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# Infants' performance in the indirect false belief tasks: A second-person interpretation

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**Abstract**

Research in the last 15 years has challenged the idea that false belief attribution develops at 4 years of age. Studies with indirect false belief tasks contend to provide evidence of false belief attribution in the second year of life. We review the literature on indirect false belief tasks carried out in infants using looking and active helping paradigms. Although the results are heterogeneous and not conclusive, such tasks appear to capture a real effect. However, it is misleading to call them "false belief" tasks, as it is possible to pass them without making any false belief attribution. Infants need to keep track of the object's and agent's positions, trajectories, and focus of attention, given an intentional understanding of the agent, to pass these new tasks. We, therefore, argue that the evidence can be better explained in terms of second-person attributions, which are transparent, extensional, nonpropositional, reciprocally contingent, and implicit. Second-person attributions can also account for primates' mentalizing abilities, as revealed by similar indirect tasks.

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false belief, false belief attribution, indirect false belief tasks, intentional understanding, mentalizing, second-person attribution

## 1 | INTRODUCTION

The ability to attribute mental states, such as beliefs, desires, and intentions to other people was called a "theory of mind" (Premack & Woodruff, 1978), and lately, in a more neutral way, mentalizing. By making such attributions, we understand why a person behaved in a specific manner (she opened the empty drawer because she *thought* her diary was inside and *wanted* to update it) or anticipate what she will do next (attributing her that she *wants* to see the new Oscar winner movie, and the cinema where she always goes, we can predict that she will likely go to that cinema soon). False belief attribution was thought to hallmark the achievement of this ability, as it requires considering at the same time one's own perspective on how things stand and that of somebody else (Bennett, 1978; Dennett, 1978; Harman, 1978). Research in the nineties reached a consensus that the development of this capacity for false belief

attribution emerged between the age of 4 and 5, when children successfully overcome the classical, verbal, false belief tasks (Wellman, Cross, & Watson, 2001). Research in the last 15 years has challenged this consensus. Evidence from new, indirect, tasks has been interpreted as support for false belief attribution in the second year of life. We call them "indirect" because, even if they may involve verbal prompting, the dependent variable is not verbal but behavioral and spontaneous (for a discussion on the terminology, see Low & Perner, 2012).

In the present article, we focus on these indirect tasks and challenge the view that they provide evidence for false belief attribution in the second year. First, we review the results obtained with these tasks, which come in three different paradigms, and show that while the results are not conclusive, there appears to be an effect to consider. Second, we argue that it is misleading to call them "false belief" tasks, as it is possible to pass them without making any false belief attribution, and since there is no evidence that infants grasp the concept of belief. Third, we identify the socioperceptive cues that may allow to pass these tasks. We argue that this evidence can therefore be better explained in terms of second-person attributions, a simpler form of mental attribution (Pérez & Gomila, *2021*).

## 2 | THE NEW INDIRECT TASKS AND THEIR RESULTS

The indirect false belief tasks were designed to make them as simple as possible, without any linguistic demands and with minimal memory and executive control requirements. It was proposed that passing the classical false belief tasks might happen at four because the degree of inhibitory control required to point to an empty place, for example, emerges at that age and is a requirement to pass the classical, verbal task. Three experimental paradigms can be distinguished as ways to achieve this simplification. Two of them study participants' looking behavior as the dependent measure, and the third one focuses on infants' active responses, such as helping or pointing, as indicators of false belief understanding.

### 2.1 | Violation of expectation paradigm

Onishi and Baillargeon (2005) designed the first indirect false belief task using a procedural variant of the habituation paradigm known as the violation-of-expectation (VoE) paradigm (Baillargeon, 1987; Colombo & Mitchell, 2009; Kellman & Spelke, 1983). It involved two steps: first, a habituation or familiarization phase, in which infants are repeatedly exposed to the same sequence of events in order to set up context-dependent expectations. Second, in the test trial, they are presented with a single event that is either consistent or inconsistent with their previous expectations. If infants look longer at inconsistent events this is interpreted as an indication of surprise, and therefore, as evidence about the nature and content of the infants' expectations (Jacob, 2013).

During the familiarization phase of Onishi and Baillargeon (2005) task, 15-month-old infants saw an agent retrieving a slice of watermelon from a green box. Then, during the "belief induction" trial, the watermelon moved from the green to the yellow box while the agent could see its displacement (true belief condition) or could not see it because she was absent from the scene (false belief condition). In the experimental trials, infants watched the agent searching in one of the two boxes: either in the box that was congruent with her belief about the location of the watermelon (i.e., its real location in the true belief condition, but the former one in the false condition) or in the box that was incongruent with her belief (i.e., in its current position in the false belief condition, but in the former location in the true belief condition). Onishi and Baillargeon (2005) measured how much time infants spent watching each event trial and found that they looked longer when the agent with a true belief searched in the empty box and when the agent with a false belief searched in the full box. This finding suggested that 15-month-olds expected the agent to search according to her belief about the toy's location and that they were surprised if she did not act according to her belief (Onishi & Baillargeon, 2005).

