Infants' differentiate between successful and failed communication in a false-belief context

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Abstract

Communication is based on social interaction, that is, interlocutors sharing attention to the intentions that they communicate about. In this study, we asked whether infants are aware of the fact that for information to be transferred, both interlocutors need to be present and share attention. Using a violation-of-expectation paradigm created to test infants' understanding of others' false beliefs, we asked whether 18-month-olds ($n=84$) understood that correcting an agent's false belief via communication requires that the agent discerns the verbal statement. Participants saw how an agent put a toy into a box and left. An assistant then moved the toy into a cup. The intervention phase varied between three conditions: The agent and the assistant communicated about the actual location of the toy (full-communication), the agent was absent during the assistant's statement (incomplete-communication) or no communication took place (no-communication). At test, the agent reached into either the box or the cup. When no communication took place, infants expected the agent to search the toy at the original location. Full communication resulted in infants' expectations that the recipient's mental states were altered, that is, the infants expected her to search the toy at the actual location. In contrast, incomplete communication did not yield clear expectations. Eighteen-month-olds thus seem to understand that for information to be transferred, it is a precondition that the recipient of the communicative act must be present and share attention during the communicator's statement. Only then communication can change a recipient's mental state.

Keywords: social interaction, shared attention, early communication, infants, implicit Theory of Mind, violation of expectation

Humans communicate every day to inform others about objects or facts, to share their experiences, or to get others to do things. Recipients of such communication try to work out the communicator's goals based on the communicative signals they receive (cf., Liebal & Tomasello, 2009; Schulze et al., 2013; Tomasello, 2008; Tomasello et al., 2007). Thus, human communication can be described as a cooperative endeavor in which both interlocutors work towards mutual comprehension and a successful transmission of beliefs and goals (Shafro et al., 2021; see also Searle, 1975; Sperber & Wilson, 1995; Tomasello, 2008). Both interlocutors do so based on the mutual assumption that they both use communicative signals that best fit their goals and beliefs (Frank & Goodman, 2012; Jara-Ettinger et al., 2016; Sperber & Wilson, 1995; Tomasello et al., 2005). Thus, if there were two communication partners and the communicator wanted to verbally inform the recipient about a hidden toy, the communicator will pick the linguistic cues that will likely induce the intended belief in the recipient. The recipient will then infer the intended meaning on the basis of these linguistic cues but also based on more general assumptions about the context, the communicator, world knowledge and so on. During this process, shared attention between communicator and recipient is necessary in order to intentionally transfer information (Carpenter & Liebal, 2012; see also Csibra, 2010; Rohlfing et al., 2016; Schulze, 2020; Sperber & Wilson, 1995; Tomasello, 2008).

Prior research shows that children can take the role of communicator or recipient in such communicative exchanges of goals and beliefs from very early on. That is, 12- to 18-month-old infants point at objects for others, and they also understand when someone points at objects for them (Behne et al., 2005, 2012; Liszkowski et al., 2004, 2006; for a review, see Tomasello et al., 2007). Moreover, infants also seem to acknowledge that shared attention is required for successful communication: They prefer eye-contact when communicating about objects (Senju & Csibra, 2008) and take the interlocutor's attentional focus into account when

they hear a novel label (Baldwin, 1991, 1995). Infants also only interpret a pointing gesture to a hiding-location as informative when this pointing is accompanied by gaze-alteration (Behne et al., 2005, 2012). In the same line, when pointing for others, infants not only want to direct the others' attention towards the object, they also want their intentions to be acknowledged and to share attention (Liszkowski et al., 2004).

In verbal communication, 16-month-olds have been shown to understand direct statements about changes in the world (e.g., The dog is on the table) and expect the world to have changed accordingly (Ganea et al., 2016). That is, in a visual world paradigm, infants first saw a table, a dog and a cat, followed by a blank screen during which they heard that the dog moved on top of the table. The infants then saw a picture that either matched or did not match this description. The infants looked longer at the incongruent scene, showing that they had updated their expectations about the dog's current location. However, other studies suggest that 19-month-old infants only use communication to update their knowledge about the actual location of a toy after a location-change when they had not seen the toy being hidden in its first location (Ganea & Harris, 2010, 2013; Özdemir & Ganea, 2020).

