out that theory of mind need not entail the ability to reason about false beliefs (e.g., one may hold a more primitive theory) and that succeeding on the task requires abilities other than theory of mind (e.g., understanding the test question). To repeat, younger children and animals that fail the task may do so for reasons other than lack of theory of mind. In fact, even if they were unable to appreciate false beliefs they may still have some form of theory of mind. Beliefs, after all, are not the only mental states and one may have ideas about, for example, desires or perceptions without understanding beliefs. This does not mean that the task is useless. Far from it. As originally conceived, when the task is reliably passed we can conclude that the individual has a theory of mind (Bennett, 1978; Dennett, 1978; Harman, 1978). If the task is failed, however, we can only conclude that we failed to reject the null hypothesis.

YOUNG CHILDREN'S THEORY OF MIND

Children may have some understanding of mind well before they pass false belief tasks, even if we do not have an unequivocal test for this. Studies have documented support for some, although limited, competence in reading emotion (Bartsch & Wellman, 1995), desire (Repacholi & Gopnik, 1997), ignorance (O'Neill, 1996), seeing (Flavell, Everett, Croft, & Flavell, 1981), intention (Meltzoff, 1995) and attention (Baldwin & Moses, 1994), to name but a few. Do these performances result from theory of mind or to other mechanisms?

Developmental psychologists differ in their accounts, but most do attribute some theory of mind to their young subjects. Let us briefly consider three of the most influential theories. Wellman and colleagues (Wellman et al., 2001) argue that even 2 year olds have a theory of mind, but a theory that is under constant revision based on feedback from the environment. Specifically, this account proposes that young children have a desire psychology (they reason about people's desires) that only later (indicated by false-belief competence) develops into a belief-desire theory of mind. Leslie and colleagues (e.g., Leslie & Thaiss, 1992; Scholl & Leslie, 2001) argue instead that even 2 year olds have an innate, operating *theory-of-mind module*, but insufficient *selection processing* (read: executive control) to pass false-belief tasks (because the default setting of the theory-of-mind module is thought to be for true beliefs). Finally, Perner (1991) proposed that 2 year olds have an intermediate representational capacity that allows them to construct a *mentalistic theory of behavior* (based on secondary representation) rather than a *representational theory of mind* (based on metarepresentation). What these approaches have in common is that they all acknowledge some form of theory of mind in children too young to pass false-belief tasks. Is there comparable evidence in great apes to extend such theories to our cousin species?

EVIDENCE FROM GREAT APES

Povinelli's own research has systematically investigated the capacities of chimpanzees and has been most prolific and influential in the area. In scores of studies, he and his colleagues subjected their group of young chimpanzees to tests of gaze following, pointing, understanding of 'seeing' and 'knowing', and the ability to distinguish intentional from accidental actions (e.g., Povinelli, Perilloux, Reaux, & Bierschwale, 1998; Povinelli & Eddy, 1996, 1997; Reaux, Theall, & Povinelli, 1999). Contrary to his earlier findings (Povinelli et al., 1990; Povinelli, Nelson, & Boysen, 1992), these extensive research efforts produced consistently negative results. That is, chimpanzees' performances on all these tasks suggested that they employed mechanisms other than theory of mind, which led the researchers to propose the reinterpretation hypothesis.

However, should we accept generalizations from the failures of this particular set of chimpanzees? Povinelli used the same group as subjects in numerous experiments. Are there reasons to doubt that he has tested a representative chimpanzee sample? Povinelli's subjects are all young (below age 10), and one may wonder whether we can generalize to older chimpanzees. This worry is a particular concern for his early studies when the subjects were juveniles. One may further wonder whether the subjects are otherwise atypical, perhaps unusually dense, impaired, or indifferent. Their artificial upbringing includes being raised in a peer group rather than by parents. Imagine Martians studying a group of human children raised as a group in a Martian enclosure. What generalizations about human intelligence could be drawn from research on these children? There is evidence for social traditions in wild chimpanzees and such traditions may be crucial to normal development of a chimpanzee mind. Generalizations from performances of Povinelli's chimps thus need to presuppose that the capacities under scrutiny are not affected by drastic changes to the normal developmental environment. We do not know whether these issues account for the data Povinelli reports, but they certainly are a threat to the external validity of the findings (see Allen, 2002; Hauser, 2001; Whiten, 2001, for further critical assessments of the generalizability of Povinelli's results).

