Received: 18 April 2016 | Revised: 22 September 2016 | Accepted: 24 October 2016

DOI 10.1111/phc3.12394

WILEY

ARTICLE

Chimpanzee mind reading: Don't stop believing

Kristin Andrews

York University, Canada

Correspondence
Kristin Andrews, Department of Philosophy, York University, Toronto, Canada.
Email: kristin.alexandra.andrews@gmail.com

Abstract

Since the question "Do chimpanzees have a theory of mind?" was raised in 1978, scientists have attempted to answer it, and philosophers have attempted to clarify what the question means and whether it has been, or could be, answered. *Mindreading* (a term used mostly by philosophers) or *theory of mind* (a term preferred by scientists) refers to the ability to attribute mental states to other individuals. Some versions of the question focus on whether chimpanzees engage in belief reasoning or can think about false belief, and chimpanzees have been given nonverbal versions of the false belief moved-object task (also known as the Sally–Anne task). Other versions of the question focus on whether chimpanzees understand what others can see, and chimpanzees can pass those tests. From this data, some claim that chimpanzees know something about perceptions, but nothing about belief. Others claim that chimpanzees do not understand belief or perceptions, because the data fails to overcome the "logical problem," and permits an alternative, non-mentalistic interpretation. I will argue that neither view is warranted. Belief reasoning in chimpanzees has focused on examining false belief in a moved object scenario, but has largely ignored other functions of belief. The first part of the paper is an argument for how to best understand belief reasoning and offers suggestion for future investigation. The second part of the paper addresses and diffuses the "logical problem." I conclude that chimpanzees may reason about belief, but that there is already compelling evidence that they reason about perceptions.

1 | INTRODUCTION

"Do chimpanzees mindread?" is the question, but to attempt to answer it, we need to know what it means. *Mindreading* (a term used mostly by philosophers) or *theory of mind* (a term preferred by scientists) generally refers to the ability to attribute mental states to other individuals. However, there are different kinds of mental states that might be attributed—states with phenomenal content such as emotions or moods; states with perceptual content such as images or auditions; states with procedural content such as such as know-how; propositional states such as beliefs, desires, hopes, and fears—and this is not an exhaustive catalogue. It is possible that the ability to see someone

as having one such state does not entail the ability to see someone as having all the others; young children might be able to mindread desire, but not belief, for example.

In the last 20 years, there has been a flurry of research on two versions of the question: do chimpanzees know what others believe; and do chimpanzees know what others perceive?[1] On the belief question, experimental studies have failed to find evidence that chimpanzees understand belief, and on the perception question, experimental studies have found evidence that chimpanzees understand what others see and hear. So one might think that we can conclude that while chimpanzees do not engage in belief reasoning, they do engage in perceptual reasoning. However, that conclusion would be too hasty. I will examine each question in turn and discuss what is being asked and what would serve as evidence of the capacity in question.

On the belief question, I will deny that we have any reason to conclude that chimpanzees do not mindread, even if we do not currently have overwhelming evidence that they do mindread beliefs. My argument goes beyond simple methodological points—that the absence of evidence is not evidence of the absence of a capacity[2] or that a statistical study cannot affirm the null hypothesis.[3] Rather, after examining what belief reasoning is, and the function of belief reasoning, I will argue that the logic behind the experimental paradigms used to test belief reasoning in apes is too narrow. All the experiments used to investigate belief reasoning in chimpanzees have focused on one aspect of belief reasoning, namely false belief reasoning. However, belief has other aspects as well; it is an amodal presentation of information—not tied to any perceptual sense—and it is used to explain behavior in addition to predicting it. If looking for evidence of mind reading in one place does not provide positive results, rather than quitting and suggesting that chimpanzees likely do not mindread, the next step would be to examine other aspects of belief. I previously suggested ways of examining chimpanzee mind reading in terms of seeking explanations of behavior (Andrews, 2012). Here I will suggest other ways to proceed and present evidence from the field suggesting that chimpanzees may indeed understand that others have different amodal informational states—beliefs.

On the perception question, the data used to support the claim that chimpanzees engage in perceptual reasoning has been challenged by those who think that chimpanzees can solve the experimental tasks without thinking about the minds of other animals—that they are behavior readers, not mind readers at all. There have been a number of rejoinders to this challenge. I will build upon previous work and aim to put the challenge to rest, affirming the conclusion that chimpanzees mindread perceptions. The current evidence supports the hypothesis that chimpanzees understand that other chimpanzees are minded; they understand what others perceive, feel, want, and know; and they understand others' personalities.

2 | MINDREADING BELIEFS IN CHIMPANZEES

2.1 | Experimental background

In the experiment that set off the research back in 1978, psychologists David Premack and Guy Woodruff wanted to know whether a 14-year-old chimpanzee named Sarah could attribute states of mind to a human actor in order to predict what the actor would do next (Premack and Woodruff, 1978). To test this, they asked Sarah to watch videos of a person trying to achieve a goal, such as warming up a cold room with a heater. Then Sarah was asked to indicate the human's goal by choosing the correct photograph. Sarah was proficient at this task, and Premack and Woodruff interpreted Sarah's performance as an understanding that the person had a certain intention and that she ascribed intention and knowledge (or desire and belief) to the person. In commentaries on the article, Dennett (1978), Bennett (1978), and Harman (1978) independently worried that Sarah's behavior could be explained via associative reasoning and suggested an alternative experiment based on asking whether chimpanzees can think that others have false beliefs. In particular, Harman suggested an experiment for examining whether chimpanzees attribute beliefs:

> *Suppose that a subject chimpanzee sees a second chimpanzee watch a banana being placed into one of two opaque pots. The second chimpanzee is then distracted while the banana is removed from the first pot and*

