Do 18-Month-Olds Really Attribute Mental States to Others? : A Critical Test

Atsushi Senju, Victoria Southgate, Charlotte Snape, Mark Leonard and Gergely Csibra

Psychological Science 2011 22: 878 originally published online 3 June 2011
DOI: 10.1177/0956797611411584

Research Report

Psychological Science
22(7) 878–880

DOI: 10.1177/0956797611411584
http://pss.sagepub.com

Do 18-Month-Olds Really Attribute Mental States to Others? A Critical Test

Atsushi Senju[1], Victoria Southgate[1], Charlotte Snape[2], Mark Leonard[2], and Gergely Csibra[3]

[1]Centre for Brain and Cognitive Development, Birkbeck, University of London; [2]Department of Psychological Sciences, Birkbeck, University of London; and [3]Department of Cognitive Science, Central European University

Abstract

In the research reported here, we investigated whether 18-month-olds would use their own past experience of visual access to attribute perception and consequent beliefs to other people. Infants in this study wore either opaque blindfolds (opaque condition) or trick blindfolds that looked opaque but were actually transparent (trick condition). Then both groups of infants observed an actor wearing one of the same blindfolds that they themselves had experienced, while a puppet removed an object from its location. Anticipatory eye movements revealed that infants who had experienced opaque blindfolds expected the actor to behave in accordance with a false belief about the object's location, but that infants who had experienced trick blindfolds did not exhibit that expectation. Our results suggest that 18-month-olds used self-experience with the blindfolds to assess the actor's visual access and to update her belief state accordingly. These data constitute compelling evidence that 18-month-olds infer perceptual access and appreciate its causal role in altering the epistemic states of other people.

Keywords

theory of mind, infants, eye tracking, social cognition

Received 10/20/10; Revision accepted 3/22/11

Recent studies have indicated that human infants are able to spontaneously understand that other people's actions are driven by their beliefs about the real world, even when those beliefs are false (Buttelmann, Carpenter, & Tomasello, 2009; Kovács, Téglás, & Endress, 2010; Scott & Baillargeon, 2009; Song, Onishi, Baillargeon, & Fisher, 2008; Southgate, Chevallier, & Csibra, 2010; Southgate, Senju, & Csibra, 2007; Surian, Caldi, & Sperber, 2007). These findings have been met with skepticism because children at this age usually fail traditional explicit tests of false-belief understanding; some psychologists have suggested that the infants' success in these recent studies reflects a reliance on behavioral cues rather than mental-state attribution (Perner & Ruffman, 2005). Such alternative explanations cannot be completely ruled out because all these studies used behavioral cues to indicate the presence of true or false beliefs.

One way to attempt to resolve this controversy is to create a paradigm in which different infants would attribute different mental states to exactly the same person in the same event. A manipulation that could lead to such an ideal experiment was proposed by Heyes (1998) and implemented by Meltzoff and Brooks (2008) to test 18-month-olds' attribution of visual access to other people. In Meltzoff and Brooks's study, infants were provided with either an opaque blindfold or a trick blindfold (which appeared opaque but was in fact transparent). Those who had worn the trick blindfold subsequently followed a blindfolded adult's gaze, but those who had worn the opaque blindfold did not. These results suggest that infants' attribution of perceptual access to other people is modulated by their own past experience of visual access.

In the study we report here, we investigated whether 18-month-olds would use their own past experience of visual access to attribute perception and consequent beliefs to another person. Infants first wore either opaque blindfolds or trick blindfolds (which appeared to be identical to the opaque blindfolds) and subsequently watched a video sequence in which an actor wore what appeared to be the same kind of blindfold while an object was displaced in front of her. By measuring visual anticipation, we assessed whether the infants' own experience with the blindfolds influenced their predictions of where the actor would search for the displaced object. Because the infants could not observe either themselves or other people wearing the blindfolds, they had no opportunity to acquire

Corresponding Author:
Atsushi Senju, Centre for Brain and Cognitive Development, Birkbeck, University of London, Malet Street, London WC1E 7HX, United Kingdom
E-mail: a.senju@bbk.ac.uk

possible associations between blindfold wearing and observable behaviors; thus, any differences in infants' expectations following the different blindfold experiences would necessarily be the result of attributing an unobservable mental state to the actor.

