Beyond learning fixed rules and social cues: abstraction in the social arena

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Abstraction is a central idea in many areas of physical comparative cognition such as categorization, numerical competence or problem solving. This idea, however, has rarely been applied to comparative social cognition. In this paper, I propose that the notion of abstraction can be applied to the social arena and become an important tool to investigate the social cognition and behaviour processes in animals. To make this point, I present recent evidence showing that chimpanzees know about what others can see and about what others intend. These data do not fit either low-level mechanisms based on stimulus–response associations or high-level explanations based on metarepresentational mechanisms such as false belief attribution. Instead, I argue that social abstraction, in particular the development of concepts such as seeing in others, is key to explaining the behaviour of our closest relative in a variety of situations.

Keywords: theory of mind; social cognition; mindreading; social intelligence; chimpanzees

1. INTRODUCTION

A recurrent topic in psychological research is the interplay between direct perception and representation, between learning particular exemplars and developing abstract concepts. Although it is widely accepted that many animals go beyond the information they perceive and form representations in several areas of physical cognition such as numerical competence, spatial reasoning or categorization, it is still a matter of debate what kinds of representation they form. In no area is this felt more than in concept formation (Savage-Rumbaugh et al. 1980; Herrnstein 1984). Do animals learn specific exemplars, form perceptual categories or even develop functional categories? The guiding principle behind these distinctions is none other than the level of abstraction from the stimuli in the environment.

In the social arena we see similar discussions between learning particular social cues (e.g. head orientation) and developing abstract social concepts such as a theory of mind (e.g. Heyes 1998). Several authors contend that apes only learn fixed rules and cues to solve social problems whereas others argue that these mechanisms alone are not sufficient to explain certain results. I will defend this latter position in this paper. I will propose that, like in the physical domain, perception of cues and learning fixed rules alone is not sufficient to explain the behaviour in our closest relative: the chimpanzee. Recent advances in the study of mental state attribution suggest that chimpanzees, at least, go beyond learning specific body configurations (e.g. head oriented in a certain way) in certain situations. Instead, I will argue that chimpanzees show evidence of social abstraction, understood as the ability to develop not just general rules about behaviour but also social concepts about certain psychological states that explain the behaviours of others.

Applying the notion of abstraction in the social arena may seem quite strange, and I will not dispute that there are still many open questions. However, it is important that a concept such as abstraction, which plays such a central part in physical cognition, is also introduced and developed in social cognition. To make a case for abstraction in the social arena, I will present data on two problems that individuals commonly face in social situations: the problem of what others perceive and the problem of what others intend. These data do not consist of categorizing social stimuli (see Dasser 1988), so they are not a parallel to studies on categorization in the physical domain. Instead, they consist of behaviour displayed in social problem-solving situations that we use to infer the cognitive mechanisms. Note that the problem of what others perceive and the problem of what others intend are the social counterparts of perception and action, respectively. Again, these are two key concepts in psychological research. I will finish with a discussion of the levels of social abstraction that can be distinguished and two reasons why the notion of abstraction has not played a more predominant part in the field of social comparative cognition.

2. THE PROBLEM OF WHAT OTHERS PERCEIVE

Social situations are particularly challenging to individuals, who have to compete and cooperate with conspecifics to obtain limited resources such as food or mates. One important skill in cooperative and competitive situations is the ability to read and anticipate the behaviour of conspecifics (Krebs & Dawkins 1984). Predictive power can be enhanced if animals can not only read certain cues in certain situations but can also anticipate the behaviour of conspecifics in novel situations based on the knowledge they have of their group mates. One important factor that
determines how others will behave is what others can perceive. For example, suppose that a subordinate chimpanzee is foraging with the rest of her group and has discovered two pieces of highly preferred food. One piece lies behind a tree whereas the other is in the open. As she approaches the food locations, she observes a dominant chimpanzee coming towards her in the opposite direction so that he has visual access to the food in the open but not the one that is behind the tree. Because dominant animals usually try to monopolize resources, especially preferred ones, the subordinate chimpanzee has to make a decision about what pieces she should take, if any. One possibility would be to try to take the food in the open, but the dominant animal may block her approach, or she could try to get the food that is behind the tree. A recent study shows that when chimpanzees are confronted with this situation, they preferentially select the food that is behind a barrier (Hare et al. 2000).