All of these studies on infants' communication skills used first-person scenarios in which the child actively takes part in the communication. But what do infants know about communication and its structure in third-person scenarios when the child was an observer of communication between two other agents (i.e., when they themselves are not part of the triad of communicator, recipient and the subject matter)? That is, do they perceive shared attention between communicator and recipient as a vital feature of communication and do they assume that only shared attention successfully transmits information and thus affects the recipient's behavior?

Previous research investigating this research question showed that infants before and around their first birthday are sensitive to shared attention between two agents (Thiele,

Hepach, Michel, Gredebäck, et al., 2021; Thiele, Hepach, Michel, & Haun, 2021). When confronted with interlocutors that stood either back-to-back or face-to-face to each other during the communicator's statement, 2-year-old children expected recipients to respond to speech when being addressed face-to-face – but not when communicator and recipient stood back-to-back (Thorgrimsson et al., 2015). However, for infants, the results are mixed and suggest that they have no clear expectations about the social aspects of communication. That is, in Thorgrimsson and colleagues' study, 1-year-olds did not differentiate these two situations. Other studies, in contrast, showed that even before their first birthday, infants looked less to the recipient of spoken language in the back-to-back compared to the face-to-face situation (Augusti et al., 2010; see also Meng et al., 2017).

Importantly, those previous studies investigated infants' expectations regarding the interlocutors' turn-taking behavior. Only very few studies focused on the actual *inferences* infants might draw about the recipient's behavior based on the communicative exchange of intentions. These studies found that 12-month-olds expect speech (but not noise) to transmit information (Martin et al., 2012; Tauzin & Gergely, 2018; Vouloumanos et al., 2012; Yamashiro & Vouloumanos, 2018), even if the infants do not understand the actual speech content. Two recent studies further suggest that 18-month-olds even expect informative communication to change the recipient's belief (Song et al., 2008, Jin et al., 2019). That is, in a false belief scenario, an agent put a ball into a box. An assistant then moved the ball into a cup during the agent's absence. When the agent returned, infants expected her to search the ball in the box when no communication took place (i.e., infants looked longer when the agent searched in the cup than when she searched in the box). In contrast, when the assistant told the agent that the ball is now in the cup, infants updated their expectations about the agent's searching behavior and expected her to search the ball in the cup (i.e., they looked longer when the agent searched in the box than when she searched in the cup).

It is important to note, however, that both prior studies on infants' updating of an agent's beliefs via communication have used face-to-face-interactions in which both interlocutors clearly communicated in a shared attentional frame. Thus, infants always observed a successful information transfer regarding a referent between a communicator and a recipient who were both present and shared attention (Bühler, 1999; Shannon & Weaver, 1949). Consequently, these previous studies did not manipulate the level of shared attention between the interlocutors. This leaves open the question whether infants draw specific inferences about an agent's belief-based behavior based on the level of shared attention during communication.

To address this question, we used the paradigm by Song and colleagues (2008) and varied the level of communication between the interlocutors by manipulating the level of shared attention between the two. After a familiarization phase (where the experimenter repeatedly put a ball in a box) and the belief induction phase (where the assistant moved the ball from the box to the cup unbeknownst to the experimenter), infants watched a test event in one of three conditions. In the No-Communication condition (NC), the experimenter and the assistant were present but did not interact (such as in Onishi & Baillargeon, 2005; and Song et al., 2008, Study 2, no-intervention condition). In the Full-Communication condition (FC), the assistant said, "The ball is in the cup" in the presence of the experimenter, sharing attention with her (Jin et al., 2019; Song et al., 2008). In the Incomplete-Communication condition (IC), the assistant said, "The ball is in the cup" but here the experimenter was absent (and assumingly did not hear this statement). Thus, the assistant made identical statements in both the FC and the IC, but only in the FC this statement had the potential to change the experimenter's belief state.