Another potential problem is that, as part of their daily routine, these chimpanzees are being tested constantly in weird and wonderful ways. At the end of the day, however, their performance on any of the tasks may not matter to them too much – they will be fed anyway. Many of the ingenious experimental paradigms presuppose that the chimpanzee has a certain understanding of a rather unnatural situation. In many cases, for example, the chimpanzee needs to communicate with a human and appreciate that he (or she) wants to help her find food. Helping to find, rather than competing for, food is itself an atypical behavior for a chimpanzee. Therefore, although these studies are internally coherent and consistently fail to reject the null hypothesis, they do not close on whether the null hypothesis should be accepted for the chimpanzee population in general.

Work by Tomasello, Call, and colleagues has recently provided several positive results that question Povinelli's conclusions. First, these authors found evidence for quite sophisticated gaze following abilities in chimpanzees. Tomasello, Hare, and Agnetta (1999), for example, found that chimpanzees could project somebody else's line of sight geometrically beyond their immediate visual field. They did this even around barriers, moving in ways that allowed them to see what was behind them. They also followed gaze after having been distracted by an interesting object, which contrasts with the low-level hypothesis (Povinelli & Eddy, 1996) that chimpanzees simply look in the general direction the experimenter is gazing to find an interesting object or sight. Furthermore, they have also been observed 'checking back' to the experimenter in cases of apparent uncertainty (Call, Hare, & Tomasello, 1998). Other studies suggest that chimpanzees and orangutans, like 2-year-old toddlers, can discriminate between accidental and intentional actions (Call & Tomasello, 1998; Povinelli, 1991).

Perhaps most important, chimpanzees were found to preferentially head toward seizure of whichever of two food items was visually screened from a more dominant competitor (Hare, Call, Agnetta, & Tomasello, 2000). Several control tests appear to rule out the possibility that the chimpanzees were using some kind of behavioral or other contextual cues. When the opaque screens were replaced with transparent screens, this preference for the 'concealed' food vanished;

the chimpanzee presumably recognized that the screen no longer blocked the visual access of the dominant competitor. This study of understanding 'seeing' was then extended to investigate appreciation of 'knowing'. The results showed that chimpanzees also took into account whether a dominant competitor had earlier observed the baiting or was ignorant of the location of the food (Hare, Call, & Thomasello, 2001). These findings suggest a very different picture of chimpanzees' competence.[2]

Why should these new studies have produced positive results where other attempts failed? One possibility is that they appear to be more ecologically valid than earlier laboratory experiments (e.g., Povinelli & Eddy, 1996) in that they utilize the naturally strong motivation of competition with a conspecific. In previous attempts, as mentioned, chimpanzees had to communicate with humans, be trained extensively in particular ways, and often had to appreciate an unusual situation where a human had a cooperative motive (indicating where food is hidden) that runs against natural chimpanzee food competition. Whatever the reasons may be, these positive findings have more epistemological weight than previous failures to reject the null hypothesis.

These findings are also more consistent with observations both in the wild and in rich captive settings that indicate that great apes compute basic mental states such as attention and intention in their social dealings (see also Byrne & Whiten, 1990; de Waal, 1986; Whiten & Byrne, 1988). Does this mean that we should abandon the reinterpretation hypothesis and accept great apes into the circle of mindreading species? Hare et al. remain cautious in their interpretation (see also Call, 2001). They suggest that we should abandon the simple dichotomy between either having or not having a theory of mind (c.f., Suddendorf, 1998b, 1999; Suddendorf & Whiten, 2001; Whiten, 1996). Chimpanzees may occupy some middle ground in that they do have, as Hare et al. (2001) suggest, some limited understanding of, for example, 'seeing' (level 1 perspective taking – knowing what others can or cannot see) without level 2 understanding (knowing how others see objects – e.g., from a different perspective) (Flavell, 1985). We agree with such an intermediate position (Whiten & Suddendorf, 2001). So our claim is that great apes and young children can entertain information about other minds that influences their behavior without necessarily having an understanding of beliefs sufficient for passing false-belief tasks. We have also recently made a broader claim about the nature of such an intermediate position.