One possibility is that chimpanzees learn fixed rules such as ‘take food that is near a tree but only when a dominant animal is in the opposite side of it’ or simply ‘take food that is close to visual barriers’ (Povinelli 2002). Learning a rule like this provides little flexibility because novel situations make fixed rules quickly obsolete. For instance, if instead of one tree and two pieces of food, there are two trees and one piece of food and the dominant animal has seen how the piece fell behind the tree, the fixed rule would predict that subordinates should approach the food. However, this is not what chimpanzees do. Chimpanzees refrain from approaching a currently hidden piece of food if the dominant has seen the food going behind the barrier, but they approach if the dominant has not seen the food going behind the barrier (Hare et al. 2001). Note that the position of the barriers in relation to the food is identical in both conditions. The only thing that changes is what the dominant animal has seen. In an additional experiment, Hare et al. (2001) extended the generality of these findings further. The authors switched the dominant who had witnessed the baiting for another individual that was also dominant to the subject but who had not witnessed the baiting and compared it with a situation in which the dominant was not switched. Results indicated that subjects approached and retrieved more food when the dominant had been switched than when she was not switched, thus demonstrating their ability to keep track of precisely who had witnessed what. Additional experiments ruled out the possibility that subordinates used cues from the dominant’s approach to decide which piece to approach, or that subordinates simply preferred food pieces lying close to barriers. The chimpanzees’ preference for the piece close to the barrier disappeared when the opaque barrier was replaced by a transparent one.

Despite the range of problems that chimpanzees were able to solve, it could still be argued that they were confined to a single paradigm, and therefore, lack generality. However, other recent studies show that chimpanzees have a more sophisticated understanding of visual perception in others that is extensible to other problems as well. Namely, chimpanzees follow the gaze of conspecifics and humans (Tomasello et al. 1998) including eye direction alone (Whiten 2000), follow it past distractors and behind barriers (Povinelli & Eddy 1996a; Tomasello et al. 1999), and ‘check back’ with humans when gaze following does not yield interesting sights (Call et al. 1998). They use gestures appropriately depending on the visual access of the recipient (Tomasello et al. 1994, 1997b), with some evidence suggesting that they attach special importance to the recipient’s face and eyes rather than just their body orientation (Call & Tomasello 1994; Gómez 1996). Finally, chimpanzees and the other great apes also know what they themselves have and have not seen (Call & Carpenter 2001; Call 2003). When they did not have visual access to the baiting procedure, apes preferentially look inside tubes with food before choosing. If they had not seen where the food was placed they looked and then chose a tube, whereas if they saw where the food was deposited, they simply chose, without looking first.

Taken together, these results show that at least chimpanzees know what others can and cannot see, and they can use this knowledge to predict others’ behaviour. It makes the claim of cues, even remembered cues, unlikely and opens the possibility that subjects are using some deeper level of understanding of social cues than simply learning fixed rules for specific problems.

### 3. The Problem of What Others Intend

Another problem faced by individuals engaged in social exchanges has to do with properly interpreting the behaviour of groupmates. Given the central role that social exchanges (including communicative displays) have in regulating the behaviour of animals, this is no trivial matter. For example, imagine a situation in which a human is offering food to a chimpanzee through a hole in a Plexiglas partition. In one condition, the human holds a grape, brings it close to the hole and when the ape is about to take it, the human pulls the grape away. Then the human again brings the grape close to the hole and again when the ape is about to take it, the human pulls the grape away. Once again, the human brings the grape closer to the hole and tries unsuccessfully to introduce the grape through the hole so he pulls the grape away from the hole and so on. Adult humans watching these two situations would interpret the behaviour of the human in the first situation as unwilling whereas the human in the second situation would be judged as unable to share the food with the ape. Are chimpanzees also capable of making such a distinction? A recent study shows that chimpanzees do distinguish between the two (Call et al. 2003a). Chimpanzees spontaneously (without training) gestured more and left the testing station earlier when the experimenter was unwilling compared with unable (but willing), despite the fact that they were not differentially rewarded in these conditions.