We expected the infants to look longer at the cup event than at the box event in the NC condition (cf., Onishi & Baillargeon, 2005; Song et al., 2008), because they expected the

experimenter to falsely believe the ball to be in the box. In the FC condition, we expected the infants to look longer at box event than at the cup event (cf., Jin et al., 2019; Song et al., 2008), because the actual location of the ball was fully communicated, and so the experimenter correctly believed the ball to be in the cup. For the IC condition, our expectations were less clear given that prior research found mixed evidence for infants' awareness about the importance of shared attention in third-person-scenarios. On the one hand, in line with Augusti and colleagues (2010; see also Meng et al., 2017), infants could infer that the experimenter holds a false belief about the current location of the ball (longer looking times to the cup compared to the box event). This would entail that infants understand the necessity of shared attention during the exchange of information (see Baldwin, 1991, 1995; Behne et al., 2005, 2012; Liszkowski et al., 2004; Senju & Csibra, 2008, for research using first-person-scenarios). On the other hand, they could underestimate the fact that the experimenter is absent during the verbal statement and infer that she now holds a true belief about the hidden object's location (longer looking times to the box compared to the box event). This would be in line with the findings that infants do not differentiate between face-to-face and back-to-back communication (Thorgrímsson et al., 2015) and do update their own beliefs about the location of an object based on communication when being addressed as the recipient (Ganea et al., 2016). This result would entail that infants do not see shared attention as a prerequisite of successful communication. A third possibility arises from a study that investigated 2-year-olds' word learning by overhearing (Fitch et al., 2020). While previous research showed that infants can learn words by watching labeling events between two interlocutors (Akhtar et al., 2001, 2019; Gampe et al., 2012; Shneidman et al., 2009), the study by Fitch and colleagues emphasizes the importance of shared attention between those interlocutors. In this study, the recipient was either attentive (i.e. establishing eye contact with the communicator) or inattentive (i.e.

looking at a clipboard while nodding from time to time) during the labeling event. The children who overheard the labeling event were then asked to choose the labeled object (from a choice of three novel objects). The children chose the labeled object when the recipient had been attentive, but chose at chance level if the recipient had been inattentive. Thus, the absence of shared attention during the labeling event resulted in a null-effect, presumably because the children (as a group) did not know how to interpret the scene. Given this finding, one could assume a null-effect in the IC condition in the present study.

Method

Participants

Eighty-four 18-month-old monolingual German-speaking children participated in the current study. The children's mean age was 18 months; 24 days (range: 17;11 – 20;07, 40 boys and 44 girls). These participants were separated into three conditions and two events, so that each cell of the 3x2-design contained $n = 14$ participants. We doubled the number of participants of the original study by Song and colleagues (2008) since we had the impression that the original study tested a rather small sample (see Maxwell et al., 2015; and Simonsohn, 2015 for advice on how to deal with sample sizes in replication attempts). Since we strictly adopted the inclusion criteria by Song and colleagues, twelve additional children were tested but had to be excluded from the final sample due to being bilingual ($n=1$), because they were drowsy or inattentive ($n=2$), because they did not see the experimenter put the ball in the box in at least one of the two relevant familiarization phases ($n=2$), because they did not reach the minimum looking-time criterion in the paused phase of the test phase ($n=5$, see procedure), or because they looked at the paused scene in the test phase for longer than 3 standard deviations from the mean of their condition ($n=2$, see data handling).

This study was conducted in accordance with the ethical standards laid down in the Declaration of Helsinki and the standards of the local ethics committee of the University of

[blinded for review]. The children's parents had previously agreed to their children participating in studies on child development in a mid-sized German city. In addition to their general agreement, parents signed a consent form for participating at the current study prior to testing. Each infant received a toy and a certificate as gratification.

The participants and conditions reported here were part of a research project investigating the role of communication in infants' Theory of Mind. While the current set of studies focused on the role of *social interaction* in communication in a false-belief paradigm, additional conditions reported in a separate publication focused on the *direct replication* of the Song et al. (2008) study (Schulze & Buttelmann, 2021).

Materials and set-up

Throughout the study, the child sat in a highchair in a distance of about 30 cm in front of an apparatus. The apparatus consisted of a table (i.e., the stage) enclosed by a wooden frame which held curtain rods for the grey-brown curtains that could be drawn in front of the experimenter (sitting across from the child) and the assistant (sitting to her right) during the experiment. A yellow curtain was attached to the apparatus right in front of the child. The apparatus' stage area was approximately 100 cm wide, 60 cm deep, and 100 cm high (see Figure 1). The experimenter wore an ivory visor that hid her eyes from the child's view, the assistant wore a light-green visor. On either side of the apparatus stood a frame made from grey card board (160 cm high, 80 cm wide) that blocked the child's view of the room.

A box (10 x 10 x 10 cm) with a lid (both light-blue with a white pattern) and a cup (10 cm tall, 10 cm in diameter at the top) with a lid (both red) served as possible hiding locations. They stood on the stage approximately 40 cm away from the child, centered and 20 cm apart from each other. In the middle between the box and the cup and about 5 cm in front of them lay a green plastic koosh ball (5 cm in diameter), see Figure 1.