Several subsequent studies replicated this pattern of findings (Moriguchi, Ban, Osanai, & Uchiyama, 2018; Song, Onishi, Baillargeon, & Fisher, 2008; Träuble, Marinovi, & Pauen, 2010) and even showed the complexity of infants' capacity to attribute false belief in different situations (Luo, 2011; Scott & Baillargeon, 2009; Scott, Baillargeon, Song, & Leslie, 2010; Scott, Richman, & Baillargeon, 2015; Song & Baillargeon, 2008) and to different agents (Burnside, Severdija, & Poulin-Dubois, 2020). However, other researchers recently failed to replicate Onishi and Baillargeon's original results (Dörrenberg, Rakoczy, & Liszkowski, 2018; Powell, Hobbs, Bardis, Carey, & Saxe, 2018; Yott & Poulin-Dubois, 2016) or replicated them just partially (Yott & Poulin-Dubois, 2012, where only the false belief condition was administered). Other VoE tasks also claimed to have found some evidence of belief understanding (Surian, Caldi, & Sperber, 2007 but only in the true belief condition) or no evidence at all (Poulin-Dubois, Polonia, & Yott, 2013). In

summary, at least 16 articles have carried out studies using the VoE paradigm in infants, 10 reporting positive results, 4 negative, and 2 mixed or ambiguous results.

## 2.2 | Anticipatory looking paradigm

Following Clements and Perner's (1994) insight to study children's anticipatory looking (AL) behavior instead of directly asking the false belief question in the standard task, Southgate, Senju, and Csibra (2007) used an eye-tracker to test whether younger children anticipated (by looking first) where an agent would reach for her object. Again, this paradigm involves a familiarization phase to induce the relevant expectations.

In the familiarization phase, 25-month-old infants saw an agent retrieving an object from one of two boxes. In one false belief condition, the agent saw the object be transferred to the second box but failed to see when the object was removed from the scene. In the second false belief condition, the agent did not witness any movement of the object (she falsely believed it was in the first box). Southgate et al. (2007) found that infants' first look correctly anticipated the box where the agent would search her object according to her false belief. Interestingly, this methodology also measured the amount of time infants spent looking at each box: in this case, they looked to the belief-congruent box significantly longer than the other box.

After Southgate and colleagues' positive results, many authors tried to deepen the comprehension of infants' looking behavior designing direct as well as conceptual replications. Although some studies provided additional evidence of correct anticipatory look in scenarios in which the agent had a false belief about an object's location (Meristo et al., 2012; Senju, Southgate, Snape, Leonard, & Csibra, 2011; Surian & Geraci, 2012), more recent studies found only partial support (Dörrenberg et al., 2018; Grosse Wiesmann, Friederici, Disla, Steinbeis, & Singer, 2018; Kulke, Reiß, Krist, & Rakoczy, 2018; Surian & Franchin, 2020: evidence with 20-month-olds but not with 15-months-olds) or no evidence at all of this capacity (Kulke, Johannsen, & Rakoczy, 2019; Schuwerk, Priewasser, Sodian, & Perner, 2018; Sodian et al., 2016; Thoermer, Sodian, Vuori, Perst, & Kristen, 2012; Zmyj, Prinz, & Daum, 2015). In summary, at least 13 articles were published using the AL methodology in infants, only 4 of them founding positive results, 5 negative, and 4 mix or ambiguous results.

## 2.3 | Active helping paradigms

Taking a different approach, some authors designed an indirect false belief task as part of a situation in which the infants were required to help the agent by doing some action (like opening a box) or pointing (D. Buttelmann, Carpenter, & Tomasello, 2009; D. Buttelmann, Over, Carpenter, & Tomasello, 2014; Knudsen & Liszkowski, 2012a; Southgate, Chevallier, & Csibra, 2010). The idea is that the belief attribution will show up within a context of intention attribution. In the first false belief study with the active helping paradigm, the agent played with the child with a caterpillar toy (D. Buttelmann et al., 2009). After some time playing together, she announced that she had to leave so she put the toy in one of two boxes (box 1). In the true belief condition, the experimenter (E) transferred the toy from box 1 to box 2 before the agent left the room and then, while she was outside, E locked both boxes. In the false belief condition, the agent left the room immediately after placing the toy. In her absence, E sneakily transferred the toy to box 2 and finally locked the boxes.

