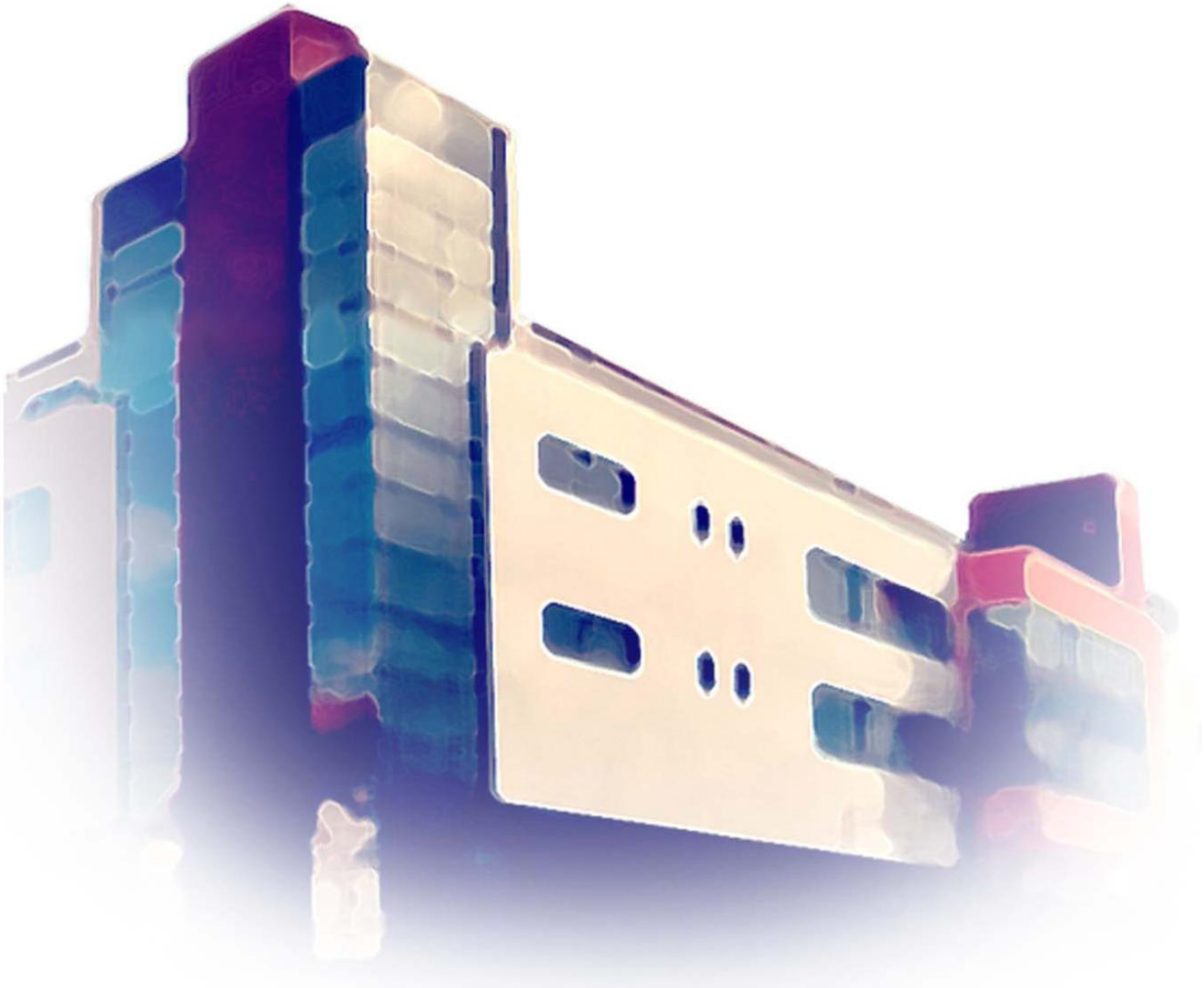
Nicole Troxler

Theory of Mind in Chimpanzees - An Overview of the Recent Debate



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Theory of mind in chimpanzees – An overview of the recent debate

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Contents

1 Introduction

In their seminal paper *Does the chimpanzee have a theory of mind?*, Premack and Woodruff (1978) tried to determine whether chimpanzees can recognize the mental states of others and then use this information to predict their behaviour. According to Premack and Woodruff, animals that possess this capacity can be said to have a theory of mind. Because chimpanzees are social animals which live in groups with a complex social structure, the ability to foresee the reactions of conspecifics is essential for them. Only an individual that can predict another individual's next actions is able to react appropriately in a given situation. Thus, the question raised by Premack and Woodruff is not whether chimpanzees are particularly skillful in social interactions because they definitely are. Instead, Premack and Woodruff ask which cognitive processes underlie the chimpanzees' social behaviours. Do they reason about the behaviour of others in the same way as humans do, that means in terms of mental states? Do they think about what others believe, what they want or what they may know?

In order to find some evidence for the chimpanzee's ability to attribute mental states, Premack and Woodruff designed an experiment which required the subject to recognize the intentions of a human actor. They showed Sarah, an adult female chimpanzee, several short video sequences of a human struggling with different problems. After every video, Sarah was confronted with two pictures, one of them showing a way to solve the problem she had just seen in the video sequence, the other one showing an action that would not constitute a solution to the problem. Sarah's task then was to choose the correct picture, thereby demonstrating that she understood the intention of the actor and the problem he was facing. As a matter of fact, Sarah was able to choose the correct picture in twenty-one of twenty-four trials and Premack and Woodruff took this as evidence for Sarah's ability to attribute mental states, like intentions and beliefs, to the human actor. Some critics noted that there were other possible explanations for Sarah's performance which did not require her to understand the actor's intentions. As Sarah was familiar with the actions shown in the video, she might have just chosen the picture which depicted the next step in a well-known sequence of actions (Savage-Rumbaugh et al., 1978). However, despite this critcism, Premack and Woodruff's experiment aroused a great deal of interest among psychologists and philosophers. In the last decades, researchers became more and more interested in the evolution and ontogenesis of what Premack and Woodruff had denoted theory of mind. Today a lot can be said about the development of mental state attribution in children but after three decades of research there is no generally accepted answer to the question posed by Premack and Woodruff. On the contrary, whether chimpanzees can reason about others' mental states is topic of a vigorous debate. This can be seen by looking at

the current research of two of the most prominent research groups in this field which come to very different conclusions.

Michael Tomasello and his colleagues from the Max-Planck Institute for Evolutionary Anthropology in Leipzig are convinced that chimpanzees can understand simple mental states but not more complex ones (Tomasello et al., 2003a; Call and Tomasello, 2008). According to Call and Tomasello, the available empirical evidence clearly suggests that chimpanzees can understand what others perceive. For instance, it was found that when competing with a conspecific for food, chimpanzees take into account what their opponent has seen or not seen (Hare et al., 2000). Call and Tomasello also cite evidence for the chimpanzee's ability to recognize his conspecifics' goals and intentions. However, it seems that chimpanzees probably do not have the same theory of mind capacities like humans because they do not show any understanding of false beliefs. Call and Tomasello thus conclude that chimpanzees understand some mental states but not all of them. According to Daniel Povinelli and his colleagues from the University of Louisiana at Lafayette, this conclusion is not warranted. They claim that up to now no experiment could demonstrate that chimpanzees attribute any mental state to either humans or conspecifics (e.g. Povinelli and Vonk, 2003; Penn and Povinelli, 2007). They believe that the experiments conducted by Tomasello and his colleagues suffer from severe methodological shortcomings and that, as a consequence, the experiments do not show what they are supposed to. According to Penn and Povinelli, recent findings rather indicate that chimpanzees are not able to reason about mental states at all.

In the following, I will give a comprehensive overview of the experimental work and argumentations of both research groups. I will first present the experiments from Leipzig which are thought to prove that chimpanzees can understand others' visual perception and intentions. Then I will outline the criticism of Povinelli and his colleagues and explain why they think that the experiments by Tomasello and his colleagues cannot provide conclusive evidence for the chimpanzees' ability to understand others' mental states. After that, I will summarize the debate that followed this critique. In particular, it should become clear to the reader why Tomasello and his colleagues are convinced that a mentalistic interpretation of their findings is warranted and why the researchers from Louisiana disagree. Finally I will evaluate the presented arguments and argue that the differences between the two research groups are not as irreconcilable as commonly believed.

2 Evidence for the chimpanzees' understanding of mental states

In this section, I will provide an overview of the recent work of the Leipzig group. I will begin with some studies about the chimpanzees' understanding of visual perception and continue with three studies about their understanding of goals and intentions. Then I will present a study about the chimpanzees' understanding of false beliefs which yielded negative results. Finally, I will put all this together and summarize what Tomasello and his colleagues conclude from these different studies about the chimpanzees' understandig of others' mental states.

It is noteworthy that in their comprehensive survey of the current literature on primate cognition, Tomasello and Call (1997, pp. 340-341) state that chimpanzees probably do not have a theory of mind. Although Tomasello and Call admit that there is not much evidence available they reason that given the evidence provided by the few experiments that were conducted to investigate whether chimpanzees can attribute mental states there is no reason to assume that they can. A few years later, however, Tomasello and Call, together with Brian Hare, published a paper entitled *Chimpanzees know what conspecifics do and do not see* in which they present evidence for the chimpanzees' ability to understand the visual perception of others (Hare et al., 2000). Following Premack and Woodruff, to have a theory of mind means first and foremost to understand the intentions and beliefs of others. However, the ability to understand what others see is a prerequisite for this kind of understanding. First, in order to know what another person believes, one must understand what she perceives and has perceived in the past because a person's beliefs are based on her perceptions. Second, in order to understand what a person intends, it is necessary to know what she believes. Therefore, any organism that is seriously considered as a candidate for having a theory of mind must understand how an individual's perception alters her state of knowledge.

2.1 Understanding others' visual perception

Povinelli and Eddy (1996) conducted a series of studies in which they investigated whether chimpanzees understand the concept of seeing. They found that while begging for food from a human experimenter, chimpanzees were not able to distinguish a seeing experimenter from an ignorant one. When confronted with two experimenters, one wearing blindfolds over his eyes, the other wearing blindfolds over his mouth, the chimpanzees begged indifferently from both experimenters. The same happend in another task condition where one experimenter was holding a bucket over his head and the other one was holding the bucket just *next* to his head. Although the chimpanzees learned to respond correctly after several hundred trials, careful control tests revealed that the chimpanzees did not discriminate which exper-

imenter could see them. Instead, they learned to behave according to the following behavioural rules. They started to beg from the person whose front was visible. When both experimenters turned their back or when both fronts were visible, the chimpanzees begged from the person whose face was visible. When the faces of both experimenters were partly concealed, they begged from the person whose eyes wer visible. Although these results showed that the chimpanzees were able to learn a fairly complex set of hierarchical rules, it also demonstrated that they did not understand the basic principles of visual perception.