Figure 1.

Illustration of the study set-up.

All sessions were videotaped from three different angles. One camera stood behind the child (slightly to her left), another one was mounted on the wooden frame centered above the child and the third camera stood behind the experimenter (approximately 100 cm above her head).

Design and Procedure

All children saw one trial consisting of three familiarization phases, one belief induction phase, one intervention phase (that differed according to three between-subjects conditions, see below) and one test phase. The position of both containers was counterbalanced between children. Children were randomly assigned to one of the three conditions and one of two events.

Except for the intervention phase, the procedure was identical to Schulze and Buttelmann (2021; see also Song et al., 2008). A detailed description of the familiarization and belief induction phase can be found in the supplemental materials. In the familiarization phase, the experimenter repeatedly placed a ball in a box. This was followed by the belief induction phase, in which the experimenter was absent (she sat behind a closed curtain). During her absence, the assistant moved the ball from the box to a cup. Subsequently, the intervention phase followed. In the conditions in which the experimenter was present during

the intervention phase (i.e., conditions NC and FC), the experimenter returned, that is, she opened her curtain, interlaced her fingers in front of her and looked at her hands. In the IC condition, the experimenter stayed behind her curtain.

In the intervention phase, we manipulated the level of communication and shared attention between the interlocutors (see Figure 2). In the **No-Communication condition (NC)**, the experimenter and the assistant sat in their respective positions, looking at their hands, saying nothing (7 sec). In the **Incomplete-Communication condition (IC)**, the experimenter stayed behind her curtain and the assistant sat in her position, looking at her hands. She then raised her head, looked at wall opposite of her (1 sec) and *in the absence of the experimenter* said the German equivalent of “The ball is in the cup” (“der BALL IST IN DER TASse”; 2 sec, capital letters mark emphasized syllables), paused (1 sec), and repeated the sentence (2 sec). She then looked at her hands (1 sec). In the **Full-Communication condition (FC)**, the experimenter and the assistant sat in their respective positions, looking at their hands and then simultaneously raised their heads and looked at each other (1 sec). The assistant then said the German equivalent of “The ball is in the cup” (“der BALL IST IN DER TASse”; 2 sec, capital letters mark emphasized syllables), paused (1 sec), and repeated the sentence (2 sec). Both experimenter and assistant then looked back at their hands (1 sec).

Figure 2.

Illustration of the intervention phase in each condition.

After the intervention, the curtain in front of the child closed for approximately 10 seconds. During this time, the assistant closed the curtain in front of her while the experimenter opened her curtain (IC condition) or left it open (conditions NC and FC). The experimenter then interlaced her fingers in front of her and looked at her hands. When the curtain in front of the child re-opened, the experimenter proceeded with the test phase in which the child saw either a box event or a cup event (between subjects).

Test phase – initial scene: box event. The experimenter moved her hand next to the box towards the lid of the box (1 sec), opened it (1 sec) and reached inside the box with her other hand (1 sec). She then held this position during the paused scene that followed.

Test phase – initial scene: cup event. The experimenter moved her hand next to the cup towards the lid of the cup (1 sec), opened it by lifting it about 9 cm above the cup (1 sec) and reached inside the cup with her other hand (1 sec). She then held this position during the paused scene that followed.

Test phase – paused scene. Children's looking times towards the objects and the experimenter were measured until the child (1) had looked at the scene for at least 5 cumulative seconds and looked away for 2 consecutive seconds or (2) had looked for 60 seconds without looking away for 2 consecutive seconds.

Coding and reliability

Since all sessions were videotaped, we were able to code children's looking times in a fine-grained way. We used ELAN, a program developed by the Max Planck Institute for Psycholinguistics, The Language Archive, Nijmegen, The Netherlands (<http://tla.mpi.nl/tools/tla-tools/elan/>) and coded children's looking times in 40 ms intervals frame by frame. An independent, blind coder coded a random sample of 21 children (25% of the sample). As described in Song and colleagues (2008), we divided the paused scenes of the familiarization and test phases into 100ms-intervals to determine whether both coders agreed

that the child was or was not looking at the event. Percent agreement was calculated for each paused scene by dividing the number of intervals in which both coders agreed by the total number of intervals in the respective paused scene and then averaged per child. Inter-coder agreement averaged 90.0%.