As was the case in the previous section, it is possible that subjects are just using superficial cues tied to this particular situation rather than interpreting the behaviour of the experimenter. Two arguments, however, undermine this possibility. First, the experimenter’s actions were superficially highly similar in the two different kinds of
situation. Namely, both involved a back-and-forth motion of the grape and the same pattern of looks at the ape’s face. Second, we found the same pattern of results in other situations: for example, one that compared the experimenter nibbling at the grape (unwilling condition) compared with attempting to extract the grape from a transparent tube (unable condition). Therefore, the variety of different situations involved makes a discrimination on the basis of specific perceptual cues less unlikely. Nevertheless, it should be noted that results only held for those conditions in which the experimenter directed an overt behaviour of one kind or another to the food (i.e. as opposed to conditions in which he did not touch the food). For instance, chimpanzees did not distinguish between a human staring at them, with the grape placed on the platform (unwilling condition), and a human in the same posture but scratching their body with both hands (unable condition).

There is other research that supports the idea that apes interpret the behaviour of others. In their seminal study, Premack & Woodruff (1978) showed the language-trained chimpanzee ‘Sarah’ videotapes of human actors coming upon obstacles in problem-solving situations. For example, Sarah saw a human looking up to an out-of-reach banana hanging from the ceiling, or a human wishing to exit through a locked cage door. The videotape was then stopped and Sarah was presented with a pair of pictures, one of which represented, from the human point of view, a solution to the problem: such things as the person mounting a box under the banana or unlocking the cage. In general, Sarah performed in a seemingly insightful fashion on these tasks. Premack and Woodruff argued that Sarah’s success constituted evidence that she ‘recognized the videotape as representing a problem, understood the actor’s purpose, and chose alternatives compatible with that purpose’.

Moreover, Call & Tomasello (1998) trained chimpanzees and orang-utans to use a marker placed on top of one of three opaque containers to identify the container where the food was located. During training the apes never saw the human actually placing the marker on the container, but the marker was already on top of one of the containers when they were presented to the subject. On test trials a human experimenter then placed the marker on one of the containers intentionally, but either before or after this he let the marker fall accidentally onto one of the other containers. The marker was removed at the time of choice of the subject, so for test trials the subject was faced with a choice in which one container had been marked with the marker intentionally and the other accidentally. Apes as a group chose the container that was marked intentionally, although no individual except a language-trained orang-utan was above chance on his own.

Taken together, these results suggest that chimpanzees may not just perceive the behaviour of others, they also interpret it, which is a more abstract operation than just perception. Results are not as compelling as those in the previous section (and there are several negative results (e.g. Povinelli et al. 1998; Premack 1988)), but it is also true that fewer studies have been devoted to the topic of intention compared with the topic of visual perception in others. Nevertheless, this evidence is suggestive and deserves further scrutiny.

4. TWO INTERPRETATIONS IN SOCIAL COGNITION

Chimpanzees know quite a lot about visual perception in others. They follow gaze behind barriers, use visual gestures when others are attending, take food that dominant animals cannot see or have not seen, and they also know when they themselves have not seen something. Chimpanzees also seem to interpret others’ behaviour, not just perceive it, albeit the supporting evidence is more fragile than in the case of knowledge about visual perception in others. There is evidence suggesting that they know when somebody is unwilling or unable, when someone has a problem, and they can also discount accidental actions.

Debates regarding the interpretation of these results have often taken one of two positions. Whereas some researchers propose low-level explanations for the observed phenomena based on stimulus–response associations, others favour high-level explanations based on metarepresentational mechanisms such as false belief attribution. I think that neither of these two explanations is fully satisfactory. The low-level explanation is unlikely owing to the current evidence available against it, whereas the high-level explanation is not proved precisely because of the lack of the appropriate evidence. Next, I review each position in greater detail.

One possible interpretation of these results is that chimpanzees have learned cues and fixed rules to solve these various problems. However, there are three arguments, all anchored around the notion of flexibility, that make the interpretation of learning of fixed rules unlikely. First, chimpanzees solve novel tasks and they do so in a way that contradicts the fixed rules that we and others have put forward to explain the phenomena (Tomasello & Call 1997; Hare et al. 2000; Povinelli 2002). For instance, when competing for food with a dominant animal, chimpanzees treated transparent and opaque barriers very differently. They took food preferentially from behind opaque barriers, not transparent ones, presumably because they knew the food was hidden from the dominant behind opaque barriers, not transparent ones. This differential treatment of the two types of barrier occurred even though they had not previously experienced transparent barriers in such a situation and they knew about the solid properties of a transparent barrier.