However, this complete lack of understanding visual perception appeared peculiar to many researchers given the fact that chimpanzees reliably follow the gaze of humans and conspecifics (see Call et al., 1998; Tomasello et al., 1998). Tomasello et al. (1999) found that chimpanzees even follow the gaze of a human experimenter around barriers and to a location behind their back. For that reason, Hare et al. (2000) wanted to further investigate the possibility that chimpanzees understand what others can see. However, in contrast to previous studies, Hare et al. considered it important to develop a task that was more natural for the apes. The idea was that there might be other reasons for the chimpanzees' unsuccessful performance in former studies than their lack of understanding of visual perception. Hare et al. reasoned that the failure of the chimpanzees might be due to the fact that their life in general is dominated by competition between group members rather than by cooperation. It is highly unlikely for chimpanzees that they will ever encounter a situation in which a conspecific purposely offers them a piece of food or even tries to help them to find one. Therefore, chimpanzees may find experimental settings in which they are expected to understand the cooperative communicative intent of a human experimenter very unintuitive. In order to circumvent this problem, Hare et al. designed an experiment in which the subjects competed for food with one of their groupmates.

2.1.1 Chimpanzees choose the food that their competitor cannot see

At the beginning of the experiment, the subject, a subordinate chimpanzee, and his competitor, a dominant, waited in two opposite rooms adjacent to a middle room. After an experimenter had placed two pieces of food in the middle room, the connecting guillotine doors were slightly opened such that both chimpanzees could now see into the middle room. Whereas the subject could see both pieces of reward, the dominant could only see one. From his viewpoint the other piece of food was hidden behind a small barrier. Then, after a few seconds when both chimpanzees had looked through their respective doors, the subordinate was released into the middle room. After he started to approach one of the food items, the dominant's door was fully opened too. Hare et al.'s main finding was that the subordinates approached the piece of food that only they could see significantly more often than

the piece which was visible to both competitors. As a consequence, they obtained more food in this condition than in a control condition where both competitors could see both pieces. Accordingt to Hare et al., this shows that the subordinates understood that the dominant could not see the food item next to the occluder and that it was therefore safe for them to go for it. Although other explanations of the chimpanzees' performance are conceivable, Hare et al. argue that the following two points speak in favour of their interpretation.

First, the behaviour of the subordinates cannot be explained as a mere reaction to the dominant's behaviour. In the moment the subordinates had to decide what to do, their competitor was not yet released and there was no intimidating behaviour from the dominant. In addition, the experiment was replicated a few months later in a slightly modified version where the dominant's door was closed after the baiting until the subordinate made his decision and started to approach one of the food items. In this case, the subordinates thus could not even see the dominant when they decided where to go but they still showed a strong preference for the hidden food. Second, in another control experiment a different type of occluder was used. This time the small barrier was transparent and thus did not obstruct the dominant's sight. Hare et al. found that the subordinates immediately adjusted their strategy and no longer demonstrated a preference for the piece of food next to the occluder. Therefore the possibility that the subordinates for some reason tended to approach food items next to some barrier could be excluded. The subjects rather exhibited a capacity for adapting their behavior to the current situation, thus indicating that they acutally understood the different properties of the two types of occluder and the effect they had on the perception of their competitor.

Hare et al. thus conclude that the subordinates really understood what their competitor could see. Compared to the mostly negative findings of previous studies investigating chimpanzees understanding of visual perception (e.g. Povinelli et al., 1990; Povinelli and Eddy, 1996), the findings of Hare et al. were very promising. Therefore, Hare et al. (2001) conducted another serie of experiments to learn more about the chimpanzee's understanding of visual perception. In particular, they wanted to find out whether chimpanzees also can take into account what their conspecifics have seen in the immediate past. The key features of the experimental procedure were the same as in the previous study – competition instead of cooperation and a simple setting that required no training phase. In a first experiment, a dominant and a subordinate chimpanzee waited again in two opposite rooms while an experimenter hid some food in the room in between. However, this time the experimenter only placed a single piece of food behind one of two small barriers. Both chimpanzees could observe the baiting procedure, but the food was placed on the subordinate's side of the barrier so that only he could see it. In the test condition, the dominant's door then was closed and the experimenter took the piece of food and

put it behind the other barrier. In the control condition, the dominant's door was left ajar so that he could observe the relocation of the piece of food. Only then was the door closed until the subordinate entered the middle cage. The idea was that the subordinate should decide what to do without being influenced by any signals from the dominant. In a second experiment, both the subject and its competitor first watched the baiting and then the dominant's door was closed for a minute. In the experimental condition the dominant then was switched with another dominant individual before the door was raised again. In the control condition the dominant remained the same. After the subordinate was given the chance to see whether his competitor still was the same or not, the dominant's door was closed again and the subordinate was finally released into the middle cage.

It turned out that in both experiments the subordinates obtained the piece of food more often in the test condition than in the control condition. In addition, the subordinates refrained from approaching the piece of food more often when the dominant knew its true location than when he was misinformed. Thereby the subjects demonstrated that they were able to discriminate between the two conditions although in the very moment they had to decide whether to approach the food or not, the observable situation was exactly the same – in both conditions they could not see the dominant and there was one very desirable piece of food in front of them. According to Hare et al., this shows that the subordinates' behaviour is not just a reaction to some behavioural cues of the dominant. Instead, it seems that the subordinates can take into accout what their competitor has seen in the immediate past and thus one might say, what he knows. Furthermore, the subordinates seem to understand how the dominant's knowledge will affect his behaviour and they can use this information for their own advantage. However, Hare et al. note that these results do not imply that chimpanzees have the same understanding of visual perception like humans. In the experiments, the subordinates showed that they understand that they can see something which their competitor cannot see. Following Flavell (1985), this ability is called Level 1 perspective taking. Level 2 perspective taking is more advanced and includes an appreciation of the distinct impressions that two observers can have of the same object due to a different point of view. Whereas children start to understand this around the age of five, Hare et al. expect that Level 2 perspective taking would be too difficult for chimpanzees.

2.1.2 Chimpanzees understand that their competitor will pick the food he has seen being hidden

Povinelli and Vonk (2003) argue that the chimpanzees' performance in the studies of Hare et al. (2000, 2001) can also be explained without assuming that they understood what their competitor has seen. Povinelli and Vonk believe that the chimpanzees learned the following behavioural rule: If a dominant individual orients towards

a piece of food in particular location, then that food must be avoided. In order to rule out this alternative explanation, Kaminski et al. (2008) conducted another experiment in which the subjects competed with a conspecific for food. The two chimpanzees, the subject and his competitor, sat behind a Plexiglas wall on opposite sides of a table. On the table, there were three cups, two of them containing a piece of food. Whereas the competitor only knew the location of one food item, the subject could observe the hiding of both pieces and also whether his competitor could see the placement of a particular food item or not. After the baiting, either the subject or his competitor was allowed to pick a cup first. The other chimpanzee could only choose afterwards and he did not know which cup had been chosen by his opponent in the first round.

Kaminski et al. reasoned that if the subjects understood what their competitor knows, they would choose differently depending on whether they were allowed to choose first or second. In fact, the subjects picked the cup with the reward only they had seen significantly more often when they chose second. When they were allowed to choose first, they picked both food items equally often. According to Kaminski et al., this shows that the subjects inferred that their competitor probably already has taken the piece of food he had seen being hidden. Therefore, the subjects picked the cup with the unknown reward when they chose second but did not discriminate between the food items when they are allowed to choose first. These results cannot be explained by the behavioural rule posited by Povinelli and Vonk because according to this rule, the chimpanzees should avoid the piece of food their competitor has seen regardless whether they choose first or second which is not what they did. Kaminski et al. take this as corroborating evidence for the hypothesis that chimpanzees are able to infer what conspecifics have seen and that they can use this knowledge to form predictions about their conspecifics' future behavior.

2.1.3 Chimpanzees hide from their competitor

In another study of Hare et al. (2006), it was found that chimpanzees avoided to be seen by a human competitor when trying to steal a piece of food from him. In the experiment, the competitor sat in a plexiglas booth and two pieces of food were lying next to him, one on the left and one on the right side. The chimpanzees could approach the booth from either side and then reach through a hole to grab the food. However, when the experimenter spotted the chimpanzees attempt to take the food, he pulled it away. Hare et al. then presented the chimpanzees different variations of this basic experimental setting. In a first condition the experimenter turned his body either to the left or the right side of the booth and interestingly, the chimpanzees changed their behaviour accordingly. Whereas they had not shown a preference for approaching from one particular side before, they now were inclined to approach from the side where the experimenter could not see them. The same

was found for another condition where the experimenter turned his front to one side of the booth but his head to the other. In a third condition, the competitor's view to one side was blocked by a barrier. Again the chimpanzees avoided to come near the booth from the side where they could be seen.

According to Hare et al., taken together with the previous findings presented in this section, these results strongly suggest that chimpanzees can understand what others see, at least in some situations. By contrast, an explanation of the chimpanzees' behaviour in terms of behavioural rules that they might have learned appears questionable. The available evidence stems from different studies in which the chimpanzees were confronted with varying problems they had not encountered before. Thus, in order to account for all these results, one would have to postulate many different behavioural rules and each of them could only explain a small extract of the findings. In this case it seems just more plausible to assume a mentalistic explanation of the chimpanzees' performance.

2.2 Understanding others' intentions

As already mentioned at the beginning, in order to be said to have theory of mind, an organims has not only to understand what others perceive but also what they intend. In the following, I will thus present three experiments that the Leipzig group has conducted in order to determine what chimpanzees understand about the intentions of others. This kind of understanding is crucial because it allows an organims to predict what another individual is going to do, even in novel situations. The reason for the explanatory power of intentions is that behaviour usually is not a series of random unconnected movement. Instead, most of the time an individual's movements can be interpreted as actions directed towards a goal. As a consequence, behaviour becomes comprehensible in terms of an actor's underlying intentions, they can be seen as the causes for the observed behaviour. Therefore, only if one knows what kind of situation someone is trying to bring about, one can make an attempt to predict his next actions. It is the ability to understand anothers' intentions which allows an observer to see beneath the surface of the displayed behaviour and to speculate about its causes.

2.2.1 Chimpanzees help instrumentally

Warneken and Tomasello (2006) wanted to compare the helping behaviour of 18-month old infants and human-raised chimpanzees. They thus confronted infants and chimpanzees with various situations in which they had the opportunity to help an experimenter with some problem he was facing. There were different problem categories but for the chimpanzees only in one kind of situation an effect was found. In the out-of-reach task, the experimenter accidentally dropped various items on the

floor and then unsuccessfully reached for them. It was found that both chimpanzees and infants reliably picked up the objects and handed them over. However, in the control condition when the experimenter had thrown the objects on purpose, chimpanzees and infants refrained from helping. According to Warneken and Tomasello, the children's and the chimpanzees' behaviour clearly shows that they recognized which goal the experimenter was trying to achieve. They understood that he wanted to pick up the objects from the floor but that he could not reach them. They then decided to help the adult although he did not ask them to. That the children as well as the chimpanzees reacted differently in the control condition further indicates that picking up the objects was not an end in itself to them but that they actually intended to help the experimenter with a problem he encountered. The fact that the children in contrast to the chimpanzees also helped the experimenter in other, more complex situations could be explained by two factors. It might be that the children's understanding of others' intentions is more sophisticated. For instance, the infants opened the door of a cabinet when the experimenter was trying to put some magazines in it and his hands were not free. It is possible that the chimpanzees in this kind of situation did not understand what the experimenter was trying to do. One might speculate that the reaching gesture in the out-of-reach task is particularly easy to comprehend as it is a very natural and spontaneous behaviour that the chimpanzees know from themselves. However, it is also possible that the chimpanzees did very well understand what the experimenter was aiming for but that they were just less motivated to help than the infants.