Method

Thirty-six infants (23 male, 13 female; ages 17.5 to 18.5 months, M = 18.0 months) were randomly assigned to either an opaque (n = 18) or a trick (n = 18) condition. Twelve additional infants were tested but were excluded from the analyses, because they did not show anticipatory saccades by the end of the familiarization trials in the test phase (n = 4; 2 in the opaque and 2 in the trick condition), looked away from the stimuli at the critical moment in the test trial (n = 4; 2 in the opaque and 2 in the trick condition), did not look at one of the two windows (the location to which the anticipatory saccade should have been made) on the test trial (n = 3; 1 in the opaque and 2 in the trick condition), or did not complete the familiarization phase (1 infant in the trick condition).

During familiarization, each infant was introduced to one of two pairs of blindfolds, either a pair of opaque blindfolds or a pair of trick blindfolds. Each pair consisted of a broad cloth (29 cm × 29 cm) and a narrow cloth (51 cm × 6 cm); all blindfolds were made of black cloth with pink trimming around the edge to make them easily identifiable. The opaque and trick blindfolds looked identical, but the absence of a thick middle layer in the trick blindfolds made it possible for the wearer to see through. Infants were presented with various pictures and toys while a blindfold was interposed between their eyes and the objects. On each such trial, the experimenter asked, "Where's the [object label]?" Across trials, each infant experienced both blindfolds in the pair appropriate to that infant's condition. This familiarization lasted for 5 min and provided the infant with experience about the optical properties of the opaque or the trick (see-through) blindfolds, depending on the condition to which the infant was assigned.

During the test phase, infants watched a video similar to the one used in our previous study (Southgate et al., 2007). The video, which was presented on a Tobii 1750 eye tracker (Tobii Technology, Danderyd, Sweden), consisted of five trials. In the video, a female actor sat behind a panel with two windows. In front of the panel there were two boxes on a table. The first two trials began with a small toy in view on one of the boxes. Next, simultaneous illumination of the windows and sounding of a chime indicated that the actor was going to reach through one of the windows. After a 1,750-ms delay, the actor reached through a window (the left window in the first trial and the right window in the second trial) toward the toy. In the third and fourth trials, the sequence began when a puppet appeared, opened the lid of one of the boxes, picked up a toy (the same one used in Trials 1 and 2) from its initial location (i.e., on the center of the table) and placed it into the box, closed the lid, and left the scene. Then the windows were illuminated, and simultaneously the chime was sounded. After a 1,750-ms delay, the actor reached through the window corresponding to the location of the toy. To be included in the analyses, infants had to show anticipatory saccades (i.e., saccades to the window corresponding to the location of the toy before the actor reached through the window) by the fourth trial. In the final (fifth) trial, which was the test trial, the puppet picked up the toy from its initial location (which was the same as in Trials 3 and 4) and placed it into the left-hand box, after which the actor put on a blindfold ostensibly previously experienced by the infant (the narrow cloth). The puppet then removed the toy from the box and left the scene with it. Once the puppet had disappeared, the actor removed the blindfold, the windows were illuminated, and the chime was sounded. (See Video S1 in the Supplemental Material available online, which shows the whole video sequence used in the test phase.)

Results

On the basis of the eye-tracking data for the test trial, we coded the direction of each infant's first saccade following the illumination of the windows. We also calculated the infant's differential looking score (DLS) by subtracting total looking time to the right window from total looking time to the left window and dividing this value by the total looking time to both windows (Senju, Southgate, White, & Frith, 2009). We found that 14 of the 18 infants in the opaque condition made first saccades toward the left window (p = .031, g = .278, binomial test), whereas only 6 of the 18 infants in the trick condition did so (p = .238, g = .167, binomial test). Thus, the location of first gaze was influenced by infants' experience with the blindfold (p = .018, Φ = .447, Fisher's exact test). The DLS also differed significantly between the groups, $t(33) = 2.668$, p = .012, d = 0.871, being above zero in the opaque condition, DLS = .39, $t(17) = 2.32$, p = .03, d = 0.549, but not in the trick condition, DLS = −.31, $t(17) = -1.53$, p = .15, d = 0.360.