THE MENTALITY OF APES

Utilizing the scheme of Perner (1991) referred to earlier, we recently reviewed the evidence for cognitive capacities in great apes and young children (Suddendorf & Whiten, 2001). We concluded that great apes have not yet been shown to be capable of the metarepresentation that characterizes the normal 4year-old child in Perrier's scheme, but that there is more reason to believe they are capable of secondary representation. Let us first clarify the difference between *secondary representation* and *second-order representation* (see Suddendorf & Whiten, *2001*, for more details). The term second-order representation was introduced to describe recursion in mindreading. "I think" is first order, "I think that you think" is second-order, "I think that you think that he thinks" is third-order, and so on (Dennett, 1983). Secondary representation, on the other hand, does not refer to a level of recursion, but to mental representations that, in addition to primary representations of the reality, can reflect nonpresent states of the world (e.g., past, future, or hypothetical). Once capable of entertaining secondary representations one can collate and compare the current state of affairs with what was, what could be, and what might be the case. One of us therefore coined the term *collating mind* (Suddendorf, 1999).

Perner (1991) proposed secondary representation as the intermediate stage in his three-stage model of the development of representational capacities underlying theory of mind. Infants are believed to entertain single updating models of the world until in the second year they begin to additionally entertain hypothetical models; models that can refer not just to the present but to different entities, properties, times, and places. For example, toddlers begin to attribute desires to another person that are different from their own. In their early pretend play, they hold a primary representation of the true current situation and simultaneously a secondary representation of the

pretend world. Around this age they also begin to understand hidden displacement (Piagetian stage 6 object-permanence), demonstrate means-ends reasoning, show empathic behavior, engage in simultaneous imitation games, interpret external representations, and recognize themselves in mirrors (see Suddendorf & Whiten, *2001,* for a review). All these new displays are argued to be based on the ability to go beyond a direct model of the world and recombine elements of previous primary representations into past or novel (projected future or merely hypothetical) constellations (Asendorpf, Warkentin, & Baudonniere, 1996; Perner, 1991; Suddendorf, 1998b) and correlational findings in support of this have been reported (Asendorpf et al., 1996; Baudonniere, Margules, Belkhenchir, Pepe, & Warkentin, in press; Bischof-Kohler, 1989; Chapman, 1987; Lewis & Ramsay, 1999; Nielsen & Dissanayake, *2001).*

Is there evidence for secondary representations in the great apes beyond the apparent mind-reading discussed thus far? Do they perform similarly to human toddlers in their second year? At least some data can be put forward for each of the domains (reviewed fully by Suddendorf & Whiten, *2001).* We discuss them in turn.

Stage 6 Object Permanence

Hidden displacement tasks, where an object is invisibly displaced and a subject's search behavior is recorded, are supposed to measure the ability to mentally reconstruct the past trajectory of the target object. Although early research on chimpanzees (e.g., Mathieu & Bergeron, *1981;* Wood, Moriatry, Gardner, & Gardner, *1980)* and gorillas (Redshaw, *1978)* suggested stage *6* capability in great apes, these studies have been criticized for lacking necessary control conditions (e.g., Natale & Antinucci, *1989).* Subjects may simply have adopted a rule-based search strategy. Thus, success alone may not be regarded as evidence for stage *6* object permanence. However, careful use of appropriate control conditions has shown that at least one gorilla, in contrast to a macaque, has reached this level (Natale, Antinucci, Spinozzi, & Poti, *1986).* Similarly strong evidence now is also available for orangutans (de Blois, Novak, & Bond, *1998).* Chimpanzees, however, still need to be subjected to an appropriately controlled research paradigm. Nevertheless, given the earlier reports it seems likely that all great ape species can reach stage *6* object permanence.

Pretense

Pretend play is difficult to investigate experimentally. Observational reports of pretence in great apes, however, have become more frequent. Home-reared members of all great ape species have been reported to treat dolls and toys as if they were animate characters (e.g., bathing them), sometimes even employing sign language to convey the pretend processes (e.g., Jensvold & Fouts, *1993;* Patterson & Linden, *1981;* Savage-Rumbaugh, *1986;* Savage-Rumbaugh & McDonald, *1988;* Tanner, *1985).* The chimpanzee Viki reportedly acted as if she was pulling a toy on a string and then followed through with the pretend implications when the pretend string appeared to be stuck on a real object (Hayes, *1951).* It is, of course, inherently difficult to judge if a behavioral display in the wild involves any make believe. However, Wrangham *(1996)* reported that a subadult chimpanzee traveling with his pregnant mother, picked up a log, carrying it for hours and treating it suspiciously like a baby (e.g., he made a nest and placed the log in it). A more adaptively valuable expression of this skill may be in the realm of deception, where a perpetrator acts as if doing something that must be in contradiction with their primary perception of the situation. Whiten and Byrne *(1988)* collated such cases, in which, for example, an individual was observed to notice some half-hidden choice food, yet when a competitor appeared they inhibited their attention to the food, only looking at it again and retrieving it once the competitor departed. Such records were logged only for great apes (chimpanzee and gorilla). Although this suggests that pretence is within great apes' potential, it contrasts with 2-year-old children, in that it appears to be relatively rare, rather than an obvious everyday manifestation.