> *placed in the second. If the subject chimpanzee expects the second chimpanzee to reach into the pot which originally contained the banana, that would seem to show that it [sic] has a conception of mere belief (Harman, 1978, pp. 576–578).*

If Harman's proposal sounds familiar, it is because it became the basis for decades of research on chimpanzees, children, and infants. Child psychologists Hans Wimmer and Josef Perner (1983) tested children using a verbal version of what has come to be known as the *moved object false belief test*. Children watch a puppet show in which Maxi hides a piece of chocolate and then leaves the room. While Maxi is out, his mother finds the chocolate and moves it to another location. When Maxi comes back in the room to get his chocolate, the child is asked where Maxi will go to look for his chocolate. If children predict that Maxi will look for the chocolate where he left it, they then pass the test. But the child who predicts that Maxi will look for the chocolate where it really is fails. Passing the test is interpreted as being able to reason about beliefs.

Although human children pass this task between 4 and 5 years old (Wellman et al., 2001), and human infants appear to pass a nonverbal version of the task in the first years of life (Onishi & Baillargeon, 2005; Southgate et al., 2007), chimpanzees have failed to pass any published version of this task. Call and Tomasello (1999) designed a nonverbal false belief task modeled on the Maxi task that they used to test chimpanzees, orangutans, and children. The participants learned during training that the communicator could see in which of two boxes the hider placed a treat, though the subjects themselves could not tell. After the hider did his job, the communicator marked the box that contained the treat by placing a token on top of the box. Then the participants had the chance to choose one box, and they received the contents. Once a participant was competent at this task, they were given the false belief task. The situation started out the same, but after the hider placed the treat, the communicator left the room, and while she was gone, the hider switched the location of the two boxes, which were identical in appearance. When the communicator returned, she marked the box sitting in the location of the original placement of the treat, which, unbeknownst to her, was empty. Although 5-year-old children correctly gained the treat by choosing the unmarked box, 4-year-old children, chimpanzees, and orangutans persisted in choosing the marked box, receiving nothing.

Call and Tomasello later became convinced that this style of experiment is insufficient to elicit false belief understanding in great apes because it requires them to do something that is against their natural behavior; it requires them to cooperate and to understand that the communicator shared the food-seeking goal with the participant.[4] In order to avoid what Call and Tomasello saw as a barrier to demonstrating false belief reasoning, chimpanzees, bonobos, and children were given a competitive version of this task, in which the communicator was replaced by a competitor who reached for a container to get the treat for herself. Apes consistently reached for the same container as the competitor, even when the treat had been moved when the competitor was not looking; however, 5-year-old children did recognize the difference in the false belief condition (Krachun et al., 2009). Replacing the human competitor with a chimpanzee competitor did not facilitate the apes' ability to pass this false belief task either (Kaminski et al., 2008).

Carla Krachun, who worried that both cooperation and competition may interfere with passing the task, devised a new version of the false belief moved object task (Krachun et al., 2010). Her version of the task had chimpanzees watch a human who was supposed to put fruit into opaque boxes and then sort the boxes according to the type of food inside. Chimpanzees saw the experimenter put the food into the box, but did not see where the box was sorted; thus, they had to rely on their experience observing humans putting fruit into boxes in order to seek out the box in the right place. In the false belief conditions, the experimenter sorted the box in the wrong place, not realizing that the fruit inside was swapped when she was not looking. Chimpanzees who understand the scenario should put aside their own beliefs about where the box should be placed and choose the location corresponding to the experimenter's belief. The five chimpanzees tested failed to acquire the food in the false belief conditions, even though they reliably gained it in true belief conditions. Five-year-old children, on the other hand, were reliably successful in the false belief condition as well.

Given this consistent failure of chimpanzees to pass formal false belief tasks (especially, as we will see, because they are proficient at perception tasks), it might be tempting to conclude that chimpanzees lack the capacity to

understand false belief. After all, chimpanzees have failed false belief tests in four separate published studies. At some point, the bulk of negative evidence should lead to a negative conclusion.

However, the problems with that conclusion begin with worries facing the moved object false belief task—the only type of test that has been use to examine chimpanzee belief reasoning. It may be that this test is not the best way to elicit belief reasoning in chimpanzees, especially given that it also fails to elicit false belief reasoning in some human populations (see Lillard, 1998; Heyes and Frith, 2014, for reviews). A recent study in Samoa found that 5–7-year-old children consistently failed such a task, whereas it was passed by age-matched German children (Mayer & Träuble, 2015). This result is consistent with previous findings regarding false belief reasoning in Samoa. Although in some cases it appears that passing the task is delayed a few years, in others, the results are more drastic; a study in the Tainae community of Papua New Guinea failed to elicit a pass on the task with children up to 14 years old (Vinden, 1999). There are two possible interpretations of these findings. One is that children in these communities lack an understanding of others' beliefs. But the other interpretation, and the one I favor, is that the experiment does not elicit belief reasoning in these individuals. What appears to be the same experiment may be interpreted differently by people in different cultures, and this can lead to different results without reflecting real differences in the cognitive capacities being examined (see, e.g., Henrich et al., 2010, and commentary, especially Baumard and Sperber, 2010).

When we turn to using an experiment designed for human children on chimpanzee adults, the implementation of the paradigm can also result in the subjects responding differently for reasons having nothing to do with the capacity being tested. The primatologist Christophe Boesch has identified several significant differences between the children's and the chimpanzees' tests—chimpanzees are tested while separated and behind barriers, whereas children are tested in a social environment and often with their caregiver in the room; chimpanzees are tested by a member of another species with that species' materials, whereas children are tested by a member of their own species on their own materials; chimpanzee subjects are typically captive individuals, whereas child subjects are free-ranging individuals living in natural social groups (Boesch, 2007).