2.2.2 Chimpanzees can discriminate whether an experimenter is unwilling or unable

Call et al. (2004) wanted to determine whether chimpanzees are able to distinguish two different intentions from superficially similar behaviour. They tested whether chimpanzees would show different reactions when an experimenter was either unwilling or unable to give them a piece of food. If the experimenter was unwilling, he simply refused to give the subjects a piece of food. By contrast, if he was unable, he attempted to hand the chimpanzees the food but did not succeed for some specific reason. To ensure that the experimenter's intentions were not invariably associated with one particular behaviour, there were different versions of both the 'unwilling' and the 'unable' situation. For example, in one condition the experimenter could not pass the chimpanzee a grape because the hole in the plexiglas wall between them was too small for his hand. In another condition he dropped the raisin by accident and it fell down so that he could not see it anymore. In some instances of the 'unwilling' situation the experimenter moved the grape toward the hole but pulled it back as soon as the chimpanzee tried to grab it, in other instances he put the grape on the table where the chimpanzee could see it and then waited. Furthermore, to control

that the chimpanzees' reactions were due to the different underlying intentions of the experimenter and not just due to some differences in his observable behaviour, the bodily movements of the experimenter in the 'unable' and the corresponding 'unwiling' conditions were kept as similar as possible.

Call et al. found that the chimpanzees discriminated between the experimenter's different intentions in some but not all of the presented conditions. It turned out that the crucial factor for this difference was whether the experimenter actively acted on the grape or not. In those conditions where the experimenter just sat there and did basically nothing, the chimpanzees showed quite similar reactions to his differing motivations. By contrast, when the experimenter was unwilling to give the chimpanzees the desired piece of food and held it up in front of them, the chimpanzees knocked on the glass or tried to squeeze their finger through the hole significantly more often than in the 'unable' situation where the experimenter tried to hand them the food. In addition, they also left the testing area earlier. Call el al. state that these results suggest that it is possible that chimpanzees recognize another individual's intentions. However, it seems that they easyily understand those intentions which are expressed in conspicuous behaviours but have difficulties with those which must be inferred from very subtle behavioural cues.

2.2.3 Chimpanzees can imitate rationally

Buttelmann et al. (2007) tested whether human-raised chimpanzees can imitate rationally. For that purpose they presented eight chimpanzees with the following situation. The chimpanzees were allowed to observe a human experimenter operating on some apparatus that could either make a sound or flash a light. The experimenter then triggered this effect by pushing a button but instead of using his hands, he used a rather odd body part like his forehead or his foot. In the 'hands free' condition there seemed to be no good reason for the experimenter's unusual behaviour. By contrast, in the 'hands occupied' condition the experimenter could not use his hands for some reason, e.g. because he was holding a bucket. The chimpanzees were then given the chance to inspect the apparatus and to manipulate it.

Interestingly, Buttelmann et al. found that the chimpanzees distinguished whether there appeared to be a reason for the experimenter's peculiar behaviour or not. When the experimenter pushed the light switch with his forehead because his hands were occupied, the chimpanzees rarely imitated his action but rather pushed the light switch with their own hands. However, in the 'hands free' condition of the same task the chimpanzees imitated the experimenter's action significantly more often. Following Gergely et al. (2002) who obtained the same results in a study with 14-months old infants, Buttelmann et al. explain the chimpanzees' performance by assuming that they understood the difference between a freely chosen action and one resulting from being constrained by circumstances. Apparently the chimpanzees

realized that in the 'hands free' condition there was no need for them to copy the behaviour of the experimenter because they were not constrained in the same way as he was. Only in the 'hands occupied' condition the chimpanzees found the experimenter's action worth imitating for some reason. It is also noteworthy that in most of the trials the chimpanzees first pressed the button with a different body part than that used by the experimenter. This shows that they did not believe that it was necessary to push the button in exactly the same way as demonstrated. They already knew how to bring the interesting effect of the apparatus about but nevertheless found it interesting to imitate the experimenter's behaviour. Buttelmann et al. state that these results can be seen as particularly strong evidence for the chimpanzees' ability to understand the intentions of others. By imitating more often in the 'hands free' condition, the chimpanzees demonstrated that they understood that different actions can serve as means to reach the same goal and that which action an individual perfoms is partly determined by the situational circumstances.

2.3 Understanding others' false beliefs

At last I will now present a study investigating another important element of having a theory of mind – the understanding of others' false beliefs. In theory of mind research with children, false belief tasks are well-established as a crucial test for a child's theory of mind abilities. In the classic false belief task designed by Wimmer and Perner (1983), an experimenter tells the subject the following story. 'Little Maxi puts a bar of chocolate in the cupboard and leaves the room. His mother then takes the chocolate out of the cupboard and puts it in the drawer. When Maxi comes back, he wants to eat a piece of chocolate.' The child is then asked: 'What do you think, where will Maxi now look for the chocolate?' Wimmer and Perner found that children younger than four years old usually give the wrong answer to this question – they say that Maxi will look for the chocolate in the drawer. The children do not understand that Maxi has a false belief about the location of the chocolate which will lead him to search for it in the wrong place. However, older children answer correctly that Maxi will search for the chocolate in the cupboard. They understand that a person's beliefs can differ from what they know to be real and they take this knowledge into account when predicting Maxi's actions. Therefore, an individual who is able to draw this kind of inferences is more successful in predicting another person's behaviour than one who does not understand false beliefs. In order to assess whether chimpanzees recognize that others can have false beliefs, researchers had to develop nonverbal versions of false belief tasks. I will now present an example of such a study.

2.3.1 Chimpanzees do not take advantage of a competitor's false belief

Krachun et al. (2009) developed a false belief task in which chimpanzees competed for food with a human experimenter. Following Hare and Tomasello (2004), Krachun et al. expect that the chimpanzees' most sophisticated cognitive abilities rather become apparent in tasks involving competition than in tasks which require them to cooperate with a human experimenter. They speculate that the chimpanzees' unsuccessful performance in previous false belief studies (e.g. Call and Tomasello, 1999) might be due to their inability to understand an experimenter's communicative intent. If this was true, the negative results of those studies must be interpreted with caution. In order to resolve this issue, Krachun et al. designed a task in which chimpanzees were supposed to understand a human's false belief in a food competition situation. In the experiment, a chimpanzee and a human competitor sat face to face on a table. On the table were two identical containers and both chimpanzee and human could observe how another experimenter placed a piece of food in one of them. However, before the baiting the experimenter put a small screen in front of the containers so that the chimpanzee was unable to see in which of them the reward was hidden. The chimpanzee could now only see his competitor who was carefully monitoring the baiting. In the 'false belief' condition the competitor then stood up and left the room. When he was gone, the experimenter quickly switched the locations of the two containers. After a while the competitor came back and tried to take one of the containers but they were out of reach. Next the subject was allowed to choose one of the containers. In the 'true belief' condition the procedure was basically the same but the experimenter only switched the containers when the competitor was back in the room and could observe it.

Krachun et al. reasoned that if the subjects understood the human's false belief, they should pick the opposite container than their competitor in the 'false belief' condition. The chimpanzees were supposed to infer the competitor's belief about where the food was hidden from his gesture. Taking into account that the experimenter had switched the containers in the competitor's absence, the chimpanzees should realize that the food now was in the container the human was *not* reaching for. By contrast, in the 'true belief' condition the subjects should reach for the same container as their competitor. What Krachun et al. found was that the chimpanzees did not choose differently in the 'false belief' condition than in the 'true belief' condition. In both versions of the task, the chimpanzees most often chose the same container as their competitor. Whereas this strategy worked very well in the 'true belief' condition, the chimpanzees did not profit from it in the 'false belief' condition. Krachun et al. conclude from these results that the chimpanzees had no problem with understanding the task in general but that they were unable to take into account their competitor's false belief, even though it would have been

beneficial for them. The competitive setting of the false belief task thus did not help to improve the chimpanzees' performance and Krachun et al. state that this might indicate that the understanding of others' false beliefs is an uniquely human ability.

2.4 Conclusions from the evidence presented

Taken together, the studies of Michael Tomasello and his colleagues seem to confirm the hypothesis that chimpanzees understand others' mental states at least to some extent. In particular, the evidence available suggests that chimpanzees can predict their conspecifics' behaviour by taking into account what others know and intend. They can use information about their opponent's perception and knowledge for their own advantage in various food competion situations. Furthermore, they can recognize the goals and intentions which underlie their conspecifics' behaviour. Thus, chimpanzees understand a lot more about others' mental states than previously thought. However, Krachun et al. (2009) have shown that chimpanzees probably do not understand more complex mental states like false beliefs. Which answer should then be given to Premack and Woodruff's initial question? Does the chimpanzee have a theory of mind or not? Call and Tomasello (2008) argue that this has now become a matter of definition. If one believes that only those organisms can be said to have a theory of mind which understand mental states in the same way as humans do, one must deny that chimpanzees have a theory of mind. The chimpanzees' understanding of mental states clearly is less sophisticated than that of humans. Nevertheless, it seems as if chimpanzees reason about simple mental states of others at least in some situations and thus, one could say that they have a theory of mind in a broad sense. With that said, Call and Tomasello conclude that we should not ask whether chimpanzees have a theory of mind but rather which mental states they understand and to what degree.

3 Critique of evidence

At first sight, the evidence for the chimpanzee's understanding of mental states may seem convincing. However, which conclusions can be drawn from the studies presented in the previous section has become the subject of a contentious debate. Daniel Povinelli and his colleagues from the University of Louisiana at Lafayette claim that all these experiments cannot show whether chimpanzees have the ability to attribute mental states or not (see Povinelli and Vonk, 2003, 2004; Penn and Povinelli, 2007). In this section I will thus provide an overview of their arguments. I will start by explaining why Povinelli and Vonk believe that the experiments we have encountered so far are hopelessly flawed. Then I will present a new experimental paradigm suggested by Penn and Povinelli which is supposed to overcome the shortcomings of the criticised experiments. At last, I will explain why Povinelli and his colleagues believe that the evidence available suggests that chimpanzees do not understand others' mental states at all.

The critique of the Louisiana group is first and foremost concerned with methodological and conceptual issues. Povinelli and his colleagues claim that the studies of the Leipzig group cannot resolve the issue whether chimpanzees reason about others' mental states because the experimental results can be interpreted in different ways. In order to understand this critique, it is important to remember what all the experiments conducted by Tomasello and his colleagues were supposed to show. The aim was not solely to examine the chimpanzee's social behaviour but to understand which cognitive processes underlie and generate that behaviour. The experiments should thus reveal what goes on in a chimpanzee's mind when he observes his conspecifics and interacts with them. The following questions must be answered – is the chimpanzee's behaviour best explained as the result of a reasoning process about mental states or are there other possible explanations? If more than one explanation is conceivable, which of them is then the most plausible one and why? The results of the experiments should enable researchers to reliably distinguish between different interpretations of the chimpanzee's behaviour.

With that said, the critique of the Louisiana group becomes more comprehensible. Povinelli and his colleagues argue that the experiments done so far do not provide a basis to differentiate between competing hypotheses. Although it is possible to explain the chimpanzees' behaviour in the experiments by assuming that they recognized others' mental states, it could also be that they solely reasoned about their behaviour. For example, in the studies of Hare et al. (2000, 2001) the chimpanzees chose the food that their competior could not see and thus it might be that they understood his visual perception. However, Povinelli and Vonk (2003, 2004) state that the same behaviour could also result from taking into account what the competitor did, in which direction he turned his head and whether he was present in

a particular situation. They conclude that therefore, on the basis of this experiments it is impossible to determine whether chimpanzees understand what others see or not. Certainly, a mentalistic interpretation of the chimpanzee's behaviour is feasible but whether it is also more plausible than a nonmentalistic one is far from clear. In fact, the difficulty to distinguish between different interpretations of animals' social behaviour is well-recognised and was discussed at length in the nineties. The question was whether observations of spontaneous behaviour of wild-living animals can provide evidence for their ability to attribute mental states. Heyes (1998) forcefully argued that they cannot because they are always open to multiple interpretations. I will now shortly present Heyes' arguments and then explain why Povinelli and Vonk believe that the same criticism applies to the experiments of Tomasello and his colleagues.