Means-Ends Reasoning

When problem solving involves keeping in mind a goal state while mentally working through subgoals, then this may be regarded as means-ends reasoning. Chimpanzees have been shown to solve tasks that appear to involve such reasoning as when they are required to make the right initial

choice on the basis of foreseen consequences (Dohl, 1966, 1968, 1969; Rensch & Dohl, 1968; Kohler's *The mentality of apes* (1927) reported experiments that suggested that chimpanzees can solve problems by mental processes rather than mere physical trial and error. Visalberghi's (1996) findings on tool use support the idea that chimpanzees can understand means-ends relationships at least in some case without recourse to trial and error. All these studies, however, also reveal inconsistencies and individual differences that have dampened some researchers' enthusiasm (Povinelli, 2000). Povinelli concludes from the failure of his chimpanzees that they cannot take unobservable forces into account.

Again, ecologically valid tasks may be most likely to elicit behavior that reflects great apes' potential. Group-specific tool-use traditions have been re ported in wild chimpanzees (e.g. Boesch & Boesch, 1984; Goodall, 1986; Whiten et al., 2001) and orangutans (Fox, Sitompul, & van Schaik, 1999; van Schaik, Fox, & Sitompul, 1996). These apes use different tools for different tasks (Whiten et a1.,1999) and modify them appropriately for the task at hand (McGrew,1992) suggesting a high degree of flexible anticipation in relation to goals. Gorillas are not known to use tools in the wild, but tool use in captivity includes comparable tool modification and application (Boysen, Kuhlmeier, Halliday, & Halliday, 1999; see Parker, Kerr, Markowitz, & Gould, 1999, for a review).

Understanding External Representation

Members of all great ape species have been reported to enjoy watching picture and television (e.g., Patterson, 1991; Premack & Woodruff, 1978; Savage Rumbaugh, 1986). They also do not seem to have problems interpreting photographs appropriately (Jensvold & Fouts, 1993; Miles, Mitchell, & Harper, 199 Patterson, 1978). The home-reared chimpanzee Viki, for example, was able to match photographs to real objects, suggesting that she understood what the picture represented (Hayes & Hayes, 1953). Sherman, a male chimpanzee who spent his early years with human female caretakers (e.g., Savage-Rumbaugh 1986), displays interest in photos of human females, especially when wearing fur, and has become sexually aroused by them to the point of ejaculation (AW personal observations). Now, such behavior may simply result from the image involving sufficient cues to elicit certain behavioral responses. To ascertain that an individual has understood that one object can inform about another (representational insight), developmental psychologists use a search paradigm (e.g., DeLoache, 1987). For example, a photo shows the location of an object in a other room and the child is asked to search for that object after viewing the picture (or video, drawing, scale model, etc.). Kuhlmeier, Boysen, and Muki (1999) have recently shown that at least some chimpanzees can pass such a task. Great apes have not invented external representations in the wild, but their representational capacities appear to enable them to interpret and utilize human symbols.