Given these considerations, the failure of researchers to design a moved-object false-belief test that elicits false-belief reasoning in the chimpanzees should not lead us to conclude that chimpanzees cannot mindread belief. Of course, it should not lead us to conclude that they do either. To move ahead, we can try to create a moved object false belief task that is interesting to chimpanzees and motivates them to pay attention to another's belief. Indeed, as this paper was going to press, we have the first published reports of apes passing a version of this task, but one that had nothing to do with hidden treats; the scenario that elicited false-belief prediction involved keeping track of an aggressive actor (Krupenye et al., 2016). Still, it would be a mistake to equate belief reasoning with the ability to pass a moved object false belief task. We can also consider the other roles of belief reasoning and look for evidence in those contexts.

2.2 | The nature and functions of belief reasoning

The current focus on false belief strikes me as a fetishization of Donald Davidson's claim that "error is what gives belief its point" (Davidson, 1975, p. 20). This idea stems from Davidson's commitment that to have a belief, one must have the concept of truth and falsity, the concept of belief, and, not least, language (Davidson, 1982, 1984). These concepts all arise together in young humans as they engage with competent language users who correct their errors.

However, Davidson's theory offers a terrible starting position for examining animal belief and mind reading, because he argues that using language is necessary both for having belief and attributing belief. Because the working hypothesis shared by all researchers investigating chimpanzee mind reading is that chimpanzees have beliefs, Davidson's theoretical perspective is at odds with the research program.

Instead of the focus on falsity, we can consider additional properties of belief that are widely shared. Although the nature of belief is disputed even in the human case, with advocates of belief as representational states (e.g., Fodor, 1975; Dretske, 1983, and for specific discussion of animal beliefs as representations, see Allen, 2013; Bermúdez, 2003; Rowlands, 2012), interpretive gambits (e.g., Dennett, 1989a, 1991, 2009, and on animal belief, see Dennett, 1989b, 1995, 1998), and dispositions (Braithwaite, 1933; Marcus, 1990; Schwitzgebel, 2001, 2002), there are some

properties that are widely accepted (see Lesson and Andrews, forthcoming, for a discussion of representationalism, interpretationism, and dispositionalism in animal belief). We can describe belief as a multifunctional, amodal cognitive process that has satisfaction conditions. Let us unpack it piece by piece.

The cognitive process aspect of belief is most typically understood as a mental representation with a direction of fit from world to mind, where the content of the belief is a propositional attitude (or something that tracks (Rowlands, 2012) or is geometrically similar to (Allen, 2013) the propositional attitude) that is accepted by the believer. Accepting the content can be understood as taking it to reflect the way the world is, as true, accurate, or reliable. Unlike perceptions, the content of the belief is not tied to a sensory modality. Less information is present in a belief than in a perception.

Accurate beliefs are multifunctional. Knowing facts about the world helps us to understand, to coordinate, to control, and to predict aspects of our world, and all of these functions offer value. The function of belief that has been of sole interest in the chimpanzee mind reading belief studies has been limited to one—predicting behavior. We do sometimes think about someone's belief to predict their behavior (e.g., my prediction that dad will vote for Hillary is based on my belief that he believes all the other candidates are incompetent). However, I have argued that the need to think about belief when predicting behavior more generally is greatly overblown (Andrews, 2012). In most cases, and even in moved object false belief scenarios, it is cognitively simpler to use heuristics than to try to figure out what exactly another believes and desires. For example, I can predict that Maxi will look for the chocolate in the box, because that is where he left it. If we turn to the verbal explanations 4-year-old children give after passing the Maxi task, they typically refer to the situation, not to belief, with responses such as, "He looked for the chocolate there because that's where he left it" (Wimmer & Mayringer, 1998, Andrews and Verbeek, unpublished Perner et al., 2002).

Human belief reasoning is apparent in our explanations of behavior; I can explain dad's vote for Hillary in terms of his belief about the other candidates. When we explain people's actions in terms of their beliefs and desires, we do not just offer a reason for their action, but in many cases, we also provide a justification, explaining behavior in terms of belief allows us to rehabilitate the reputation of individuals who acted outside of the social norms (Malle et al., 2000). For our hominid ancestors and current ape cousins, being able to explain the behaviors of group members in terms of their reasons for action could offer a significant advantage, preserving the cohesion of social groups and permitting the spread of innovative behaviors and cumulative culture (see Andrews, 2012).

Chimpanzee belief-reasoning research could investigate the various aspects of belief. Although looking for belief reasoning in chimpanzees by examining false belief about moved objects is a fine place to start, it is a terrible place to end; there are so many other places to look.

2.3 | Moving forward investigating chimpanzee belief reasoning

Given the many different functions of belief reasoning, we can turn to a consideration of which situations might naturally elicit belief reasoning in chimpanzees. Chimpanzees' natural fission-fusion social structure, in which not all social members are visible to one another at all times, may offer a number of conditions in which it would make sense to think about others' beliefs. Chimpanzees may be more inclined to think about another's beliefs when they are worried about another's safety (e.g., he thinks it is safe there but really there is a scary human), when they are developing novel technology (e.g., she thinks that creating a brush at the tip of her probe tool will acquire more termites, so I should adopt that approach too), when a communicative message failed (e.g., I want him to do A but he does not know that is what I am saying; how can I better provide the information?), or when they are trying to explain or justify anomalous behavior (e.g., what was he thinking when he did A? why did he make that face, give that scream, and manipulate the material that way?).