It can still be argued that the tasks are not sufficiently novel, that chimpanzees may have encountered similar situations in the past, and that is why they are capable of solving them. Leaving aside the non-trivial issue of determining what constitutes a novel task, learning explanations of this kind are often invoked but rarely demonstrated (see below). It is very hard to determine what constitutes a novel task for a chimpanzee. Keeping a precise record of all the experiences a chimpanzee has before the presentation of a given task is unrealistic unless the study is done with very young infants. Restricting the range of experiences is another strategy that has been used to control the amount of input subjects receive, but this strategy compromises the validity of the findings precisely because of the restrictive input of information.

A second argument against the explanation of learning fixed rules is that chimpanzees solve multiple problems in a variety of situations. Here, we have to postulate either that they learn a fixed rule for each problem or that they
develop a more abstract notion that can be used across a variety of related problems. This more abstract notion is similar to the idea of an intervening variable that Whiten (1994, 1996) has used to discuss the issue of ‘mindreading’ in animals. Whiten argued for postulating a one-to-one correspondence between sets of stimuli and responses, another possibility being that a set of stimuli produces a common intervening state, which in turn regulates various responses. For instance, chimpanzees would not merely learn to respond in certain ways to certain types of barrier but would also develop an intervening variable about their conspecific’s perceptual experience. This would be a more economical model—with fewer links between potential stimuli and responses than one with a one-to-one correspondence between stimuli–response sets.

Third, elsewhere I have used an argument by analogy with physical cognition (Call 2001) and argued that it would be surprising to find no abstraction in the social arena given that apes and other animals show ample evidence of abstraction (i.e. going beyond the information perceptually available and operating on representations) in areas such as categorization, numerical competence or spatial reasoning.

Turning now to the high-level explanation, various studies have shown that at least chimpanzees (and presumably other apes) know what they have seen and they know what others can or cannot see. Likewise, they make some inferences about others’ motives to interpret certain behaviours. Some researchers may be tempted to translate this into a strong theory of mind and metarepresentational account. That is, chimpanzees know what others know, believe or intend. Currently, however, there is no study that can distinguish between these mental states and others. For instance, those studies that suggest that individuals make inferences about others’ knowledge (Hare et al 2001) can also be interpreted as instances of making inferences about others’ visual access, not necessarily knowledge. Although both seeing and knowing are psychological states (see Call & Tomasello (2003) and Tomasello et al. (2003) for a more detailed discussion), they differ in the degree of abstraction that they entail. Whereas perceptual information is a key component of seeing, such perceptual support is less relevant in the case of knowing. Individuals may represent the idea of seeing by visualizing someone facing in a certain direction and observing a given event. Knowing is harder to represent at such a perceptual level. This is why epistemic mental states such as knowing are often referred as more opaque than perceptual mental states such as seeing. An analogy with the area of categorization may help to clarify the distinction between seeing and knowing and the different level of abstraction that they represent. Perceptual categories would be analogous to seeing whereas conceptual (or functional) categories would be analogous to knowing.

If knowledge is not equivalent to seeing, it is also important to point out that seeing is not equivalent to purely observable behaviour. Seeing, like knowledge, is a psychological state, not just memorized observable behaviour. Again, using the analogy with categories can help illustrate the difference between seeing and observable behaviour. Seeing, like perceptual categories, allows individuals to solve problems with new exemplars of a given category, whereas purely observable behaviour, like rote memory, only allows individuals to remember previously seen exemplars. If subjects just understand seeing as ‘someone facing in a certain direction’ they would treat a dominant facing an opaque barrier equally to a dominant facing a transparent barrier: but they do not (Hare et al. 2000).

5. LEVELS OF ABSTRACTION IN SOCIAL PROBLEM SOLVING

Previously I have argued that neither the low-level nor the high-level explanations for social cognition in chimpanzees are fully satisfactory. On the one hand, current evidence suggests that apes do more than stimulus–response associations. On the other hand, there is no evidence that they necessarily use metarepresentation of the kind that allows children to solve false belief attribution. Instead, we have argued that a third kind of explanation that falls between these two extreme alternatives can be useful (Tomasello & Call 1997; Call 2001; see also Suddendorf & Whiten 2001). It is precisely here that the notion of social abstraction can play a key part in explaining the current results, at least at the heuristic level. Based on the evidence available, one can distinguish four different levels of abstraction based on the use of: (i) cues, (ii) fixed rules, (iii) generalized rules, and (iv) concepts. Although only the last two levels represent true cases of abstraction, the two initial levels (cues and fixed rules) are included here for purposes of comparison. To present the various levels of abstraction, first I define them and provide examples in physical cognition tasks, and later I use the same mechanisms to sort out some of the examples reviewed in the previous sections of this paper.