Mirror Self-Recognition

It is established that some members of all genera of great apes can pass the classic mirror self-recognition task (e.g., Gallup, 1970; Parker, Mitchell, & Boccia, 1994; Povinelli et a1.,1997; Povinelli, Rulf, Landau, & Bierschwale, 1993; Swartz, Sarauw, & Evans, 1999). Alternative interpretations such as the anesthetic recovery hypothesis (Heyes, 1994) have not held up to further scrutiny (van den Bos, 1999). Chimpanzees and orangutans have provided the most convincing performance (Boysen, Bryan, & Shreyer, 1994; Calhoun & Thompson, 1988; Gallup, 1970; Gallup, McClure, Hill, & Bundy, 1971; Hill, Bundy, Gallup, & McGlure,1970; Lethmate & Ducker, 1973; Lin, Bard, & Anderson, 1992; Miles, 1994; Povinelli et al., 1993; Suarez & Gallup, 1981; Swartz & Evans, 1991). Early studies with gorillas were unsuccessful (e.g., Ledbetter & Basen, 1982; Suarez & Gallup, 1981), but more recent research has provided positive results (Parker, 1994; Patterson & Cohen, 1994; Swartz & Evans, 1994). Reviewing the research to date, Swartz, Sarauw, and Evans (1999) report that 43% of chimpanzees, 31% of gorillas, and 50% of orangutans tested with the classic mirror mark test have passed. Failure may result from any number of reasons ranging from differences in motivation to differences in age. The research clearly shows that MSR is within the capacity of great apes.

Empathic Responding

Comforting conspecifics other than one's own offspring, is rare in animals but has been reported for chimpanzees (Boesch, 1992; de Waal, 1996; Goodall, 1986). Special care is given to conspecifics that are distressed or injured (de Waal, 1996). De Waal and Aureli (1996) analyzed over a thousand spontaneous aggressive incidents in a group of chimpanzees and found that bystanders' kissing, hugging, grooming, and gentle touching were provided significantly more often to victims of aggression, immediately after fights and more after serious than after mild conflicts. The other great apes have not been reported to show such consoling behavior.

Understanding Imitation

Great apes have shown some ability at imitation as a way of learning and exploring (Russon & Galdikas, 1993; Stoinski, Ure, Wrate, & Whiten, 2000; Whiten, 1998). But do they understand imitation in the way a human toddler does? Some great apes appear to have some grasp of the concept of imitation. For example, they have been taught to play a do-as-I-do imitation game (Custance, Whiten, & Bard, 1994; 1995; Hayes & Hayes, 1952; Miles et al., 1996; Tanner & Byrne, unpublished). However, there appear to be no formal studies that have investigated whether apes can recognize when they are being imitated, as children come to do in the second year of life, although some observations suggest that this may be within their capability (Miles et al., 1996).

TABLE 8.1. Strength of Reviewed Evidence for Each Realm

Expression of Secondary Representation	Chimpanzee	Gorilla	Orangutan
Hidden displacement	*	**	**
Pretence	*	*	*
Means-ends reasoning	**	*	**
External representation	**	*	*
Mirror self recognition	***	**	***
Empathic responding	*		
Recognising mental states	**		**
Understanding imitation	*	*	*

*Some evidence (observational or weak experimental).
**Stronger evidence (experimental).
***Undisputed evidence.

Taken together, then, the current data suggest that these achievements characteristic of humans' cognitive development in the second year are within the capacities of our great ape cousins (Table 8.1). If it is correct that all of them are related to the emergence of the ability to entertain secondary representations, then it seems reasonable to propose that, as a working hypothesis at least, the great apes share this ability. Our working hypothesis thus predicts that chimpanzees *(troglodytes* and pansicus), orangutans, and gorillas will all be shown to have skills in all those realms. Furthermore, it predicts correlations between performances in these domains (e.g., between mirror self-recognition and empathic behavior) similar to those found in toddlers.

This working hypothesis is also the most parsimonious explanation when one considers the phylogenetic relationship of the species under investigation. The great apes shared a common ancestor approximately 16 million years ago. When all species of this group display the same behavioral phenotype, it is more parsimonious to assume that these features are homologous (that is, that they originated in a common ancestor), than to conclude that each of them evolved it independently. The latter explanation requires more assumptions than the former. Furthermore, if those capacities discussed in the preceding are the product of a common history, then it is also likely that they are based on the same underlying psychological processes (Byrne, 1995; de Waal, 1996; Parker, 1996: Suddendorf, 1998b, 1999). This reasoning may be best described as the argu-

ment by homology (in contrast to the criticized 'argument by analogy', see Suddendorf & Whiten, 2001).