There is one further experiment on chimpanzee belief reasoning that should be discussed in this context—a test of wild chimpanzees that has nothing to do with moved objects. A group of field researchers examined whether wild chimpanzees are more likely to inform an ignorant chimpanzee of danger than a chimpanzee who already has the information (Crockford et al., 2012). In this study, researchers placed a model of a snake on the projected travel path

of a chimpanzee group and recorded the alarm call behavior of the chimpanzees. They found that although the chimpanzees who first encountered the snake gave alarm calls, they were less likely to call when informed individuals returned to the area, but more likely to call when naïve individuals came into proximity with the snake model. It appears that chimpanzees know which of their peers already believe that there is a snake in the area and thus do not need to be warned and that they know which of their peers do not believe there is a snake around and thus do need to be warned.

What is particularly interesting about this study is that the chimpanzees callers treated as naïve those who neither saw the snake nor heard the prior alarm call, and they treated as knowledgeable those who either saw the snake or heard the alarm calls. That is, the chimpanzees did not rely on information from a single modality, but they were able to combine seers and hearers into a category of knowledgeable and those who neither see nor hear as naïve. In this way, they are demonstrating sensitivity to the amodal nature of belief, as representing the information "there is a snake here" regardless of how that information was acquired.

Because alternative explanations are possible, this study should not be taken as definitive evidence that chimpanzees understand others' beliefs. The informant chimpanzees might not have been reasoning about a naïve chimpanzee's belief state, but rather about their prior proximity to the snake, for example. However, this study does raise the likelihood that chimpanzee engages in belief reasoning. Evidence in favor, or against, chimpanzee belief mind reading requires evidence from a variety of contexts that may elicit belief reasoning in chimpanzees. To continue seeking evidence about belief reasoning in chimpanzees requires doing different kinds of experiments, in the field and in the lab, and it requires examining wild chimpanzee behavior for evidence and for clues into the kinds of situations that might elicit belief reasoning. In particular, ethologists who can describe patterns of behavior in wild chimpanzees will provide evidence that avoids Boesch's methodological worries about experimental research on captive chimpanzees can corroborate (or challenge) experimental research findings. In particular, those who accept interpretationism or dispositionalism about belief will be interested less in supposed acid tests such as the moved-object false-belief task and more in sensible patterns of behavior. According to Dennett's intentional systems theory, for example, if chimpanzees engaged in robust patterns of behavior that are usefully predicted and explained through attributing mind reading abilities to them, we should conclude that they mindread (Dennett, 2009). The patterns of behavior have to be widespread, and not just exist in a single domain, in order to produce a useful appeal to the cognitive capacity.

A good theory is going to be based on a robust body of evidence. The worry with the chimpanzee mind reading research is that the body of evidence that is used to decide between theories is too thin. Gilbert Harman, who first suggested the moved object false belief task structure in his commentary on Premack and Woodruff's formative paper, also popularized abduction as an inference method (Harman, 1965). Abduction is an inference to the best explanation method, and, as an inference method, it is only as strong as the body of evidence is large. Harman, least of all, would suggest we stop examining chimpanzee belief reasoning after testing them on versions of his proposed false belief test. We need to look for chimpanzee belief reasoning in other, chimpanzee-relevant contexts as well, taking into account the nature, and function, of belief.

3 | MINDREADING PERCEPTIONS IN CHIMPANZEES

3.1 | Experimental background

Independently of whether chimpanzees understand that others have beliefs, they may have some understanding of others' perceptual states—what others see, hear, or smell. Daniel Povinelli and colleagues' initial experimental attempts to find evidence that chimpanzees understand what other chimpanzees see failed to find any evidence of this capacity (Povinelli & Eddy, 1996). Povinelli and Eddy gave chimpanzees the opportunity to request food from one of two humans, when the humans had different visual access (e.g., due to buckets on their heads or not, eyes

open and pointed forward or eyes pointed away). Overall, chimpanzees failed to discriminate between the seeing human and the non-seeing human.

In response to these tests, Brian Hare suggested that the problem might be social rather than cognitive. He suggested that because chimpanzees do not tend to cooperate, the begging tests might not be the best way to elicit chimpanzee sensitivity to perceptual state. Hare and colleagues offered subordinate chimpanzee subjects a chance to compete for food with a dominant chimpanzee (Hare et al., 2000, 2001). In these studies the subordinate and dominant chimpanzees were released into a room via two doors across from one another. Because subordinate chimpanzees are not allowed to take food from a dominant chimpanzee, the subordinate would not take food that he expected the dominant would try to eat. The experimenters set up the room so as to sometimes hide a piece of food from the dominant; the subordinate always saw where the food was. The results indicated that the subordinate chimpanzees avoided food that the dominants could see, or saw being hidden, and would seek out food that the dominant did not see, which suggests that chimpanzees understand what others can see (Figure 1).

A number of other studies found evidence that chimpanzees understand what others can see, as well as what they can hear. In another prominently discussed study, Melis et al. (2006) examined whether chimpanzees that compete with a human prefer to reach through an opaque tunnel or a transparent tunnel to gain food. Right away, chimpanzees preferred using the sneakier opaque tunnel. In another condition, they examined whether chimpanzees preferred using a noisy trapdoor or a silent trapdoor to get food, and again, they preferred the sneaky, silent way. Given these results, the researchers conclude that chimpanzees understand others' perceptual states.

3.2 | The logical problem

Although these findings are widely interpreted as evidence for chimpanzee perceptual reasoning, Povinelli and his colleagues Vonk (Povinelli & Vonk, 2003, 2004) and Penn (Penn & Povinelli, 2007; Penn et al., 2008) disagree. Their alternative explanation is that because chimpanzees have observed chimpanzee food behavior all their lives, they have already formed behavioral regularities between chimpanzee behavior or bodily posture and chimpanzee action. For example, chimps may know that when a dominant turns his head toward food, he will next move to get the food. These chimpanzees may be reading behavior, rather than reading minds.