First, the use of cues consists of adjusting the behaviour after detecting a certain stimulus feature. For instance, in colour discrimination, subjects learn to select the red cup, which is always baited, as opposed to the blue cup that is always empty. Second, the use of fixed rules consists of adjusting the behaviour depending on a conditional discrimination. For instance in matching to sample, subjects learn a rule to select the alternative that matches the sample; that is, if the sample is a circle, pick the circle, not the square, and vice versa. Note that in this case, like in the previous level, subjects can respond appropriately to specific stimuli that they have encountered before. Subjects presented with a pair of novel stimuli (e.g. a star and a polygon) would not know how to respond. Third, the use of generalized rules represents an extension of the previous mechanism. In this case, however, subjects are able to apply the rule to novel stimuli. For instance, in matching to sample, this would mean that subjects are able to correctly select alternatives that match the sample that are presented for the first time. Fourth, the use of concepts consists of generalizing not only across stimuli but also across problems. For instance, those subjects who match to sample based on similarity would be able to show that they have the concept of sameness if they, for instance, sorted a set of stimuli into groups of identical stimuli, or were able to solve analogies using the relationship between pairs of stimuli, not simply stimuli alone.

Current evidence regarding knowledge about what others can or cannot see suggests that chimpanzees can use all these levels, not just cues and fixed rules. First, the
use of cues is illustrated by the fact that chimpanzees can be trained to use gestures towards experimenters depending on whether their face is visible (Povinelli & Eddy 1996b). Second, the use of fixed rules in the form of conditional discrimination can also be illustrated with a gestural example. For instance, chimpanzees and orangutans respond to the frontal orientation preferentially when the face is also oriented towards the subject, but not when the human has the face turned from the subject or the face is towards the subject but the front is away from the subject (Call et al. 2003b). Third, the use of generalized rules can be found in other paradigms such as gaze following or food competition. In particular, subjects follow gaze geometrically around different types of barrier (Tomasello et al. 1999). Similarly, in food competition they solve problems with different kinds of barrier, some of which they have never experienced before (Hare et al. 2000). Finally, there is also evidence for the use of concepts because subjects not only can generalize across stimuli within particular problems, they can also generalize across problems. Their knowledge about seeing in others is shown across various problems including gestural communication, foraging, gaze following and food competition.

Taken together, the findings of these various problems suggest that chimpanzees have some knowledge about what others can or cannot see. This knowledge can be characterized as having a concept of seeing in others, an abstract appreciation of others’ behaviour, not just a recollection of remembered cues, behaviours or fixed rules. Nevertheless, there are still many questions that remain unresolved. As mentioned before, previous studies have shown that chimpanzees know what others can and cannot see (this corresponds to level 1 visual perspective taking in Flavell’s (1985) account). But other aspects such as perspective taking (how an individual would see an object from a given perspective) or whether individuals recognize that others can be attending to two different aspects of an object (e.g. colour versus shape) remain totally unexplored. Not to mention the distinction between seeing and knowing that was previously mentioned, it is still unresolved.

By presenting the view that social abstraction, including the use of concepts, is an important part of social cognition, I do not mean to deny that individuals also use fixed rules or arbitrary cues. On the contrary, there is evidence that chimpanzees do this as well (Povinelli & Eddy 1996b; Tomasello et al. 1997a; Reaux et al. 1999). Rather, it is intended that the use of fixed rules and more abstract constructs is considered as part of their social cognitive skills. Just focusing on only one of these two aspects is misleading and it is more fruitful to consider both sets of mechanisms and investigate their levels and the interplay between them. Clearly, the development of social abstraction does not replace other mechanisms. Instead, the different mechanisms complement and compete against each other.