Although toddlers and great apes may share some fundamental cognitive capacities, we are, of course, not saying that they are mentally equivalent. Apes for example, do not display protodeclarative pointing. Note especially that toddlers display evidence for all of the reviewed abilities quite frequently in their everyday activities (e.g., pretend play), whereas great apes, on the other hand may display them only sporadically or weakly; in natural conditions they may be truly functional only in a subset of the domains. One may be concerned that such differences in the way and frequency by which the discussed characteristics are being expressed in each species undermines our parsimony argument. (Would one not need to make additional assumptions about the evolution of these differences?) Our argument is aimed at the basic capacity to entertain secondary representations – that is the homology. The expression of this basic capacity is influenced by other factors within and between species. Nor do we suppose that the ontogenetic and phylogenetic parallels, such as they are, represent any simple principle of 'recapitulation'. Perhaps the human propensity owes to the fact that it is a stepping stone toward more sophisticated cognitive developments, whereas this may be the outer limit of what great apes have evolved to do.

The other obvious difference is language. Language may be causally linked to the development of theory of mind (Astington & Jenkins, 1999). Indeed, language is ideally suited for explicating mental states, for teaching about mental states and to interact purely on a mental level (as in asking questions). As Dennett (2000) pointed out, chimpanzees never have the opportunity to compare notes on their mind-reading activities, if indeed they had them. Language appears to be necessary not only for public exchanges about the mind, but also to facilitate internal explicit representations of mental states. Of interest here is recent research we discuss next, which suggests that children may understand false beliefs first in action and only later in words.

IMPLICIT UNDERSTANDING OF THE MIND?

Even 3 year olds tend to look in the correct direction in false-belief tasks while continuing to explicitly select the wrong option (Clements & Perner, 1994; Garnham & Perner, 2001). This correct responding is not restricted to visual orienting, but also manifests in other action. When a character holding a false belief is about to use what amounts to the wrong one of two slides, even 36 month olds tend to place a mat for safe landing at the bottom of the appropriate slide (the one the protagonist falsely believes to be the correct slide) when asked to act quickly. Explicit verbal responses of these children, however, show the classic error: When asked which slide the protagonist will come down on, they fail to attribute a false belief (Garnham & Perner, 2001). The researchers went on to test various alternative explanations (e.g., lack of confidence; misinterpretation of question) as to why young children do not express their apparent knowledge in the explicit tasks. They found no support for these alternatives and instead argued that children's behavior is more akin to implicit processing (as in blindsight, where implicit visual perception exists without conscious awareness, inaccessible for deliberation and declaration) (Perner & Clements, 2000).

Perhaps this approach may offer an alternative avenue to adapt the reinterpretation hypothesis. Rather than explicit processing becoming automated, as discussed, Perner's research outlined in the preceding section suggests that initial implicit processing becomes progressively more explicit. Such an account is in line with Karmiloff-Smith's (1993) hypothesis of representational redescription, which proposes development of capacities to progressively recode implicit information in more explicit formats during development. Indeed, Povinelli and colleagues (Povinelli et al., 2000) view their reinterpretation model as an evolutionary analog to this developmental account. Given the data on early implicit false-belief understanding, one may advance a version of the model that postulates that great apes possess some implicit theory of mind (rather than no theory of mind) that our ancestors then progressively made more explicit (perhaps aided by the emergence of language).

The challenge is thus to design nonverbal implicit false-belief tasks for great apes that should generate positive findings if the preceding notions are correct. To increase one's chance, we might suggest making the subjects active participants in a deceptive ploy (to use those conditions shown to be easiest in children; see Wellman et al., 2001) and to create a motivating competitive situation (to use those conditions shown to be most successful in chimpanzees; see Hare et al., 2001).

The bottom line is that the debate about whether or not the chimpanzee has a theory of mind is still open, even if the likely possibilities have been narrowed down. At present there is no reason to favor the idea that great apes do not have a theory of mind over the possibility that they do have a limited (perhaps, implicit) one.

ADAPTIVE ADVANTAGE

Why would the capacity for (an explicit) theory of mind have evolved? At first sight, it seems obvious that evolution of theory of mind would have had great social ramifications and selective advantages. In children, passing the false-belief task is associated with enhanced social competence (Lalonde & Chandler, 1995; and modern-day hunter-gatherers use their deep social minds for crucial cooperative tasks; theory of mind was likely instrumental in the evolution of earl) human culture (Whiten, 1999).