This possible explanation of chimpanzees' success on the perceptual tasks leads to the challenge that has come to be known as the *logical problem*. This problem stems from the fact that in order to read minds or to read behavior, an agent has to notice the observable features of the subject—the behavior, body posture, facial expressions, and so

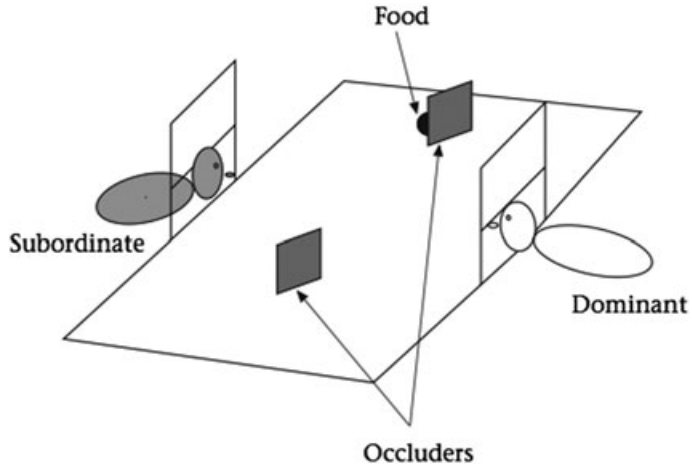

FIGURE 1 The chimpanzee food competition set-up, from Hare et al., 2001

forth. Where the behavior reader can make an inference directly from these observable features to future behavior, the mind reader must, as well, make an indirect inference to a hidden mental state before judging future behavior, as follows:

BR: S's behavior at t_1 + knowledge about behavioral regularities → S's behavior at t_2;

MR: S's behavior at t_1 + knowledge about behavioral regularities → S's beliefs and desires → S's behavior at t_2.

The problem arises because all of the observable features of the situations are the same in both conditions. Povinelli and Vonk claim that although both humans and chimpanzees have a theory of behavior, humans also have —built on top of their theory of behavior—a theory of mind. This means that to be a mind reader, one must also be a behavior reader.

To get out of the dilemma, Povinelli and Vonk propose that we need a test in which the information provided by the observable features of the situation is not the same as the information provided by the actor's mental states; for example, the chimpanzee has to experience a situation in which she lacks knowledge of behavioral regularities, but still would be able to figure out what mental states are ascribed. They endorse an early suggestion of Cecilia Heyes's that a test that would avoid the logical problem could take the form of an experience projection task (Heyes, 1998). The idea behind such a test is to give the chimpanzee subject experience with the different affordances, or potentials for action, of two objects that look, from the outside, to have the same affordances—for example, two pairs of goggles, one that is transparent and the other opaque. If a chimpanzee learns from his own experience that the red goggles are transparent, and the blue goggles are opaque, and if that chimpanzee understands seeing, he could predict that another chimpanzee who wears the red goggles will be able to see and hence to do things, whereas the chimpanzee who wears the blue goggles will not be able to see.

Importantly, there are two ways of interpreting the challenge raised by the logical problem. According to the weaker interpretation, the challenge is merely to show that the chimpanzee is using an intervening variable between observable behavior and movement. According to the stronger interpretation, there needs to be evidence that the intervening variable is a properly mentalistic one (e.g., Lurz, 2011).

On the stronger interpretation, I have argued that the experience projection task will not solve the problem because the chimpanzee might reason from his ability to do things with the red goggles to predict that another chimpanzee wearing red goggles can do things, without thinking about seeing per se (Andrews, 2005). Rather than generalizing from his mental experience with the goggles, the chimpanzee may be generalizing from his physical experience.

If this kind of experiment can still not decide between mind reading and behavior reading, then perhaps the issue is not empirically tractable. I think that conclusion is correct. Consider this case: a non-mentalistic creature correctly categorizes behaviors in the same way a mentalist does, but those categories are qualitatively understood non-mentalistically. This creature uses non-mentalistic intervening variables to group all cases involving another seeing (e.g., hiding fear grins with one's hands, hiding one's body behind a rock, or seeking out hidden food). In this case, the non-mentalistic creature's behavior will be identical to the mentalist's behavior; only the non-mentalist will lack the de dicto characterization of the states of affairs as cases of seeing. There would be qualitative differences between this non-mentalist and a mentalist, but functionally, they would behave the same way. What this shows is that the strong interpretation of the logical problem leads us to chimpanzee zombies. I conclude that the strong version of the logical problem is a form of the general skeptical problem of other minds and is not the sort of problem with which science needs to be concerned (Andrews, 2015).

The weaker interpretation appears to be what Povinelli and Vonk have in mind when they raise the problem (Buckner, 2014). So long as there is evidence of an intervening variable that the chimpanzee uses to predict behavior, we have evidence of mind reading. The experience projection task is one way to find this evidence, and indeed, recent studies on chimpanzees (Karg et al., 2015) and ravens (Bugnyar et al., 2016) have found that members of each species can pass a species appropriate version of the goggles task. Thus, it seems that the challenge raised by the logical problem, no matter the interpretation, has been defused.

4 | CONCLUSIONS

Given the functions of belief reasoning, we don't have sufficient evidence to conclude that chimpanzees do mindread beliefs, but certainly it would be premature to conclude that they do not. Furthermore, there is currently strong evidence, from a variety of sources, that chimpanzees mindread perceptual states, and the logical problem challenges have been dealt with.

Despite these conclusions, there remains a problem with the assumption that brought the logical problem to the fore in the first place–an implicit assumption that is widely shared among many working in the field. Removing this assumption, or at least acknowledging it, will help to advance research in animal mind reading. This assumption is that mind reading capacity will be built on top of a prior behavior reading capacity that requires no appeal to mentality. The idea is that individuals first understand behavior and only later come to understand mind—in both a developmental and evolutionary sense. However, mind reading includes understanding that others have minds, are intentional agents, have emotions, personalities, preferences, perspectives, beliefs, desires, fears, hopes, memories, postulates, and so forth. A mind reader is, first and foremost, able to distinguish intentional agents from rocks, rivers, and artifacts (Andrews, 2012).