6. WHY DOES THE EXPRESSION ‘SOCIAL ABSTRACTION’ SOUND ODD?

As indicated at the beginning of the paper, it may seem rather strange to invoke abstraction to explain social behaviour. In this final part of the paper I will argue that this oddity is simply a result of the little penetration that, until now, the notion of abstraction has had in social cognition, not necessarily a reflection of the inadequacy of the notion of abstraction applied to social cognition. There are two reasons that, in my view, partly explain the current state of affairs.

The first reason is that abstraction was developed and is mostly used in the area of physical cognition. It is commonly used to denote things like a set of invariant features of objects (or pictures), the properties of certain mental processes, or the essence of a set of particular exemplars (see other papers in this issue). It is rarely used to analyse social behaviour. But, in the same way that objects can be thought of as the elementary particles of physical cognition, behaviours can be thought of as the natural and elementary particles of social cognition. In other words, behaviours are the raw material for social cognition, and therefore, any exercise at social abstraction should have its starting point in behaviour.

The second reason that explains the little development of social abstraction is the prominent part that certain mechanisms such as rote learning have played in explaining a variety of phenomena in animal cognition as a whole, not just animal social cognition. The recourse to mechanisms such as trial-and-error learning as opposed to more cognitive constructs such as insight has a long history in psychological research. One of the main reasons why learning explanations are often favoured is because of their simplicity and the fewer assumptions they make. However, invoking learning as the explanation for certain phenomena also involves making three important assumptions that can be traced to three specific historical events.

One assumption is that chimpanzees learn fixed rules and use even subtle cues with ease. The recourse to such superficial explanations began with ‘Clever Hans’, the horse that outsmarted several scientists of the time by making them believe he could perform complex mathematical operations when in reality he was good at reading superficial cues from his audience (Pfungst 1911). Since then, the belief that animals, including chimpanzees, regularly use subtle cues has been very widespread among scientists. I have often met with scepticism when I mentioned that our experiments showed that apes were not so skilful at reading simple cues such as pointing or looking to find hidden food in one of two containers (Tomasello et al. 1997a; Call et al. 1998, 2000), and these studies only involve simple, easily perceivable cues. The problem of learning more complex conditional rules (or subtle ones) in the social arena is probably even harder to master. In fact, Woodruff & Premack (1979) found that chimpanzees took hundreds of trials to learn to indicate food for a cooperative trainer that shared the food with the chimpanzee and to withhold or deceive a competitive trainer that kept the food for herself. Even though both trainers wore distinctive clothing and behaved in predictable ways, it took hundreds of trials to make the distinction and some chimpanzees never did. This is not to say that they cannot learn such cues, it is just that it is not a foregone conclusion that they do in each case.

Another assumption is that even if other mechanisms besides rote learning can explain the result, it is likely that learning does it. For instance, if a given result could be
obtained either through classical conditioning or reasoning, classical conditioning is often the favoured explanation. This, however, represents a misuse of Morgan’s cannon (Morgan 1894), which states that higher psychological mechanisms should not be used to interpret behaviours that could be explained by lower psychological mechanisms. Leaving aside the very thorny issue of measuring psychological complexity, Morgan’s cannon is a healthy practice, but it is also important to realize that an excessive reliance on such practice without fresh data acting as a counterweight may lead to gross oversimplifications of the phenomena under scrutiny. Quite often results such as those reported in this paper tend to be explained by referring to mechanisms such as conditional discrimination of fixed rules, but no research is conducted to ascertain this possibility.

A third assumption is that learning is often used as a synonym of lack of insight or understanding into a problem. That is, if learning is involved in the solution of a problem, there is no possibility that insight is also involved. This state of affairs has its roots in the Thorndike–Köhler debates that took place in first quarter of the last century (Thorndike 1898; Köhler 1925). Learning was viewed as the mechanistic non-cognitive route to problem-solving whereas insight represented the holistic cognitive alternative. Although an individual may learn a skill with little understanding of its causal structure (without insight), learning to acquire a certain skill does not necessarily mean that individuals are devoid of any understanding or insight. There is no doubt that during development animals learn many things, and this learning is instrumental in acquiring knowledge. So learning per se is not the problem. The question is whether or not they learn, but what they learn and what they use those learning experiences for.