Data handling

To account for outliers, two children had to be excluded from the final sample because their mean looking time to the paused scene in the test phase was longer than 3 standard deviations from the mean of their condition. This criterion was the same as in the study by Song and colleagues (2008) to allow a direct comparison between studies. Note that, in addition, we re-ran all of our analyses after having our data log-transformed.

Results

To test our hypotheses¹, we analyzed the infants' looking time at the box event or the cup event in the paused scene of the test phase (see Figure 3). A 3 (condition) x 2 (event) ANOVA with infants' log-transformed looking times as dependent variable revealed a significant interaction ($F(2,78) = 10.279, p < .001, \eta^2 = .209, BF = 273.974$)². This indicates that the infants' looking times to box and cup events differed between the three conditions. Independent sample t-tests showed that in the No-Communication condition, infants looked longer at the cup event than at the box event (cup event: $M = 10.1$ sec, $SD = 3.2$ sec; box event: $M = 6.9$ sec, $SD = 2.1$ sec; $t(26) = -3.109, p = .005$, Cohen's $d = 1.175, BF = 9.355$). In the Full-Communication condition, infants showed the reverse looking pattern with longer looks at the box event than at the cup event (cup event: $M = 7.2$ sec, $SD = 0.9$ sec; box event: $M = 11.5$ sec, $SD = 4.6$ sec; $t(26) = 3.324, p = .005$, Cohen's $d = 1.256, BF = 14.179$). Infants

¹ For preliminary analyses of the familiarization and belief-induction phase see the supplemental materials.

² Bayes Factors were calculated using JASP (JASP Team, 2020), the analysis of the ANOVA's effects were calculated across matched models (Bergh et al., 2019).

in the Incomplete-Communication condition looked equally long at both events (cup event: $M = 9.5$ sec, $SD = 3.3$ sec; box event: $M = 10.3$ sec, $SD = 2.9$ sec $t(26) = .665$, $p = .512$, Cohen's $d = .251$, $BF = .417$). There were no main effects for condition ($F(2,78) = 1.442$, $p = .243$, $\eta^2 = .036$, $BF = .263$) or event ($F(1,78) = .888$, $p = .349$, $\eta^2 = .011$, $BF = .311$).

Figure 3.

Infants' log-transformed looking times (with 95% confidence intervals) at the box event or the cup event in the three conditions

Since we were specifically interested in whether the infants who heard an informative statement about the actual location of the toy differentiated between the shared attention situation in the Full-Communication condition and the lack of shared attention in the Incomplete-Communication condition, we ran the above ANOVA with only these two conditions. This 2 (condition) x 2 (event) ANOVA revealed a significant interaction ($F(1,52) = 4.086$, $p = .048$, $\eta^2 = .073$, $BF = 1.620$). Thus, the infants' looking behavior at the two events differed between the two conditions that included an informative statement. A further

main effect of event ($F(1,52) = 8.485, p = .005, \eta^2 = .140, BF = 6.967$) was not interpreted due to the significant interaction of condition and event.

Discussion

In this study we addressed the question whether 18-month-olds understand that successful communication – and thus the chance to alter a recipient's mental states – is based on a social interaction between interlocutors. Specifically, we asked whether infants' expectations about the recipient's actions differed when a statement about the actual location of a toy was made either in a shared attentional frame (both interlocutors were present and communicated ostensively with each other, i.e. the FC condition) or without the shared attention context (the recipient was absent during the utterance, i.e. IC condition). We found strong evidence that infants in the FC condition understood that the actual location of the toy was communicated to the experimenter and that she thus should update her belief regarding its location. Consequently, infants in this condition looked longer at the box event than at the cup event. This suggests that they expected the experimenter to search the toy in the cup after its location was communicated to her, a finding that is in line with previous research (Jin et al., 2019; Song et al., 2008; see also Ganea et al., 2016). Contrastingly, in the IC condition, infants did not show this expectation even though they also had just seen and heard the assistant utter the exact same statement about the actual location of the toy. The difference in looking time patterns we found between these conditions suggests that infants understood that only in social interactions in which the experimenter and the assistant share attention, communication changes the experimenter's mental state. They differentiated between a fully-fledged communicative exchange with a social transfer of information between communicator and recipient and an incomplete attempt on communication in which the exact same sentence was rendered a mere statement without a recipient.