3.1 Mentalistic vs. nonmentalistic interpretations of observed behaviour

The debate about the significance of field observations for the question of nonhuman primates' theory of mind abilities was started by a book called 'Machiavellian intelligence' (Byrne and Whiten, 1988). Byrne and Whiten presented a collection of anecdotal reports of field researchers about spontaneous deceptive behaviour of wild-living monkeys and apes. One example they gave was that of a female baboon who started to groom a male that had just caught an antelope. Right after the male had settled back to enjoy the procedure, the female snatched the antelope carcass and ran away. Byrne and Whiten state that observations like those at least suggest the possibility that nonhuman primates can recognize the mental states of others (p. 238). The idea is that the behaviour of the female baboon could be interpreted as an instance of tactical deception. If the female had deliberately started to groom her conspecific in order to distract him, this would show that she was aware of what he can see and to what he pays attention.

Although this argument may appear justified at first sight, Heyes (1998, p. 107) pointed out that from anecdotal reports like the one just described it is not possible to distinguish whether the deceitful animal intended to alter its conspecific's behaviour or his mental state. Thus, even if we accept the idea that the female baboon intentionally started to groom the male in order to pilfer his prey, we do not know whether she meant to manipulate his state of attention because she knew that it is easy to steal from inattentive animals or whether she just wanted him to lie down because she had learned in the past that it is easy to steal from animals in a supine position. The important difference is that only in the first case the female baboon could be said to reason about the male's mental state. In the second case, she would certainly have shown some quite sophisticated deception behaviour but

without trying to predict the male's behaviour in terms of his mental states. Rather, her performance would be based exclusively on reasoning about observable cues of his behaviour like the position of his body or his direction of view.

Heyes (pp. 112-113) suggests that in order to solve this problem, researchers investigating the social cognition of primates should turn to an experimental procedure called 'triangulation'. In contrast to field observations, these experiments would allow to distinguish whether subjects reason about others' mental states or their overt behaviour. The basic idea of the triangulation method is to use a conditional discrimination task and a subsequent transfer test. In the discrimination training the subjects have to learn to distinguish two mental states X and Y, e.g. knowing where food was hidden vs. not knowing where it was hidden, based on two different observable characteristics. Heyes cites the study of Povinelli et al. (1990) where chimpanzees were supposed to learn to discriminate a 'knowing' from an 'ignorant' experimenter. In this study chimpanzees were allowed to observe an experimenter that was hiding a piece of food under one of four opaque cups but they could not see in which of them the food was placed. After the baiting, a second experimenter entered the room and both experimenters started to point at one of the four cups. The chimpanzees were then allowed to choose a cup to find the hidden food, taking into account the hints given by the experimenters. Obviously, only one of them could help the chimpanzees to find the food because only one of them knew its true location. In fact, the experimenter who did not watch the baiting always pointed at a cup which turned out to be empty whereas the knowing experimenter always pointed at the baited cup. After a while the chimpanzees had learned to select the correct cup in most of the trials.

What we can see here is that in the training phase the experimenters' mental states were invariantly associated with particular observable cues. Knowing where food was hidden was indicated by an experimenter's presence during the baiting, whereas not knowing was indicated by an experimenter's absence. The crucial point about the transfer test is thus that one of the mental states is now correlated with a new cue. In the case of Povinelli et al., in the transfer test 'not knowing where food was hidden' was not indicated by an experimenter's absence anymore because both experimenters were present during the baiting. However, one of them now wore a blindfold over his eyes. The subjects' reaction in the transfer test should therefore reveal what they had learned in the conditional discrimination training. If they had solely learned to discriminate between different observable characteristics, their performance would break down. However, if they had learned to distinguish knowing from not knowing, they should still perform successfully. Povinelli et al. found that after several trials the chimpanzees' performance rate returned to the same level as in the discrimination training but that at the beginning of the transfer test the chimpanzees chose a cup randomly. Povinellit et al. take this as evidence that the

chimpanzees probably just learned a new discrimination but did not understand the relation between observable cues and the corresponding mental states.

Hare et al. (2001, p. 146) argue that their study can be seen as a successful instance of triangulation and that it therefore provides evidence for the chimpanzee's ability to reason about what others can see. Whereas in the first experiment of their study, not knowing where food was hidden was indicated by the competitor's absence during the relocation of a piece of food, in the second experiment the same mental state was indicated by an interchange of the competitors. In both experiments the chimpanzees behaved in the same way from the start on, they went for the food more often when the competitor had not seen where it was hidden and they obtained it more often in these conditions. Thus, Hare et al. conclude that the chimpanzees did not just reason about observable cues but about their competitor's mental state. However, as previously mentioned, Povinelli and Vonk (2003, p. 159) claim that the experiments of Hare et al. are deficient. Povinelli and Vonk agree with Heyes that anecdotes cannot help to decide whether a mentalistic interpretation of observed behaviour is warranted and they argue that the same mistake is repeated in today's experimental approaches. Like in the anecdote of the female baboon, the behaviour of the chimpanzees in the studies of of Hare et al. can either be explained in a mentalistic or a nonmentalistic fashion. The chimpanzees' behaviour might be brought about by reasoning about their competitor's mental states but it might also be the result of reasoning about observable characteristics of the situation. Whereas Hare et al. believe that the chimpanzees preferred the food their competitor had not seen being hidden because they understood what he could see, Povinelli and Vonk point out that the behaviour of the subordinates also could be explained by assuming that they followed this simple behavioural rule: 'Whenever a dominant was present during the hiding of a piece of food and has oriented towards it, the food must not be taken. When the dominant was not present when the food was hidden in its actual location, it is safe to go for it.' According to this interpretation, the chimpanzees reasoned about observable behavioral cues – whether the competitor was present and whether he directed his gaze towards a piece of food, but not about his mental state. Therefore, the experiments do not provide conclusive evidence for the chimpanzee's ability to understand what others see.

Povinelli and Vonk (2004) try explain why the studies we have encountered so far are inadequate. They recognize two common misconceptions which are responsible for the failure of the experiments. Obviously, it is crucial to determine which kind of behaviour in a given experimental situation would demonstrate that the subjects reason about mental states instead of behavioural cues. According to Povinelli and Vonk, Tomasello and his colleagues failed to specify which behaviours can only be brought about by mental state attribution but not by mere reasoning about observable cues. Instead of carefully analyzing which behaviours can be taken as

evidence for reasoning about others' mental states, the researchers relied on their folk psychological intuitions. As a consequence, they did not realize that many of the behaviours which were thought to imply reasoning about mental states can also be the result of reasoning about overt behaviour. I will now explain Povinelli and Vonk's argumentation in more detail.

3.1.1 Critique of the argument by analogy

It turns out that Povinelli and Vonk's reproach that researchers would rely on folk psychology is tantamount to a critique of the so-called 'argument by analogy' (Povinelli and Giambrone, 1999; Povinelli et al., 2000). Povinelli and Giambrone claim that reseachers in comparative psychology still rely on an obsolete idea. According to the argument by analogy, it is reasonable to assume similar cognitive processes in organisms that show similar observable behaviour. Or as George John Romanes, one of the founders of comparative psychology, stated: "Starting from what I know of the operations of my own individual mind, and the activities which in my own organism they prompt, I proceed by analogy to infer from the observable activities of other organisms what are the mental operations that underlie them" (Romanes, 1882 cited in Povinelli and Giambrone, 1999, p. 169). This argument suggests that when an organism is observed to display a kind of behaviour of which we believe that, in us, is caused by reasoning about others' mental states, the observation can be taken as evidence for the organism's ability to attribute mental states. An individual that deceives a conspecific can thus be said to reason about mental states because we know from experience that this is exactly what *we* would do in this kind of situation. Similarly, a chimpanzee that attempts to get the piece of food his competitor has not seen is said to understand the competitor's visual perception because in a food competition situation like that *we* would reason about what our competitor has seen.

Povinelli and Giambrone (pp. 189-192) argue that the argument by analogy is not valid. They are convinced that introspection is not a suitable method to understand the causes and effects of our beliefs about others' mental states. They claim that Romanes' confidence that we usually know which of our behaviours are caused by our beliefs about others' mental state is mistaken. By contrast, although we might understand the causes of our behaviour in some situations, in many others this is not the case. Povinelli and Giambrone point out that explanations in terms of what we thought about others' mental states rather serve the purpose to justify our behaviour in retrospect but that they do not reveal its actual causes. These accounts create stories which appear plausible because they are in accordance with our previous beliefs about mental states and behaviour and thus with our folk psychology. However, as a tool for researchers to detect the underlying causes of behaviour, folk psychological explanations are unapt. Consequently, the argument

of analogy is invalid. If our intuitions about which kinds of behaviour result from thinking about mental states are unreliable, the observation of these behaviours in other organisms can no longer be counted as evidence for their theory of mind abilities. Povinelli and Giambrone as well as Povinelli et al. (2000) and Povinelli and Vonk (2003, 2004) argue that by relying on the argument by analogy, and thus their own folk psychological intuitions, researchers have erroneously assumed several behaviours that in fact can be brought about solely by reasoning about observable cues to indicate mental state attribution.

3.1.2 The reinterpretation hypothesis

What Povinelli and his colleagues want to show is that chimpanzees' sophisticated social behaviours do not presuppose an ability to reason about mental states. This might sound surprising as it was often speculated that the ability to attribute mental states to others has evolved because it was advantageous for animals that live in complex social groups (e.g. Humphrey, 1976). The idea was that the members of a social group need to be able to predict the behaviour of conspecifics and that this can be achieved best by recognizing their mental states. According to Povinelli and Vonk (2003, pp. 157-158), this assumption is not warranted. They put forward the so-called 'reinterpretation hypothesis' which states that the crucial prerequiste for advanced social interactions is not the ability to attribute mental states but the ability to form behavioural abstractions. To be able to form behavioural abstractions simply means that an animal can represent different types of behaviours and the statistical relations between them. Thus, the animal may reason that behaviour A displayed by a conspecific in a particular situation is usually followed by behaviour B and based on this consideration, it can adapt its own behaviour. Animals that form these kinds of representations can thus successfully predict others' behaviour and there is no further need for the attribution of mental states.

Povinelli and Vonk then argue that the ability to form behavioural abstrations is not only sufficient to predict others' behaviour but that in addition, it is a prerequisite for reasoning about mental states. Obviously, we cannot directly perceive other people's state of mind. What we do instead is to infer others' mental states from the behaviour we observe and therefore we need to be able to recognize and classify different patterns of behaviour. Povinelli and Vonk are convinced that both chimpanzees and humans possess the capacity to form this kind of behavioural abstractions and they speculate that this ability probably evolved in a common ancestor of the two species but they also believe that the ability to reason about mental states evolved later and only in the human lineage. Therefore, to interpret others' behaviour in terms of mental states is a uniquely human characteristic. Furthermore, Povinelli et al. (2000, pp. 532-535) explain that whereas the ability to attribute mental states allowed humans to reinterpret already existing behavioural abstractions in terms of

mental states, it probably did not immediately lead to the emergence of a fundamentally new set of behaviours. Rather, it enabled humans to modulate and reorganize the knowledge about behaviour they already had. Thus, it is possible that at first the ability to reason about mental states only provided humans a minor evolutionary advantage.