To claim that one reads behavior before reading minds is to assume that humans, at some stage in their lives, were unable to distinguish between agents and non-agents, but at that time were able to form theories about the typical behavior of agents. That means that there was a time social creatures were unable to distinguish intentional agents from rocks, rivers, and artifacts. Such a picture is implausible. Human infants start to distinguish intentional from accidental behaviors by 5 months (Woodward, 1999); they can discriminate happy from sad emotional expressions by 5 months (Caron et al., 1988), and by 6 months, children distinguish animate from inanimate objects (see Rakison and Poulin-Dubois (2001) for a review). Given the biological connections that occur in mammals like humans and chimpanzees, the behavior reader's picture of us as starting out as impersonal scientists who take a spectatorial view toward our caregivers, siblings, and friends is hard to swallow.

By acknowledging the starting assumptions about the nature and function of belief attribution and about the unavoidability of reacting to minds as minds, we can make better progress in understanding the ways in which humans and other animals understand the other minds that are so central to our existence and flourishing.

NOTES

[1] This is not to suggest that other mental states have not been investigated; there is evidence the chimpanzees understand what others know (Kaminski et al. 2008) and hear (Melis et al. 2006), for example. Furthermore, I do not mean to suggest that chimpanzees and the other great apes are the only species that have been examined. Mindreading has also been investigated in monkeys (Drayton & Santos 2016; Flombaum & Santos 2005; Marticorena et al. 2011; Martin & Santos 2014; Santos et al. 2006), corvids (Bugynar et al. 2016; Bugynar et al. 2007; Dally et al. 2006; Emery & Clayton 2004), elephants (Nissani 2004), dogs (Hare et al. 1998; Hare & Tomasello 1999; Brauer et al. 2006; Udell et al. 2011) and dolphins (Browne 2004; Herman et al. 1999; Reiss 2012; Tomonaga et al. 2010; Tschudin et al. 2001; White 2009).

[2] To be fair, my criticism is related to this first point, but it goes deeper. I am concerned that the types of false belief moved object tasks given to chimpanzees have not elicited their false belief understanding not because they lack the capacity to respond to others' false beliefs, but because the particular tasks they have been given have not been created from the chimpanzee's point of view. A task that elicits a chimpanzee's facility with false belief could come from the ethologist's focus on interviewing animals in their own languages, as Nikolaas Tinbergen put it.

[3] For a discussion of this point, see Andrews and Huss (2014) and Mikhalevich (2015).

[4] Note that the view that chimpanzees do not cooperate is disputed by field researchers who observe chimpanzees acting together to hunt, to patrol boundaries, to fight with neighbors, and to cross roads (for a review, see Andrews and Gruen (2014)). However, it is true that chimpanzees in the wild do not indicate the location of hidden food to one another, so that specific kind of cooperation is not a natural behavior.

WORKS CITED

Andrews, K. (2005). Chimpanzee theory of mind: Looking in all the wrong places? *Mind & Language*, *20*, 521–536.

Andrews, K. (2012). *Do apes read minds? Toward a new folk psychology*. Cambridge, MA: MIT Press.

Andrews, K. (2015). *The animal mind: An introduction to the philosophy of animal cognition*. London: Routledge.

Andrews, K., & Huss, B. (2014). Anthropomorphism, anthropectomy, and the null hypothesis. *Biology and Philosophy*, 1–19.

Andrews, K., & Verbeek, P. (unpublished). Does explanation precede prediction in false belief understanding?

Andrews, K., & Gruen, L. (2014). Empathy in other apes. In H. L. Maibom (Ed.), *Empathy and morality* (pp. 193–209). Oxford: Oxford University Press.

Allen, C. (2013). The geometry of partial understanding. *American Philosophical Quarterly*, *50*(3), 249–262.

Baumard, N., & Sperber, D. (2010). Weird people, yes, but also weird experiments. *Behavioral and Brain Sciences*, *33*(2–3), 84–85.

Bennett, J. (1978). Commentary on three papers about animal cognition. *The Behavioral and Brain Sciences*, *1*, 556–560.

Bermudez, J. (2003). *Thinking without words*. Cambridge, MA: MIT Press.

Boesch, C. (2007). What makes us human (Homo sapiens)? The challenge of cognitive cross-species comparison. *Journal of Comparative Psychology*, *121*, 227–240.

Braithwaite, R. B. (1933). The nature of believing. *Proceedings of the Aristotelian Society*, *33*, 129–146.

Brauer, J., Kaminski, J., Riedel, J., Call, J., & Tomasello, M. (2006). Making inference about the location of hidden foods: Social dog, causal ape. *Journal of Comparative Psychology*, *120*, 38–47.

Browne, D. (2004). Do dolphins know their own minds? *Biology and Philosophy*, *19*(4), 633–653.

Buckner, C. (2014). The semantic problem(s) with research on animal mind-reading. *Mind & Language*, *29*(5), 566–589.

Bugnyar, T., Reber, S. A., & Buckner, C. (2016). Ravens attribute visual access to unseen competitors. *Nature Communications*, *7*, 10506.

Bugnyar, T., Schwab, C., Schloegl, C., Kotrschal, K., & Heinrich, B. (2007). Ravens judge competitors through experience with play caching. *Current Biology*, *17*(20), 1804–1808.

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

Caron, A. J., Caron, R. F., & MacLean, D. J. (1988). Infant discrimination of naturalistic emotional expressions: The role of face and voice. *Child Development*, *59*(3), 604–616.