The reinterpretation hypothesis, however, argues that theory of mind need not have resulted in radically new behaviors. Instead, it is suggested that its emergence may have had only subtle advantages in reorganizing existing behavioral propensities. This is the third key claim of this hypothesis. It is probably the result of the nagging difficulties Povinelli and other researchers encountered in their attempts to identify a simple discriminating behavioral correlate of theory of mind. And the point that whatever hominids evolved would have been built on, and interwoven with, the extant capacities is well taken (although some scholars seem to believe that many whole new modules were added from scratch). However, the question why humans evolved theory of mind (or why they began to explicitly reinterpret or redescribe their implicit knowledge) remains in the realm of speculation.

There are certainly viable alternatives to the reinterpretation account. One obvious candidate that needs consideration concerns language. Language, in itself a deeply social phenomenon, might have fostered the evolution of an explicit theory of mind. As pointed out, language is exceptionally well suited for mind-reading, declaration of mental states, teaching, and exchanging notes. Syntax, often hailed as the distinguishing aspect of human language, is also a prime example of the recursion that is so typical of human generativity, and recursion is also evident in human mind-reading (see Corballis, this volume).

Of course, one can argue the case both ways. Language may have fostered theory of mind evolution, but elaborate language evolution may have been possible only after the emergence of theory of mind. (How would one agree on a symbolic system to exchange ideas between minds, if no one believes the other has a mind?) The latter version of the argument, of course, implies that theory of mind has had a huge impact on the behavioral repertoire: It has made complex language possible. A more modest account simply acknowledges that there might have been coevolution of both language and theory of mind, facilitating each other's complexity Unfortunately, the suspicion of a causal link to language evolution does not help us much in terms of the timing of the evolution of explicit theory of mind. In spite of the recent flurry of theorizing (since the apparent abandonment of earlier self-restraint, such as the 1866 ban of such speculation by the Paris Linguistic Society), the origin of language remains a mystery. There are influential accounts in both, "early-bloomer" and "latebloomer" camps (see Suddendorf, 2000, for a discussion).

Finally, it is also possible that theory of mind is something of a byproduct of a different kind of adaptive evolution. Elsewhere, one of us argued that passing false-belief tasks is just one expression of a general shift in cognition (i.e., the emergence of *metamind)* occurring in children between age 3 and 4 involving advances in executive control and metarepresentational capacity (Suddendorf, 1999). These advances appear to have consequences not only in the social realm, but also in regard to how one's own mind is utilized. For example, divergent thinking in search of

alternative problem solutions has been found to be strongly associated with false-belief understanding (Suddendorf & Fletcher Flinn, 1999), and the adaptive advantage of solving problems needs no further elaboration. A related possibility is that the processes that allow for explicit theory of mind may also allow an individual to travel mentally in time (Suddendorf, 1994; Suddendorf & Corballis, 1997). This proposal turns out to be not all that new. In 1805 William Hazlitt wrote:

> The imagination by means of which alone I can anticipate future objects, or be interested in them, must carry me out of myself into the feelings of others by one and the same process by which I am thrown forward as it were into my future being, and interested in it. (1805, p. 1)

Perhaps understanding other minds is merely a byproduct of the obviously adaptive evolution of a concern for one's own future being (Suddendorf & Corballis, 1997). To be sure, there are no doubt plenty of other interesting possibilities (the explosion of cooperation in hominids, for example, could be intimately linked to the evolution of theory of mind; Sterelny, 2003). These examples, however, should suffice to illustrate that this aspect of the reinterpretation hypothesis is, at best, an educated guess (as are the other proposals) and that there are many human behavioural facets that are unique and may be causally linked to theory of mind.

In conclusion, the three key claims of the reinterpretation hypothesis that we looked at more closely are possibilities worth considering, although at present we see no reason to favor them over viable alternatives:

1. *Human theory-of-mind-like behavior may not be caused by theory of mind.* However, this impression may be the result of humans becoming theory-of-mind experts, with automatized mechanisms.
2. *Great apes do not mind-read.* However, there are positive results that suggest some intermediate theory of mind capacity.
3. *Theory of mind did not result in a host of novel behaviors.* However, unlike apes, we talk and play football.

NOTES

1. Frans de Waal describes an elaborate example in which a male chimpanzee aggressively chased a female. As the female sought cover behind a tree trunk, the male moved to the left, which prompted the female to move to the right. In full motion, the male then threw a brick in the direction of her path (to the right), while continuing to move to the left himself. To avoid the projectiles the female changed directions only to find herself being caught by the male.
2. Further preliminary reports are emerging that appear to substantiate these results (Boysen, 1998; Whiten, 2000).

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