What becomes clear from this argumentation is that it is much more difficult to determine which behaviours count as evidence for mental state attribution than previously thought. However, Povinelli and his colleagues do not believe that this task is unsolvable. In the next section, I will present an experiment they proposed in order to overcome the shortcomings of the experiments we have encountered so far. In contrast to the previous studies, this experiment is supposed to allow a distinction between behaviours resulting from reasoning about mental states and those that are produced by reasoning about behavioural abstractions.

3.2 A proposed experiment

According to Povinelli and his colleagues, the complex social behaviour of chimpanzees cannot be taken as evidence for their ability to attribute mental states because they can be explained by assuming that chimpanzees form behavioural abstractions. The question then arises, how can we establish whether chimpanzees represent mental states or not? Is this even possible after all? Penn and Povinelli (2007) assure that we can find out whether chimpanzees reason about mental states but for that we need a different type of experiment. It must allow us to detect a behaviour which can only be produced by an individual that is able to reason about mental states but not by one that can solely represent behavioural abstractions. Therefore, the most important thing for researchers to do is to specify "the unique causal work that representations about mental states do above and beyond the work that can be done by representations of the observable features of other agents' past and occurrent behaviours" (p. 731). Obviously, to reason about others' mental states must enable an individual to make predictions about their behaviour that it could not have made if it were only capable of reasoning about overt behaviour. The goal of designing better experiments thus must be to create situations in which these kind of predictions are necessary to solve a particular task.

Penn and Povinelli (pp. 737-739) suggest the following experimental procedure which in principle could fulfil this requirement. They propose to let chimpanzees play with two buckets that look basically identical except for their colour. Both buckets contain mirrored visors which look exactly the same from the outside. However, one visor is in fact transparent whereas the other one is opaque. It is crucial that the chimpanzees cannot observe others playing with the buckets. The only information about the properties of the buckets they should have is their own subjective experience. As chimpanzees like to play with buckets and can be observed

to place them over their heads and then walk around with them until they bump into something, it is to expect that they would soon discover the different characteristics of the two buckets. In the testing phase of the experiment, the chimpanzees would then be confronted with two experimenters sitting next to each other, each of them wearing one of the two buckets over his head. The chimpanzees would then be allowed to beg for food from the experimenters. Penn and Povinelli claim that at this point it would become apparent whether the chimpanzees have the ability to understand what others can see or not. Although the visors of the buckets look the same from the perspective of the chimpanzees, they should be able to distinguish the two buckets by their colour. Based on this cue, the chimpanzees could then infer which of the experimenters can see them and thus also from which experimenter they should beg.

The crucial point of this experiment is that it requires the subjects to infer the mental states of another individual from their own experience. The subjects must first recognize that wearing one of the buckets, say the blue one, leads to a state of not seeing the environment, whereas wearing the other one does not. Then they must understand that if another individual is wearing the blue bucket over his head, it is in the same perceptual state as they were themselves before. At last, the chimpanzees must infer the implications of this state of not seeing. That means they must be able to predict that somenone who cannot see its surroundings is unlikely to respond to a begging gesture. As a consequence, they should adapt their own behaviour and only beg from the experimenter who can see them. Penn and Povinelli point out that the chimpanzees could not predict which experimenter will respond to their request if they were unable to understand the experimenters' visual perception. The task is impossible to solve by relying on behavioural abstractions alone. As the chimpanzees could not observe how other individuals behave when they wear these particular buckets over their heads, they were unable to learn any statistical correlations between some kinds of behaviour and the observable characteristics of the buckets. In addition, the mental states that should be inferred in this task were indicated by arbitrary cues. The buckets' colours are not causally related to the relevant properties of the buckets. The colours have nothing to do with whether the visor of a bucket allows to see through or not and the visors themselves are indistinguishable from the outside. Therefore, the chimpanzees could not rely on any behavioural abstraction they had learned before. By contrast, in the experiments of Tomasello and his colleagues, the mental states that should be recognized were always associated with observable features that were causally relevant to the mental states. For example, knowing or not knowing where food was hidden was indicated by an individual's presence or absence during the baiting. Penn and Povinelli claim that consequently, in order to solve these tasks the chimpanzees could use behavioural abstractions they had learned in the past. From this assertion it also

follows that the assumption of Hare (2001) that competitive paradigms are better suited to investigate the chimpanzee's social cognition is mistaken. It seems plausible to expect that chimpanzees have formed behavioural abstractions especially for those situations which they encounter on a daily basis. Thus, the chimpanzee's successful performance in a food competition paradigm is highly unlikely to provide evidence for its ability to reason about mental states.

To sum up, we can say that from this example, it becomes apparent which experiments have the potential to detect whether an individual reasons about others' mental states. We have seen that to predict others' behaviour in terms of mental states means that an individual is able to represent mental states that it has inferred from observable characterics and that it can eventually use these representations to determine the next actions of others. However, as Povinelli and his colleagues have pointed out, in many situations it is not necessary to reason about mental states in order to successfully predict what others will do. Instead, it is sufficient to reason about behavioural abstractions. Thus, the effects of mental state attribution can only be detected in some particular situations. Penn and Povinelli believe that one possible instance of such a situation is described in the experiment they suggested.

3.3 Negative evidence

Up to now, we have seen why Povinelli and his colleagues disagree with the conclusions that the researchers from the Leipzig group draw from their studies. I have explained why they are convinced that these experiments cannot provide evidence for the chimpanzee's ability to reason about mental states. However, Povinelli and his colleagues do not state that we cannot conclude anything from the studies conducted so far. Although many experimental paradigms lack the power to distinguish between competing hypotheses and thus positive results can be interpreted either way, Povinelli and Vonk (2004, p. 19-21) argue that negative results indeed can reveal something about the chimpanzee's social cognition. One example for a study that turned out negative findings is the well-known study of Povinelli and Eddy (1996).

Povinelli and Eddy wanted to investigate young chimpanzee's understanding of visual perception. For that purpose, they conducted a series of experiments in which they tested whether chimpanzees can discriminate a human experimenter who can see them from one who cannot. The task for the subjects was simple. Like in the experiment proposed by Penn and Povinelli, the chimpanzees were faced with two experimenters sitting next to each other and the only thing they had to do was to decide which experimenter they should beg for food. Again only one of the experimenters could see the chimpanzees because one of them was either blind-folded, held his hands in front of his face, wore a bucket over his head or turned his back towards the subjects. Interestingly, Povinelli and Eddy found that

the chimpanzees did not distinguish between the two experimenters and gestured towards both equally often in all conditions except for one. The subjects responded correctly from the first trial on in the condition where one experimenter turned his back towards them. In all other cases they showed no sign of understanding the difference between the two experimenters. However, it turned out the chimpanzees were able to learn to choose the seeing experimenter in most of the conditions after hundreds of trials. In order to test what they actually had learned, Povinelli and Eddy then introduced two new conditions. In the first of them, both experimenters turned their backs towards the subjects but one looked over his shoulder so that he could see the chimpanzees. In the second, both experimenters faced the subjects but one of them had closed his eyes. It turned out that although the chimpanzees had learned to perform successfully in the original conditions, when they were first confronted with these new conditions they failed to beg from the seeing experimenter.

Povinelli and Eddy took this as evidence that the chimpanzees' correct responses were not based on some understanding of the experimenters visual perception. It seems that what the chimpanzees have learned instead in the course of the experiments was the following behavioural rule: 'Gesture towards the experimenter whose front is visible. If both of them turn their back, gesture towards the experimenter whose face is visible.' These results suggest that chimpanzees probably do not understand what others see and this makes it highly unlikely that they understand any other mental states. The behavioural rule that the chimpanzees have learned rather indicates that they only reason about observable cues. Taking into account that the experiments of Tomasello and his colleagues do not provide evidence for the chimpanzee's understanding of mental states either, Povinelli and Vonk conclude that up to now, we have no reason to believe that chimpanzees are capable of mental state attribution.

3.4 Conclusions from the critique

To sum up, it was argued that the experiments conducted by the Leipzig group cannot provide conclusive evidence for the chimpanzee's ability to reason about mental states. Povinelli and his colleagues emphasized that this ability and the ability to form behavioural abstractions are not mutually exclusive. On the contrary, the latter is a prerequisite for the former. Therefore, in order to distinguish which of those abilities underlies a particular observed behaviour, one must specify the causal work that having a theory of mind does – that means which predictions of others' behaviour it allows that could not be made by individuals that cannot reason in terms of mental states. Unfortunately, this problem was neglected by many researchers. Instead of providing a detailed analysis of the effects of mental state attribution, they followed the argument by analogy and relied on their folk psychological intuitions to determine which kinds of behaviour can exclusively be

produced by reasoning about others' mental states. The problem with this intuitive approach is that it does not take into account the fact that many behaviours that appear to us as the result of mental state attribution can also be the consequence of reasoning about overt behaviour alone. Hence, it is the researcher's own theory of mind that leads him to interpret the chimpanzee's behaviour in terms of mental states. Because of this mistake, the recent studies on primate social cognition do not allow us to distinguish between a mentalistic and a nonmentalistic interpretation of the chimpanzee's behaviour.

Penn and Povinelli then suggested an experiment which is believed to overcome this difficulty. In this experiment the chimpanzees were required to infer an experimenter's mental state from their own subjective experience. Penn and Povinelli explain that this is an example of a task that cannot be solved by an individual that is unable to reason about mental states, however, they are doubtful that chimpanzees would succeed in this experiment. Until now there is no experiment that provides the slightest hint that chimpanzees can reason about mental states. Moreover, there is some evidence which suggests that they would rather form more or less sophisticated behavioural abstractions than concepts about others' mental states when confronted with novel situations. Penn and Povinelli thus come to the conclusion that it is highly unlikely that chimpanzees are able to predict others' behaviour in terms of mental states.

4 Arguments and counterarguments

The critique of the Louisiana group provoked several responses of Tomasello and his colleagues (see Tomasello et al., 2003b; Tomasello and Call, 2006; Call, 2007; Call and Tomasello, 2008). They all strongly disagree with Povinelli and claim that the evidence available indeed suggests that chimpanzees can understand others' mental states. The reinterpretation hypothesis by contrast is thought to be implausible. In the following, I will give an overview of the different replies. First I will present two arguments that are supposed to show why the reinterpretation hypothesis should be rejected. Then I will explain why Tomasello and his colleagues believe that their recent findings justify a mentalistic interpretation of the chimpanzees' behaviour. Finally, I summarize the counterarguments of Penn and Povinelli (in press).

4.1 Arguments from Leipzig

First of all, Tomasello et al. (2003b) state that it is not clear how the chimpanzees would acquire the behavioural abstractions proposed by Povinelli and Vonk (2003) and even more important, how they would understand them. It seems that the reinterpretation hypothesis leaves several important questions unanswered and for that reason Tomasello et al. doubt that it provides a more plausible account for the chimpanzee's performance in their experiments. Nevertheless, they admit that in principle most of their findings could be explained in terms of behavioural abstractions. It is possible that the chimpanzee's behaviour in the various experiments was governed solely by reasoning about behavioural cues. However, Tomasello and his colleagues are convinced that we have good reason to favour an explanation which grants the chimpanzee a genuine understanding of others' mental states. Call (2007, pp. 348-349) provides the following two arguments to disprove a nonmentalistic account of the recent findings. Whereas the first one is based on empirical evidence, the second is of theoretical nature.