An example will help to illustrate the three assumptions at work. Povinelli et al. (1990) reported that chimpanzees passed a knowledge ignorance test in which they had to choose between two experimenters that had had different visual experiences. One experimenter witnessed the baiting of one of four cups whereas the other experimenter was outside the room when the baiting took place. Then both experimenters pointed to one of the cups and the chimpanzee had to decide which experimenter’s advice (the knowledgeable or the ignorant) she would follow to find the food. After hundreds of trials chimpanzees significantly selected the knowledgeable over the ignorant experimenter. In a transfer test, both experimenters stayed in the room but the ignorant one wore a paper bag over his head so that he was prevented from witnessing the baiting, but in a different way. They found that chimpanzees again significantly preferred the knowledgeable experimenter, this time in far fewer trials than in the initial experiment. Heyes (1993) argued that learning still may have been at work because chimpanzees may have learned a simple fixed rule such as ‘pick the human who did not wear a paper bag over the head’ and urged the authors to check the performance of the chimpanzees in the initial trials of the transfer test. Povinelli (1994) reanalysed the data for the initial trials and found that chimpanzees did not perform above chance in the first five trials. Heyes (1994) concluded that conditional discrimination could explain the results and that there was no need to invoke mental state attribution. This is also the conclusion that Povinelli seems to favour in his latest writings (Povinelli et al. 1994; Reaux et al. 1999).

This example illustrates the fulfilment of the three assumptions: (i) learning of cues could explain the result; (ii) although other mechanisms could be implicated, learning was favoured; and (iii) learning did not involve any insight. However, it is imperative that these assumptions be tested because otherwise the observed phenomena may be grossly oversimplified. In particular, the cue-learning-based explanation should be directly tested against the knowledge-based explanation because potentially interesting results are often dismissed simply because rote learning could be at work. Povinelli (1994) proposed one such test but, to the best of my knowledge, nobody has done it.

One way to test those assumptions would have been to compare the critical situation with a situation in which the superficial cues remained the same but without its underlying causal structure. For instance, one could compare how long it took chimpanzees to learn to use the experimenter who did not wear a paper bag over her head in the set-up of Povinelli et al. (1990) with how long it would take them to learn that an experimenter who wore a paper bag over her head was unreliable compared with one who did not wear anything in a second scenario in which subjects were prevented from witnessing the baiting phase. Note that witnessing the baiting phase (with the knower seeing where the experimenter placed the food) is what makes the paper bag over the head a critical piece of information. It is entirely possible that subjects would take longer to learn to use the paper bag cue in this second scenario because the cue is only arbitrarily connected to the reward: there is no reason why the cue should have any significance. By contrast, this cue is fundamental to understanding why in the set-up of Povinelli et al. (1990) one of the experimenters is reliable and the other is not. In this case, the cue is causally connected with the structure of the problem. If subjects made a distinction between those cues that hold an arbitrary relation compared with a causal one, this would suggest that the improvement in performance cannot be accounted for solely by invoking cues, fixed rules or contingencies. Instead it would mean that subjects understand something about the situation, something more abstract than the cues available in the situation, although perhaps not as much as an adult human of a certain age would understand.

7. Conclusion

I have argued that learning fixed rules and cues is insufficient to account for the results of two problems that chimpanzees face in the social arena. In the same way that many animals do not simply learn particular exemplars in physical cognition tasks, but instead use abstract concepts, I argue that chimpanzees (and possibly other animals) do not only learn fixed social rules but also develop social abstraction in the form of social concepts about some of the psychological states of others. In other words, our working hypothesis is that chimpanzees (and possibly other social animals) possess knowledge about their social environment. Ultimately, rule- or cue-based explanations should be directly tested against knowledge-based
explanations because there is the widespread belief that the former alone explain a variety of phenomena in the social arena when this may not necessarily be the case. Whether social abstraction and social concepts are the same in nature as those in areas of physical cognition like categorization is an open question. Further research will be necessary to uncover the similarities and differences in conceptual knowledge in physical and social cognition.

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REFERENCES


Call, J., Hare, B. H., Carpenter, M. & Tomasello, M. 2003a Unwilling or unable: chimpanzees’ understanding of human intentions. Dev. Sci. (Submitted.)

Call, J., Kaminski, J. & Tomasello, M. 2003b Apes know when they are being watched. Anim. Cogn. (Submitted.)


Hare, B., Call, J. & Tomasello, M. 2001 Do chimpanzees know what conspecifics know and do not know? Anim. Behav. 61, 139–151.