Discussion

The finding that infants in the two conditions had different expectations about the actor's action after displacement of the object suggests that the infants used self-experience with the blindfold to assess the actor's visual access, update her belief state accordingly, and use this attribution for predicting her action. Infants in the opaque condition expected the actor to search in the left box, which suggests that they attributed a false belief to the actor. Infants in the trick condition, by contrast, did not show such a bias, which suggests that they did not attribute a belief about a specific location to the actor: Because the object had been removed from the scene, the actor (if she had seen the puppet's actions) should have had no strong basis on which to choose one box over the other. Our findings are inconsistent with the proposal that infants rely solely on behavioral cues available in the stimuli to make predictions about another person's actions (e.g., Perner & Ruffman, 2005), because the same video sequence was presented in both conditions. Our results strongly suggest that 18-month-olds pay attention to other people's visual access to events and appreciate the causal role of that access in altering belief states.

Meltzoff and Brooks (2008) offered several alternative explanations for how infants can use first-person experience with a blindfold to understand its effects on another person. However, even the leanest interpretation of such extrapolation from the first to the third person entails the understanding of the unobservable mental state of seeing (Heyes, 1998; Meltzoff & Brooks, 2008; Penn & Povinelli, 2007). Thus, at the very least, infants in the present study encoded that the actor either could or could not see the displacement of the object when she wore the blindfold, and the infants were able to use this information to correctly anticipate the actor's future behavior. We are unable to determine from this study whether or not the link between visual access and consequent behavior that 18-month-olds are able to make is mediated by the attribution of an additional mental-state concept, such as belief.

Nevertheless, our findings provide further evidence that the capacity for mental-state attribution in infants should not be dismissed as simply the precursor of an adult theory of mind, relying on simpler, nonmentalistic processing. Our findings, together with those of other studies of early belief attribution, point to the existence of a genuine ability to attribute mental states beginning at least at the middle of the second year of life (Kovács et al., 2010).

Acknowledgments

We would like to thank all the participants and parents who supported our study. We acknowledge Geoff Bird, Rechele Brooks, Helena Ribeiro, and Yura Senju for their help.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Funding

This study was supported by a research fellowship from the United Kingdom Economic and Social Research Council (RES-063-27-0207) and a grant from the United Kingdom Medical Research Council (G0701484).

Supplemental Material

Additional supporting information may be found at http://pss.sagepub.com/content/by/supplemental-data

References

Buttelmann, D., Carpenter, M., & Tomasello, M. (2009). Eighteen-month-old infants show false belief understanding in an active helping paradigm. *Cognition*, *112*, 337–342.

Heyes, C. M. (1998). Theory of mind in nonhuman primates. *Behavioral & Brain Sciences*, *21*, 101–114.

Kovács, A. M., Téglás, E., & Endress, A. D. (2010). The social sense: Susceptibility to others' beliefs in human infants and adults. *Science*, *330*, 1830–1834.

Meltzoff, A. N., & Brooks, R. (2008). Self-experience as a mechanism for learning about others: A training study in social cognition. *Developmental Psychology*, *44*, 1257–1265.

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: Biological Sciences*, *362*, 731–744.

Perner, J., & Ruffman, T. (2005). Infants' insight into the mind: How deep? *Science*, *308*, 214–216.

Scott, R., & Baillargeon, R. (2009). Which penguin is this? Attributing false beliefs about object identity at 18 months. *Child Development*, *80*, 1172–1196.

Senju, A., Southgate, V., White, S., & Frith, U. (2009). Mindblind eyes: An absence of spontaneous theory of mind in Asperger syndrome. *Science*, *325*, 883–885.

Song, H.-J., Onishi, K. H., Baillargeon, R., & Fisher, C. (2008). Can an agent's false belief be corrected by an appropriate communication? Psychological reasoning in 18-month-old infants. *Cognition*, *109*, 295–315.

Southgate, V., Chevallier, C., & Csibra, G. (2010). Seventeen-month-olds appeal to false beliefs to interpret others' referential communication. *Developmental Science*, *13*, 907–912.

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

Surian, L., Caldi, S., & Sperber, D. (2007). Attribution of beliefs by 13-month-old infants. *Psychological Science*, *18*, 580–586.