4.1.1 Critique of the reinterpretation hypothesis

Call emphasizes that the reinterpretation hypothesis is a valid theoretical possibility but that there is absolutely no empirical evidence for it. According to Povinelli and Vonk, the chimpanzees would need to know many complex behavioural abstractions in order to perform successfully in the various tasks they were confronted with. It seems that they are not as good in learning from observation of other's behaviour as one might expect. Tomasello and Call (2006, p. 382) reveal that in all the experiments of the Leipzig group, the performance of the apes remained constant over time. Thus, there is no evidence that the chimpanzees have learned anything new in the course of the experiments. Although there were many opportunities to monitor conspecifics' or an experimenter's behaviour and to learn from these

observation, the chimpanzees did not take the chance. To further illustrate this point, Tomasello et al. (2003b) mention an interesting control condition in the study of Hare et al. (2000). Remember that in this experiment, a subordinate chimpanzee was competing for food with a dominant on the opposite side of the room. Usually a piece of food was placed next to a small barrier in such a way that only the subordinate could see it. In the said control condition, the food was suddenly hidden on the dominant's side of the occluder and the subordinate was given the chance to observe the dominant's behaviour. By checking in which direction its competitor was looking, the subordinate could have tried to infer where the food was hidden. However, Hare et al. found that when the subordinate was released, he seemed to be ignorant of the food's true location. Thus, in a situation where it would have been advantageous to read the dominant's behaviour, the chimpanzees seemed to be unable to do so.

In many experiments with chimpanzees it turned out that they learned associations between different stimuli only very slowly. In the previous section, I described the study of Povinelli and Eddy (1996) who found that chimpanzees can learn a hierarchical behavioural rule which tells them from which of two experimenters they should beg for food. Although the fact that the chimpanzees were able to learn this complex rule is impressive, it is also remarkable that several hundred trials were necessary until they learned to respond correctly. Call (2007) argues that this shallow learning curve shows clearly that chimpanzees are not particularly good in paying attention to behavioural cues. He points out that if learning new behavioural rules is so hard for chimpanzees, we must at least wonder how they were supposed to learn the various behavioural abstractions that were required to solve all the different problems that they encountered in the experiments. Call concludes that it is highly unlikely that the chimpanzees' behaviour was guided solely by behavioural rules. The observed findings rather suggest that chimpanzees reasoned about others' mental states.

Moreover, Tomasello and Call (2006, p. 382) stress that Povinelli and Vonk do not object their own hypothesis when they claim that the chimpanzees only succeeded in the experiments because they relied on what they have learned from past experiences with conspecifics or caretakers. Learning and understanding are not mutually exclusive. There are some forms of learning which are based solely on 'blind associations' like classical conditioning, but some other forms definitely require a high degree of insight. Tomasello and Call thus do not deny that it might be that past experiences with others have influenced the chimpanzees' performance in the experiments but they assume that what the chimpanzees know about others' behaviour is based on their comprehension of mental states. In order to support this speculation, they refer to some recent findings about physical cognition of chimpanzees. It seems that chimpanzees learn causal relations between stimuli much

more easily than arbitrary contingencies (see Call, 2006, pp. 221-225). Tomasello and Call suspect that the same might apply to the domain of social cognition. They suppose that chimpanzees would learn causal relations between others' behaviour and some characteristics of a situation more quickly than arbitrary correlations.

In addition to the empirical evidence against the reinterpretation hypothesis, Call (2007) also stresses the importance of a theoretical consideration. It is often argued that an explanation of the recent findings which refers only to behavioural abstractions is more parsimonious than one that invokes mental state attribution. The reasoning is that if an observed behaviour can either be explained by a simple cognitive mechanism or in terms of higher cognitive functions, the former interpretation is always to prefer. Psychologists are advised not to postulate the existence of complex cognitive mechanisms if the data does not force this conclusion. According to this principle, a mentalistic interpretation of the chimpanzee's behaviour is thus not warranted. One might argue that it is difficult to determine which cognitive mechanisms are simpler than others (see Tomasello and Call, 2006, p. 381), but besides this general consideration Call also points out that there is a danger in relying too much on principles like the one described. Whereas it might be useful for researchers to apply such heuristics in some situations, those kinds of prior beliefs can also lead to strong biases when interpreting new evidence. As we will see in the next section, Tomasello and his colleagues believe that in the case of the latest experiments on chimpanzees' social cognition, we have indeed good reasons to favour a mentalistic interpretation over a nonmentalistic one.

4.1.2 Converging evidence and intervening variables

Call and Tomasello (2008) concede that when each of their experiments is taken on its own, it is possible to account for the results by supposing that chimpanzees reason about overt behaviour alone. However, they claim that the different findings as a whole are best explained by granting the chimpanzees the ability to reason about others' mental states. It is correct that such an explanation is less parsimonious in the sense that it assumes more complex cognitive mechanisms but Call and Tomasello point out that in another respect, parsimony speaks in favour of a mentalistic interpretation. The single hypothesis that chimpanzees understand what others can see and intend is sufficient to account for the results of many different studies. By contrast, an explanation in terms of behavioural abstractions needs to postulate a huge number of behavioural rules, each of them explaining only a small set of the findings.

In the case of understanding others' visual perception, we have seen that chimpanzees follow the gaze of others and that they take into account what their competitor has seen in a food competition situation. Subordinates prefer to go for the piece of food that their competitor cannot see or did not see being hidden. They

also understand that when their competitor is allowed to choose first, he will pick the piece of food of which he knows where it is and they base their own decision on these considerations. Furthermore, when stealing food from a human experimenter, chimpanzees try to hide their approach. The crucial point is that in all these experiments, the observable cues which indicated the mental state in question were different. For example, in the study of Hare et al. (2000) the dominant could not see the food because it was hidden behind a barrier. In the study of Hare et al. (2001) he did not know where the food was because it was placed during his absence or the food was relocated when he could not observe it. In the study of Hare et al. (2006), the human experimenter could not see how the chimpanzees approached because he turned his head in another direction or his view was obstructed by a shield. To explain how the chimpanzees could solve all these different tasks, Povinelli and his colleagues would have to claim that the apes formed several complex behavioural abstractions. Call and Tomasello argue that it is therefore more economical to credit the chimpanzees with an understanding of what others can see.

The same argumentation then applies to the case of understanding others' goals and intentions. It was found that chimpanzees can distinguish whether an experimenter is unwilling or unable to give them a piece of food (Call et al., 2004). Furthermore, human-raised chimpanzees are able to help instrumentally and to imitate rationally (Warneken and Tomasello, 2006; Buttelmann et al., 2007). According to Call and Tomasello, it is more plausible to postulate that chimpanzees can recognize others' intentions in order to explain these findings than to invent even more sophisticated behavioural rules which the chimpanzees are supposed to know. Call and Tomasello admit that it is reasonable to be cautious when different interpretations of observed behaviour are possible. However, they point out that when an explanation in terms of simple cognitive mechanisms becomes more and more complex and eventually rests on a lot of highly speculative assumptions, we are justified to adopt a mentalistic interpretation of the observed behaviour. Therefore, the recent findings permit the conclusion that chimpanzees can understand the perception and intentions of others. In addition, Call (2007, p. 349) mentions that this explanation of the chimpanzees' behaviour is in line with the concept of intervening variables introduced by Whiten (1994, pp. 54-59).

Whiten's goal was to develop a model which illustrates what it means for nonverbal animals to reason in terms of mental states. Whiten starts his argumentation by drawing the reader's attention to the simple fact that it is not possible to read another person's mental states directly from her mind. Instead, mental states must be inferred from what can be observed, that is others' behaviour and the characteristics of a given situation. According to Whiten, it is thus reasonable to say that recognizing others' mental states or as he calls it, mind-reading, is in fact nothing more than a form of sophisticated behaviour-reading. As a consequence, in Whiten's model we

do not find a clear-cut boundary between mental state attribution and forming behavioural abstractions. On the contrary, there is a smooth transition from reasoning about behaviour to reasoning about mental states. When smart behaviour-reading reaches a certain degree of complexity it automatically becomes mind-reading. Obviously, the question that arises is, how can we then distinguish animals that reason exclusively about observable cues from those that interpret behaviour in terms of mental states? In order to resolve this issue, Whiten introduces the notion of 'intervening variables'. He explains that this concept is inspired by an idea from the behavioural sciences. A psychologist who studies the behaviour of a labratory rat needs to understand the various connections between the rat's behaviour and the relevant characteristics of the situational context. In other words, the psychologist must analyze the relationships between independent and dependent variables (see Fig. 1a). In order to represent his observations more economically, he can then introduce an intervening variable that provides a link between observed conditions and predicted outcomes (see Fig. 1b). This simple model builds the foundation for Whiten's account of mental state attribution.

He suggests that animals might try to predict their conspecifics' behaviour in a similar way to psychologists who study animal behaviour. The animals must also recognize the different connections between observed behaviour, situational cues and anticipated reactions. As there are many of those relationships, to represent each of them individually becomes quickly uneconomically and cognitively demanding. Therefore, a representation which uses intervening variables and thereby reduces the number of stored links would be advantageous. Fig. 2 shows an example of such a representation in which the intervening variable connects observations of behaviour with predicted outcomes. The intervening variable indicates that although the different types of observed behaviour do not share similar observable features, they nevertheless have something important in common – they are all manifestations of the same mental state. Thus, to form a representation like this, an animal must be able to detect the relational similarity between apparently very different kinds of behaviour. According to Whithen's model, any individual that uses this kind of intervening variables in order to predict others' behaviour then can be said to reason in terms of mental states. From that it follows that in order to determine whether some animal attributes mental states to others, we must test if it is able to reliably predict behaviour resulting from a given mental state X in various situations. The mental state should furthermore be indicated by disparate behavioural cues. If the animal then reacted correctly in a variety of circumstances, this would show that it recognizes the underlying pattern that connects the different types of behaviours. Call (2007, p. 349) now states that this is exactly what was done in the recent experiments. He argues that the converging evidence from experiments using very different paradigms suggests that chimpanzees indeed reason about others' behaviour

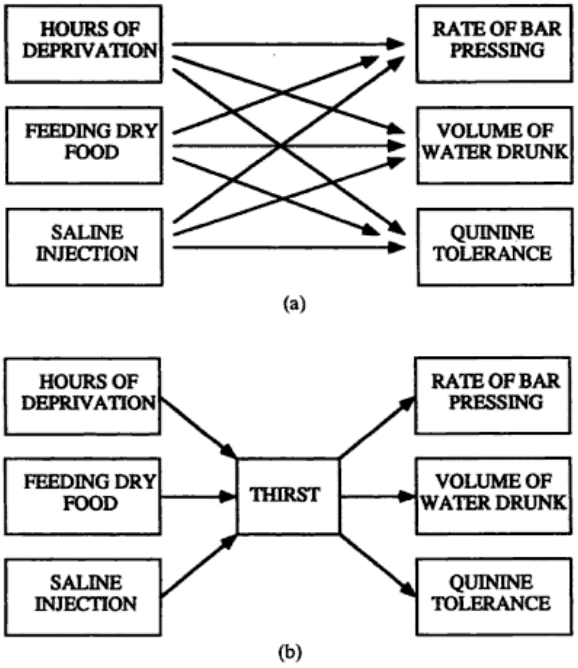

Figure 1: (a) illustrates the relationships between three independent and three dependent variables, (b) shows a more economical representation using an intervening variable [a]