Crockford, C., Wittig, R. M., Mundry, R., & Zuberbühler, K. (2012). Wild chimpanzees inform ignorant group members of danger. *Current Biology*, *22*(2), 142–146.

Dally, J. M., Emery, N. J., & Clayton, N. S. (2006). Food-caching western scrub-jays keep track of who was watching when. *Science*, *312*, 1662–1665.

Davidson, D. (1975). Thought and talk. In S. Guttenplan (Ed.), *Mind and Language*. (pp. 7–24). Oxford: Oxford University Press.

Davidson, D. (1982). Rational animals. *Dialectica*, *36*, 317–327.

Davidson, D. (1984). *Inquiries into truth and interpretation*. Oxford: Oxford University Press.

Dennett, D. C. (1978). Beliefs about beliefs. *Behavioral and Brain Sciences*, *4*, 568–570.

Dennett, D. C. (1989a). *The intentional stance*. APA: MIT Press.

Dennett, D. C. (1989b). Cognitive ethology: Hunting for bargains or a wild goose chase? In Montefiore (Ed.), *Goals, no-goals and own goals*. Unwin Hyman.

Dennett, D. C. (1991). Real Patterns. *Journal of Philosophy*, *87*, 27–51.

Dennett, D. C. (1995). Do animals have beliefs? In H. Roitblat, & J. Meyer (Eds.), *Comparative approaches to cognitive science*. Cambridge, MA: MIT Press.

Dennett, D. (1998). Out of the armchair. In D. Dennett (Ed.), *Brainchildren: Essays on designing minds*. Cambridg, MA: MIT Press.

Dennett, D. C. (2009). Intentional systems. In B. McLaughlin, A. Beckermann, & S. Walter (Eds.), *The Oxford handbook of philosophy of mind*. Oxford: Oxford University Press.

Drayton, L., & Santos, L. R. (2016). A decade of theory of mind research on Cayo Santiago: Insights into rhesus macaque social cognition. *American Journal of Primatology*, *78*(1), 106–116.

Dretske, F. (1983). The epistemology of belief. *Synthese*, *55*(1), 3–19.

Emery, N. J., & Clayton, N. S. (2004). Western scrub-jays (Aphelocoma Californica) use cognitive strategies to protect their caches from thieving conspecifics. *Animal Cognition*, *7*, 37–43.

Flombaum, J. I., & Santos, L. R. (2005). Rhesus monkeys attribute perceptions to others. *Current Biology*, (15), 447–452.

Fodor, J. (1975). *The language of thought*. New York: Thomas Y. Crowell.

Hare, B., & Tomasello, M. (1999). Domestic dogs (Canis Familiaris) use human and conspecific social cues to locate hidden food. *Journal of Comparative Psychology*, *113*, 1–5.

Hare, B., Call, J., & Tomasello, M. (1998). Communication of food location between human and dog (Canis Familiaris). *Evolution of Communication*, *2*, 137–159.

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

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

Harman, G. (1978). Studying the chimpanzees' theory of mind. *Behavioral and Brain Sciences*, *1*, 576–577.

Harman, G. (1965). The inference to the best explanation. *Philosophical Review*, *74*, 88–95.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world. *Behavioral and Brain Sciences*, *33*, 61–135.

Herman, L. M., Abichandani, S. L., Elhajj, A. N., Herman, E. Y. K., Sanchez, J. L., & Pack, A. A. (1999). Dolphins (Tursiops Truncatus) comprehend the referential character of the human pointing gesture. *Journal of Comparative Psychology*, *113*(4), 347–364.

Heyes, C. (1998). Theory of mind in nonhuman primates. *Behavioral and Brain Sciences*, *21*, 101–134.

Heyes, C. M., & Frith, C. D. (2014). The cultural evolution of mind reading. *Science*, *344*(6190), 1243091.

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

Karg, K., Schmelz, M., Call, J., & Tomasello, M. (2015). The goggles experiment: can chimpanzees use self-experience to infer what a competitor can see? *Animal Behaviour*, *105*, 211–221.

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

Krachun, C., Carpenter, C. M., Call, J., & Tomasello, M. (2010). A new change-of-contents false belief test: Children and chimpanzees compared. *International Journal of Comparative Psychology*, *23*(2).

Krupenye, C., Kano, F., Hirata, S., Call, J., & Tomasello, M. (2016). Great apes anticipate that other individuals will act according to false beliefs. *Science*, *354*(6308), 110–114.

Lesson S.B. and Andrews K. (forthcoming). Belief and representation in nonhuman animals. In Paco Calvo, Sarah Robins, & John Symons, (eds.), *The Routledge handbook of philosophy and psychology*.

Lillard, A. S. (1998). Ethnopsychologies: Cultural variations in theories of mind. *Psychological Bulletin*, *123*, 3–32.

Lurz, R. (2011). *Mindreading animals*. Cambridge, MA: MIT Press.

Malle, B. F., Knobe, J., O'Laughlin, M. J., Pearce, G. E., & Nelson, S. E. (2000). Conceptual structure and social functions of behavior explanations: Beyond person–situation attributions. *Journal of Personality and Social Psychology*, *79*, 309–326.

Marcus, R. B. (1990). Some revisionary proposals about belief and believing. *Philosophy and Phenomenological Research*, *50*, 133–153.

Marticorena, D. C. W., Ruiz, A. M., Mukerji, C., Goddu, A., & Santos, L. R. (2011). Monkeys represent others' knowledge but not their beliefs. *Developmental Science*, *14*(6), 1406–1416.

Martin, A., & Santos, L. R. (2014). The origins of belief representation: Monkeys fail to automatically represent others' beliefs. *Cognition*, *130*(3), 300–308.