The results from the NC condition revealed moderate to strong evidence that infants

ascribed a false-belief expectation to an experimenter who had not seen a change of the toy's location (conceptually replicating previous studies on early implicit Theory of Mind, cf., Onishi & Baillargeon, 2005; Song et al., 2008). That is, when no information about the actual location of the toy was provided to the experimenter, infants looked significantly longer at the cup event than at the box event. Such a looking-time pattern is consistent with the interpretation that the infants' expectation that the experimenter should search at the box (where she originally had placed her toy) was violated. This result supports the idea that in the FC condition infants did *update* their expectations about the experimenter's belief-based action as their looking time pattern in this condition was reversed.

Thus, the present research adds to and extends previous findings about infants' perception of communication and their understanding of the necessity of shared attention in social interactions. Previous research found that in third-person-scenarios, infants' grasp of the social aspects of communication seems to be limited and only developing (Thorgrímsson et al., 2015; but see Augusti et al., 2010; Meng et al., 2017) even though they have an early sensitivity for shared attention (Thiele, Hepach, Michel, Gredebäck, et al., 2021; Thiele, Hepach, Michel, & Haun, 2021). We now show that infants actually draw different inferences about other person's mental states based on the level of shared attention between two interlocutors.

This also extends earlier findings showing that infants infer a transformation of information from communication in joint attentional frames (Jin et al., 2019; Martin et al., 2012; Song et al., 2008; Tauzin & Gergely, 2018; Vouloumanos et al., 2012; Yamashiro & Vouloumanos, 2018). The present study shows that infants do not simply expect others to search at another location whenever they hear informative statements. Rather they understand that for communication (in contrast to a mere linguistic statement) to take place, the recipient of a message must share attention with the communicator while she expresses her informative

intentions. Only then will the statement lead to an update of the recipient's beliefs.

Interestingly, prior research using first-person-scenarios suggests that younger infants' ability to make inferences based on verbal testimony is limited (Ganea et al., 2007; Ganea & Harris, 2010, 2013; Özdemir & Ganea, 2020; but see Ganea et al., 2016 for evidence of successful belief update via communication). Here we find that infants use verbal testimony to update their expectations about others' mental states which might suggest that they utilize their early emerging abilities (Ganea et al., 2016) in a third-person scenario.

Moreover, our findings are in line with research regarding the role of shared attention in children's word learning through overhearing (Fitch et al., 2020). As in Fitch and colleagues' study where children had no clear association of an object and its label when the recipient was inattentive during the labeling event, the infants in our study had no clear expectation regarding the recipient's actions when she was absent during the verbal statement of the communicator. The finding that infants in the IC condition of the present study had rather long looking times in both events of the test phase (comparable to surprising events in the other two conditions) may suggest that the infants' expectations regarding the experimenter's actions were violated by both action events. Of course, another interpretation would be that the infants were simply confused by the overall situation in this condition. That is, the assistant made a statement about the toy's location while looking at the wall with the experimenter hidden behind a curtain. However, in previous research, infants did not expect the recipient of communication to respond when the interlocutors stood back-to-back compared to when they faced each other (Augusti et al., 2010; Meng et al., 2017; Thorgrímsson et al., 2015). In the IC condition of the current study, the "recipient" was invisible which seems to be an even stronger cue for the person's lack of shared attention than standing back-to-back. Thus, the infants should have all the more assumed that the experimenter was not part of the communication. Still, what might have caused the infants'

struggle with the situation might be that the assistant made the utterance in the direction of the opposite wall (instead of looking down), just as she did in the Full-Communication condition. This might have been misinterpreted as a face-to-face interaction with the invisible experimenter. Further research should test the limits of infants' knowledge about the structure of communication.

Conclusion

The present study demonstrates that 18-month-old infants attribute a false belief to an experimenter who has not observed that her toy was relocated from where she originally put it to another location (see Onishi & Baillargeon, 2005). In the same setup, when the communicator stated the actual location of the toy to the recipient, the infants expected the recipient's belief to be altered (Jin et al., 2019; Song et al., 2008). However, incomplete communication without shared attention between the interlocutors did not yield this expectation. Thus, 18-month-old infants seem to understand that for the communicative act to be successful, both interlocutors need to be present and share attention. Only if this precondition is fulfilled, communication has the potential to change a recipient's mental state.

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