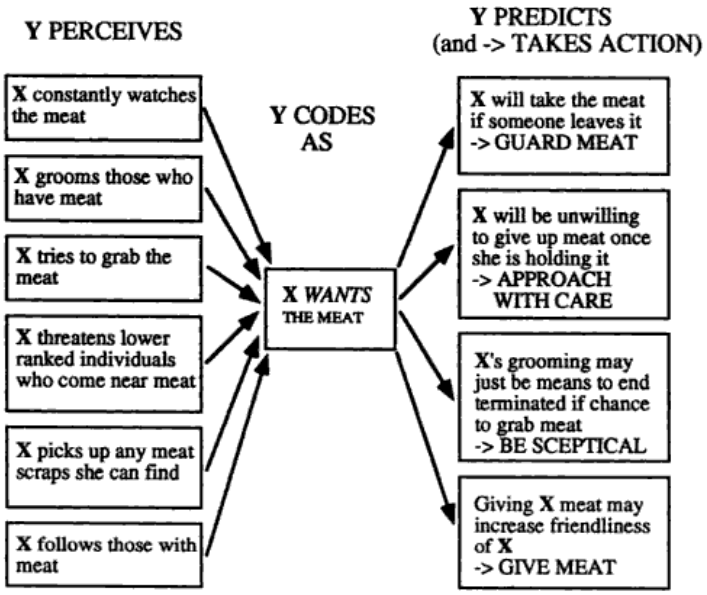

Figure 2: shows an example of using an intervening variable to represent a mental state [b]

[a] copied from Whiten 1994, p. 56
[b] copied from Whiten 1994, p. 57

in terms of mental states.

To sum up, we have seen that Tomasello and his colleagues do not believe that the reinterpretation hypothesis provides a plausible alternative explanation of their findings. As there is no empirical evidence for the assumption that chimpanzees easily learn behavioural rules, the reinterpretation hypothesis remains highly speculative. Furthermore, to claim that chimpanzees understand others' perceptions and intentions offers a much more parsimonious explanation of the experimental results. If one denies that chimpanzees have this ability, one must postulate a considerable number of behavioural abstractions that they have learned in order to account for the observed behaviour. In addition to that, Tomasello et al. (2003b) state that their approach is more promising than that of Povinelli and his colleagues because it is directed at investigating the chimpanzee's cognition in more detail. Tomasello et al. suppose that it thus generates more interesting research question like which mental states chimpanzees understand to what extent, whereas the Louisiana group's outright denial of the chimpanzee's ability to reason about mental states is assumed to become a dead end.

4.2 Counterarguments from Louisiana

In the remainder of this section I will now present the counterarguments of Penn and Povinelli (in press). Penn and Povinelli agree with Call (2007) that the concept of intervening variables is plausible and useful for distinguishing whether an animal can reason about mental states or not. They write: "Whiten's definition may very well qualify as the minimal reasonable criterion for claiming that a nonverbal animal possesses an explicit concept of a mental state" (p. 15). However, they differ in their interpretation of the latest findings. "Not only is there a striking absence of evidence for anything remotely resembling an explicit concept of perceptual mental states *sensu Whiten* in any nonhuman species, there is converging and growing evidence of an absence" (p. 15). Penn and Povinelli think that the evidence available clearly demonstrates that chimpanzees possess quite impressive cognitive abilities and they reject a behaviouristic interpretation of the experimental results which tries to explain the chimpanzee's behaviour as a result of purely associative learning. In particular, they assert that "nonhuman animals form highly structured representations about the past as well as the occurent behaviour of other agents" and that it would be impossible for them to do so if they relied exclusively on learning the statistical dependecies between observable cues, without any understanding of the underlying causal structure of these contingencies (p. 3). In order to form the behavioural abstractions that Povinelli and Vonk (2003, 2004) had in mind, chimpanzees need to distinguish statistical correlations that are meaningful from those that are just accidental. Penn and Povinelli thus assume that chimpanzees "possess a variety of top-down heuristics, ploys and biases" which help them to recognize

those contingencies between behavioural cues that are based on causal connections (p. 9).

They also admit that chimpanzees can be said to use intervening variables when reasoning about others' behaviour as they obviously are able to represent abstract classes of behaviour. However, Penn and Povinelli think that these variables differ from those that humans form - in the crucial sense that they merely represent behavioural abstractions but not mental states. If the chimpanzees' intervening variables indeed were representations of mental states, the apes should recognize the behaviours associated with particular mental states in a variety of contexts. Furthermore, they should be able to predict others' behaviour in novel situations. After all, this is exactly the reason why using intervening variables is advantageous, according to Whiten (1994, p. 56). Whereas Call and Tomasello (2008) now come to the conclusion that the recent experiments have shown that chimpanzees can understand some mental states across many different situations, Penn and Povinelli (pp. 15-16) point out that in their assessment, Call and Tomasello neglect the fact that chimpanzees seem to recognize the same mental state in some situations but not in others. Several experiments have revealed that chimpanzees can understand an experimenter's intentions in a competitive but not in a cooperative setting (Hare and Tomasello, 2004; Herrmann and Tomasello, 2006, see). Hare and Tomasello found that when a human experimenter reaches for a cup, chimpanzees understand that it probably contains a piece of food and try to take it for themselves. By contrast, when the same experimenter points at a cup, chimpanzees are unable to make sense of the gesture. They cannot infer from it where the food is hidden. Call and Tomasello explain these findings by stating that the chimpanzees' cognitive abilities are more adapted for competitive situations because their daily life is characterized by competition among conspecifics. Cooperation on the other hand does not play a significant role in their social interactions and thus they lack the ability to understand others' cooperative motives. In fact, Hare (2001) argued that researchers must take into account this trait of chimpanzees when designing new experiments. Some years ago, Tomasello and his colleagues thus started to develop tasks that involved competition, mostly for food, and as a consequence they obtained more positive results in their recent studies than ever before. Penn and Povinelli do not deny that chimpanzees are well adapted to competition situations but not to cooperation. However, they argue that this shows that chimpanzees in fact cannot predict others' behaviour in truly novel situations. If the apes indeed used intervening variables which represent mental states, one would expect that they were able to recognize others' intentions in both competitive and cooperative contexts. Therefore, Penn and Povinelli conclude that chimpanzees cannot be said to recognize others' mental states.

5 Discussion

We have seen that both Call and Tomasello (2008) and Penn and Povinelli (in press) believe that chimpanzees can use intervening variables when predicting others' behaviour. However, whereas Call and Tomasello are convinced that these intervening variables are representations of mental states, Penn and Povinelli think that they only represent behavioural abstractions. Which of these two claims is now correct? I will first explain that according to Whiten's definition of intervening variables, the question whether chimpanzees reason about mental states or behavioural abstractions is misleading. After that I will criticize Whiten's concept and suggest that it neglects the role that language and culture play for the development of an individual's ability to reason in terms of mental states. Finally, I will argue that when the strong impact of language and culture is taken into account, we may indeed draw some tentative conclusions about whether it is reasonable to call the chimpanzees' intervening variables representations of mental states or not.

As the essay's title 'Grades of mindreading' already implies, Whiten (1994) developed his concept of intervening variables first and foremost in order to classify and distinguish different grades of understanding others' mental states. Whether an animal possesses a theory of mind should thus not be interpreted as a simple yes-or-no question. Instead, the concept of intervening variables allows to differentiate between various degrees of understanding. The range is spanning from highly sophisticated intervening variables to simple ones that only capture a small fraction of the complex causal relationships that underlie others' behaviour. Where the line between reasoning about mental states and reasoning about behaviour should be drawn is not clear at all. Whiten states explicitly that "If mentalism can be boiled down to a kind of complex behaviour/context pattern recognition, the process of recognizing a mental state can, in principle, always be described alternatively in terms of the pattern of behaviour/context on which it rests: It is just that as the pattern becomes more complex, it becomes uneconomic to do so. Simple mentalism would thus appear to grade into complex behaviourism" (p. 58).

I believe that this quote reveals that the dispute about what exactly is represented by the chimpanzees' intervening variables is misguided. Although their ability to recognize others' mental states is not nearly as sophisticated as that of humans, the recent studies on chimpanzee social cognition clearly have demonstrated that they can predict others' behaviour in a variety of situations and thus can be said to use intervening variables. Call and Tomasello as well as Penn and Povinelli agree with this conclusion. However, Penn and Povinelli claim that the intervening variables which chimpanzees form cannot be said to represent mental states because they are less complex than those of humans. Call and Tomasello on the other hand are more generous. They say that the chimpanzees' intervening variables are quite

sophisticated and therefore they credit the apes with a genuine understanding of others' mental states. We can now ask which of those interpretations is more plausible but according to Whiten's quote, this distinction is meaningless. Chimpanzees can either be regarded as simple mind-readers or as advanced behaviour-readers but which of those descriptions is preferred does not tell us anything substantial about the chimpanzees' cognitive abilities.

This conclusion is definitely the most essential point to realize, however it is not the only thing that we can learn from this debate. Povinelli and Vonk (2003, 2004) are certainly right that researchers must be very careful when interpreting observations of animal behaviour. Many instances of social behaviour can either be explained by an animal's ability to reason about mental states or by reasoning about behavioural cues. Unfortunately, it is our own theory of mind that will always tempt us to interpret certain behaviours as demonstrations of mental state attribution even if there are alternative explanations. A strong point of the reinterpretation hypothesis is thus that it directs our attention to this potential fallacy. By contrast, the argumentation of Call (2007) that the reinterpretation hypothesis is implausible because chimpanzees would be unable to learn the required behavioural abstractions is not valid. We have seen that the ability to form this kind of complex behavioural abstractions is a prerequisite for mental state attribution (Povinelli and Vonk, 2003). Moreover, Penn and Povinelli (in press) clarified that no researcher of their group ever intended to suggest that chimpanzees would be restricted to purely associative learning mechanisms. Instead, it is assumed that they probably possess different cognitive mechanisms which allow them to learn those statistical contingencies in their environment that are meaningful. Therefore, they can be said to have some basic understanding of the causal structure underlying others' behaviour. The objection of Tomasello and Call (2006) that learning does not preclude understanding is thus not directed at the reinterpretation hypothesis. Furthermore, I believe that the mentioned absence of learning effects in the studies in addition to the differences between cooperative and competitive settings shows that the chimpanzees' intervening variables are quite limited. It seems that chimpanzees are well adapted to those situations which they are familiar with but that they have difficulties to apply their knowledge about others' behaviour to novel situations. However, I think it is legitimate to ask whether this finding is really surprising. I will argue that it is not, taking into account that chimpanzees lack exactly those characteristics that highly facilitate the development of mental state attribution in children: language and culture.