Mayer, A., & Träuble, B. (2015). The weird world of cross-cultural false-belief research: A true- and false-belief study among Samoan children based on commands. *Journal of Cognition and Development*, *16*(4), 650–665.

Melis, A. P., Call, J., & Tomasello, M. (2006). Chimpanzees conceal visual and auditory information from others. *Journal of Comparative Psychology*, *120*, 154–162.

Mikhalevich, I. (2015). Experiment and animal minds: Why the choice of the null hypothesis matters. *Philosophy of Science*, *82*(5), 1059–1069.

Nissani, M. (2004). Theory of mind and insight in chimpanzees, elephants, and other animals? In L. J. Rogers, & G. Kaplan (Eds.), *Comparative vertebrate cognition*. (pp. 227–261). US: Springer.

Onishi, K. H., & Baillargeon, R. (2005). Do 15-month-old infants understand false beliefs? *Science*, *308*, 255–258.

Penn, D. C., & Povinelli, D. J. (2007). On the lack of evidence that non-human animals possess anything remotely resembling a "theory of mind". *Philosophical Transactions of the Royal Society B*, *362*, 731–744.

Penn, D. C., Holyoak, K. J., & Povinelli, D. J. (2008). Darwin's mistake: Explaining the discontinuity between human and nonhuman minds. *Behavioral and Brain Sciences*, *31*, 109–178.

Perner, J., Lang, B., & Kloo, D. (2002). Theory of mind and self-control: More than a common problem of inhibition. *Child Development*, *73*, 752–767.

Povinelli, D. J., & Eddy, T. J. (1996). What young chimpanzees know about seeing. *Monographs of the Society for Research in Child Development*, *61*, 1–152.

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

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

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

Rakison, D. H., & Poulin-Dubois, D. (2001). Developmental origin of the animate–inanimate distinction. *Psychological Bulletin*, *127*(2), 209–228.

Reiss, D. (2012). *The Dolphin in the mirror: Exploring dolphin minds and saving dolphin lives*. Boston: Mariner Books.

Rowlands, M. (2012). *Can animals be moral?* New York: Oxford University Press.

Santos, L. R., Nissen, A. G., et al. (2006). Rhesus monkeys, Macaca Mulatta, know what others can and cannot hear. *Animal Behaviour*, *71*, 1175–1181.

Schwitzgebel, E. (2001). In-between believing. *The Philosophical Quarterly*, *51*, 76–82.

Schwitzgebel, E. (2002). A Phenomenal, Dispositional Account of Belief. *Nous*, *36*, 249–275.

Southgate, V., Senju, A., & Csibra, G. (2007). Action anticipation through attribution of false belief by 2-year-olds. *Psychological Science*, *18*, 587–592.

Tomonaga, M., & Uwano, Y. (2010). Bottlenose dolphins' (Tursiops truncatus) theory of mind as demonstrated by responses to their trainers' attentional states. *International Journal of Comparative Psychology*, *23*(3), 386–400.

Tschudin, A., Call, J., Dunbar, R. I. M., Harris, G., & van der Elst, C. (2001). Comprehension of signs by dolphins (*Tursiops Truncatus*). *Journal of Comparative Psychology*, *115*(1), 100–105.

Udell, M. A. R., Dorey, N. R., & Wynne, C. D. L. (2011). Can your dog read your mind? Understanding the causes of canine perspective taking. *Learning & Behavior*, *39*(4), 289–302.

Vinden, P. (1999). Children's understanding of mind and emotion: A multi-culture study. *Cognition and Emotion*, *13*, 19–48.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development*, *72*, 655–684.

White, T. (2009). *In defense of dolphins: The new moral frontier*. John Wiley & Sons.

Wimmer, H. J., & Mayringer, H. (1998). False belief understanding in young children: Explanations do not develop before predictions. *International Journal of Behavioral Development*, *22*, 403–422.

Wimmer, H. J., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, *13*, 103–128.

Woodward, A. L. (1999). Infants' ability to distinguish between purposeful and non-purposeful behaviors. *Infant Behavior & Development*, *22*, 145–160.

How to cite this article: Andrews, K. (2016), Chimpanzee mind reading: Don't stop believing, *Philosophy Compass*, doi: 10.1111/phc3.12394

AUTHOR BIOGRAPHY

Kristin Andrews' research interests span philosophy, psychology, and animal cognition research, and she works on issues in folk psychology, moral psychology, and methodology in animal cognition research. Andrews has published two books: *Do Apes Read Minds? Toward a New Folk Psychology* (MIT) is a defense of her normative and pluralistic theory of folk psychology; and *The Animal Mind* (Routledge, 2015) shows how empirical work on animal minds can help to inform debates the nature of belief, communication, and consciousness. Andrews has published her theoretical work in journals including *Mind and Language*, *Synthese*, *Philosophical Psychology*, *Journal of Consciousness Studies*, *Biology and Philosophy*, *Inquiry*, *Review of Philosophy and Psychology*, *Philosophical Explorations*, and *Southern Journal of Philosophy*. Her scientific research on orangutan communication has been published in *Biology Letters* and *Communicative and Integrative Biology*. Andrews is a member of the Royal Society of Canada's College of New Scholars, and her research is supported by the Social Sciences and Humanities Research Council of Canada. Andrews is currently an associate professor in the Department of Philosophy and Cognitive Science Program at York University, in Toronto, Canada. She received her PhD in Philosophy from the University of Minnesota in 2000 and holds a BA in philosophy from Antioch College and an MA in philosophy from Western Michigan University. In addition to her academic duties, she serves as a member of the Executive Board for The Borneo Orangutan Society Canada, which has the mission to promote conservation of orangutans and their habitat as well as to educate the public.