Several authors have emphasized the crucial role that language plays for the development of understanding others' and oneself in terms of mental states (e.g. Bartsch and Wellman, 1995; Brown et al., 1996; Astington and Jenkins, 1999). It is not that Whiten (1994) did not recognize this influence. On the contrary, he

points out that "To whatever extent the recognition of mental states depends on the achievement of insights into the causal structure of human action, the language of mental states has the capacity to point the child towards selection of the most productive intervening variables" (p. 59). As chimpanzees do not have a language, individuals cannot rely on such cultural guidelines when they begin to form behavioural abstractions and it is to expect that this task is therefore much more difficult for them than for us. Nevertheless, Whiten does not believe that this poses a problem for nonverbal animals in principle. He assumes that the explicit naming of mental states succeeds their initial recognition. Thus, children first form behavioural abstractions and only afterwards label these intervening variables with mental state terms (Whiten, 1993, p. 387).

I definitely agree with Whiten in the sense that language is not a prerequisite for using intervening variables. However, I suspect that due to the facilitating effect of talk about mental states, more complex behavioural abstractions can only be formed by humans but not by nonverbal animals. As Whiten correctly pointed out, talking about mental states directs a child's attention toward those behavioural cues of others' that are relevant for understanding their behaviour. In that respect, language can be seen as a powerful top-down mechanism that helps children to recognize the causal relationships underlying behaviour and thus to form complex and efficient intervening variables. Although it is reasonable to assume that chimpanzees also possess some cognitive mechanisms and heuristics for that purpose like Penn and Povinelli (in press) suggested, it is not clear which ones these should be and and I suppose that they are not as powerful as language.

Therefore, I would conclude that it might be legitimate to call only those intervening variables representations of mental states that are explicitly labeled with mental state terms by the individuals that use them. To me, it seems that the effect of language and the cultural practices that follow from it on the ability to understand mental states is so fundamental that it marks more than a gradual improvement. Instead, the qualitative difference appears to be so big that it justifies a verbal distinction. I would thus argue that even if according to Whiten's model chimpanzees can either be regarded as sophisticated behaviour-readers or simple mind-readers, the former description is more appropriate.

6 Conclusion

In the first section of my thesis, I have presented several experiments that are supposed to show that chimpanzees understand what others can see and what they intend. In the following, I have provided an overview of the critique that these experiments provoked. It was shown that researchers from the University of Louisiana claim that none of the recent studies on chimpanzee social cognition provide conclusive evidence for their ability to reason about others' behaviour in terms of mental states. In the subsequent debate between the two research groups it seemed as if their interpretations of the latest findings were so differing, that it would be impossible to find a consensus. Whereas Daniel Povinelli and his colleagues argue that there is no evidence that chimpanzees possess "anything remotely resembling a theory of mind" (Penn and Povinelli, 2007, p. 731), Michael Tomasello and his colleagues are convinced that chimpanzees understand others' visual perception and intentions. They claim that the recent evidence suggests that chimpanzees "understand others in terms of a relatively coherent perception-goal psychology in which the other acts in a certain way because she perceives the world in a certain way and has certain goals of how she wants the world to be" (Call and Tomasello, 2008, p. 191). These two statements clearly give the impression that the two groups strongly disagree in their evaluation of the evidence available.

However, on closer inspection it turned out that their opinions are not as diverging as initially thought. The two groups agree in their assessment of chimpanzees' social behaviour – both acknowledge that it is quite sophisticated. They only differ in their interpretation which cognitive processes underlie this behaviour. Nevertheless, both Povinelli and Tomasello accept the definition of Whiten (1994) what it means for a nonverbal animal to reason in terms of mental states. Whiten's notion of intervening variables does not aim at drawing a clear-cut boundary between reasoning about behaviour and reasoning about mental states but rather tries to provide a framework to describe different grades of understanding others' mental states. As a consequence, chimpanzees can be said to use intervening variables and the question whether these variables represent mental states or solely behavioural abstractions becomes secondary. One might side with Povinelli and argue that they only represent behavioural abstractions or one could agree with Tomasello and grant the chimpanzees the ability to reason in terms of mental states. According to Whiten's concept however, this differentiation does not provide us with any new insight.

I have argued that it might be plausible to side with Povinelli to mark the considerable difference in terms of complexity between the chimpanzee's intervening variables and those of humans. However, this is only a tentative suggestion and might be further discussed. Nevertheless, I would like to point out that by denying that chimpanzees reason in terms of mental states, we do not prevent further research

in this area as Tomasello et al. (2003b) seemed to fear. Many interesting questions wait to be answered, first and foremost the one which cognitive heuristics allow chimpanzees to distinguish causally relevant contingencies between observable cues from random correlations. At least to me it seems that this question is not any less fascinating than the one which mental states chimpanzees can understand.

References

J. W. Astington and J. M. Jenkins. A longitudinal study of the relation between language and theory-of-mind development. *Developmental Psychology*, 35(5):1311–1320, 1999.

K. Bartsch and H. M. Wellman. *Children Talk About the Mind*. Oxford University Press, 1995.

J. R. Brown, N. Donelan-McCall, and D. Judy. Why talk about mental states? the significance of children's conversations with friends, siblings and mothers. *Child Development*, 67(3):836–849, 1996.

D. Buttelmann, M. Carpenter, and J. Call. Enculturated chimpanzees imitate rationally. *Developmental Science*, 10(4):F31–F38, 2007.

R. Byrne and A. Whiten. *Machiavellian intelligence: social expertise and the evolution of intellect in monkeys, apes and humans*. Oxford University Press, 1988.

J. Call. Descartes' two errors: Reason and reflection in the great apes. In S. Hurley and M. Nudds, editors, *Rational Animals*, pages 219–234. Oxford University Press, 2006.

J. Call. Past and present challenges in theory of mind research in nonhuman primates. In C. von Hofsten and K. Rosander, editors, *From Action to Cognition*, volume 164 of *Progress in Brain Research*, pages 341–353. Elsevier, 2007.

J. Call and M. Tomasello. A nonverbal false belief task: The performance of children and great apes. *Child Development*, 70(2):381–395, 1999.

J. Call and M. Tomasello. Does the chimpanzee have a theory of mind? 30 years later. *Trends in Cognitive Sciences*, 12(5):187–192, 2008.

J. Call, B. Hare, and M. Tomasello. Chimpanzee gaze following in an object-choice task. *Animal Cognition*, 1(2):89–99, 1998.

J. Call, B. Hare, and M. Tomasello. 'unwilling' versus 'unable': chimpanzees' understanding of human intentional action. *Developmental Science*, 7(4):488–498, 2004.

J. H. Flavell. *Cognitive Development*. Englewood Cliffs: Prentice Hall, 1985.

G. Gergely, H. Bekkering, and I. Király. Rational imitation in preverbal infants. *Nature*, 415:755, 2002.

B. Hare. Can competitive paradigms increase the validity of experiments on primate social cognition? *Animal Cognition*, 4(3):269–280, 2001.

B. Hare and M. Tomasello. Chimpanzees are more skilful in competitive than in cooperative cognitive tasks. *Animal Behaviour*, 68(3):571–581, 2004.

B. Hare, J. Call, B. Agnetta, and M. Tomasello. Chimpanzees know what conspecifics do and do not see. *Animal Behaviour*, 59(4):771–785, 2000.

B. Hare, J. Call, and M. Tomasello. Do chimpanzees know what conspecifics know? *Animal Behaviour*, 61(1):139–151, 2001.

B. Hare, J. Call, and M. Tomasello. Chimpanzees deceive a human competitor by hiding. *Cognition*, 101(3):495–514, 2006.

E. Herrmann and M. Tomasello. Apes' and children's understanding of cooperative and competitive motives in a communicative situations. *Developmental Science*, 9(5):518–529, 2006.

C. Heyes. Theory of mind in nonhuman primates. *Behavioral and Brain Sciences*, 21(1):101–148, 1998.

N. K. Humphrey. The social function of intellect. In P. P. G. Bateson and R. Hinde, editors, *Growing Points in Ethology*, pages 303–317. Cambridge University Press, 1976.

J. Kaminski, J. Call, and M. Tomasello. Chimpanzees know what others know, but not what they believe. *Cognition*, 109(2):224–234, 2008.

C. Krachun, M. Carpenter, J. Call, and M. Tomasello. A competitive nonverbal false belief task for children and apes. *Developmental Science*, 12(4):521–535, 2009.

D. Penn and D. Povinelli. On the lack of evidence that non-human animals possess anything remotely resembling a 'theory of mind'. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362(1480):731–744, 2007.

D. Penn and D. Povinelli. The comparative delusion: the behaviorstic / mentalistic dichotomy in comparative theory of mind research. In R. Samuels and S. Stich, editors, *Oxford Handbook of Philosophy & Cognitive Science*. Oxford University Press, in press.

D. Povinelli and T. Eddy. *What Young Chimpanzees Know about Seeing*. Number Bd. 61,Nr. 3 in Monographs of the Society for Research in Child Development Serial Number 247, Volume 61, Number 3. John Wiley & Sons, 1996.

D. Povinelli and S. Giambrone. Inferring other mind: Failure of the argument by analogy. *Philosophical Topics*, 27(1):167–201, 1999.

D. Povinelli and J. Vonk. Chimpanzee minds: suspiciously human? *Trends in Cognitive Sciences*, 7(4):157–160, 2003.

D. Povinelli and J. Vonk. We don't need a microscope to explore the chimpanzee's mind. *Mind & Language*, 19(1):1–28, 2004.

D. Povinelli, K. Nelson, and S. Boysen. Inferences about guessing and knowing by chimpanzees (pan troglodytes). *Journal of Comparative Psychology*, 104(3): 203–210, 1990.

D. Povinelli, J. Bering, and S. Giambrone. Toward a science of other minds: Escaping the argument by analogy. *Cognitive Science*, 24(3):509–541, 2000.

D. Premack and G. Woodruff. Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, 1(04):515–526, 1978.

S. Savage-Rumbaugh, D. Rumbaugh, and S. Boysen. Sarah's problems of comprehension. *Behavioral and Brain Sciences*, 1(04):555–557, 1978.

M. Tomasello and J. Call. *Primate cognition*. Oxford University Press, 1997.

M. Tomasello and J. Call. Do chimpanzees know what others see – or only what they are looking at? In S. Hurley and M. Nudds, editors, *Rational Animals*, pages 371–384. Oxford University Press, 2006.

M. Tomasello, J. Call, and B. Hare. Five primate species follow the visual gaze of conspecifics. *Animal Behaviour*, 55(4):1063–1069, 1998.

M. Tomasello, B. Hare, and B. Agnetta. Chimpanzees, pan troglodytes, follow gaze direction geometrically. *Animal Behaviour*, 58(4):769 –777, 1999.

M. Tomasello, J. Call, and B. Hare. Chimpanzees understand psychological states - the question is which ones and to what extent. *Trends in Cognitive Sciences*, 7 (4):153–156, 2003a.

M. Tomasello, J. Call, and B. Hare. Chimpanzees versus humans: it's not that simple. *Trends in Cognitive Sciences*, 7(6):239–240, 2003b.

F. Warneken and M. Tomasello. Altruistic Helping in Human Infants and Young Chimpanzees. *Science*, 311(5765):1301–1303, 2006.

A. Whiten. Evolving a theory of mind: the nature of non-verbal mentalism in other primates. In S. Baron-Cohen, H. Tager-Flusberg, and D. Cohen, editors, *Understanding Other Minds: Perspectives from Autism*, pages 367–396. Oxford University Press, 1993.

A. Whiten. Grades of mindreading. In C. Lewis and P. Mitchell, editors, *Children's early understanding of mind: origins and development*, pages 47–70. Psychology Press, 1994.

H. Wimmer and J. Perner. Beliefs about beliefs: representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 103:103–128, 1983.