In both test conditions, the agent tried to open box 1 upon her return. However, young children helped her differently in each situation. In the false belief condition, most participants opened box 2 that now contained the object, presumably detecting that the agent did not see the transfer and might be looking for the caterpillar. In the true belief condition, however, most children opened box 1 (i.e., the empty one) because, as the agent saw the transfer, she might have another goal in that case, like wanting to open the empty box.

Many replication attempts of this study were conducted but none could successfully replicate Buttelmann and colleagues' original findings: Some studies reported partial replications, mainly differences between conditions, but not a difference from chance level within each condition (Fizke, Butterfill, van de Loo, Reindl, & Rakoczy, 2017; Powell et al., 2018; Priewasser, Rafetseder, Gargitter, & Perner, 2018) or no replication at all (Crivello & Poulin-Dubois, 2018; Poulin-Dubois & Yott, 2018).

Other false belief tasks were conducted using variations of the active helping paradigm, all of them showing that children's active behavior varied according to the agent's epistemic state (D. Buttelmann et al., 2014; F. Buttelmann,

Suhrke, & Buttelmann, 2015; Knudsen & Liszkowski, 2012a, 2012b; Powell et al., 2018; Southgate et al., 2010). However, recent studies failed to find evidence of infants' differential pointing (Dörrenberg et al., 2018;) or just partial support (Király, Oláh, Csibra, & Kovács, 2018). In summary, at least 14 studies have implemented indirect false belief tasks with active helping measures, with 7 of them reporting positive findings, 3 negative evidence, and 4 mix or ambiguous results.

### 2.4 | Overall pattern of results

Taken together, the overall pattern of results is not conclusive, even if an effect seems to be present (Table 1). In a recent meta-analysis, we found high heterogeneity among 56 indirect false belief conditions carried out in infants younger than 2 years of age (Barone, Corradi, & Gomila, 2019). The results of such studies varied much more than expected by chance, suggesting that other factors account for the resulting effect. Among them, the type of paradigm employed, as participants correctly performed, in general, VoE tasks; and the year in which the article was published: the more recent the article is, the less likely that infants pass the task. This is probably due to the fact that recent studies employ bigger samples and better control conditions and because negative results are now more likely to be published. The difficulties to replicate the positive findings and the fact that most positive evidence comes from a single laboratory can be viewed as reasons for skepticism. Still, there seems to be a relevant effect going on, even if weak and fragile. Interestingly, a similar weak effect has been found in research adapting these indirect tasks to apes[1] (D. Buttelmann, Buttelmann, Carpenter, Call, & Tomasello, 2017; Kano, Krupenye, Hirata, Tomonaga, & Call, 2019; Krupenye, Kano, Hirata, Call, & Tomasello, 2016, 2017). This pattern of mixed results cannot be easily accommodated by any theoretical account, which instead would expect them to be robust. On one hand, nativists claim that infants' performance in indirect false belief tasks proves that the ability to attribute beliefs is innate or emerges very early in ontogeny (Carruthers, 2013; Jacob, 2013, 2020; Leslie, 2005; Scott & Baillargeon, 2017). Such an early full-fledged competence is masked by performance factors, like linguistic abilities or working memory, in the standard false belief tasks. On the other hand, some researchers argue that, instead of ascribing false beliefs to the agent, infants could have used other low-level abilities to succeed in these tasks, like novelty preference (Heyes, 2014) or simpler behavioral rules (Perner & Ruffman, 2005). Still, a two-systems account of the findings suggests that indirect and explicit false belief tasks tap two different mindreading systems: (a) an implicit, automatic, efficient, and early-developing system able to reason about belief-like states (i.e., "registrations"), and (b) an explicit, effortful and flexible ToM system that reasons about proper beliefs (Apperly & Butterfill, 2009; Butterfill & Apperly, 2013; Low, Apperly, Butterfill, & Rakoczy, 2016) (for more extensive reviews and discussions of the existing accounts, see Burge, 2018; Haman, 2019; Sabbagh & Bowman, 2018).

In what follows, we first argue against a full-blown mentalistic explanation, given that these tasks can be passed without (false) belief ascription (next section); and next, we propose that the kind of mental attribution required to pass these tasks is much simpler than attribution of false belief—what we call the second-person attributions.

## 3 | PASSING THE INDIRECT FALSE BELIEF TASKS WITHOUT FALSE BELIEF ASCRIPTION

Beliefs are mental states that can be analyzed as a particular kind of attitude—that of believing—toward a propositional content. In "Mary believes that tomorrow will rain," Mary holds a specific attitude toward the proposition "that tomorrow will rain", a content that can be true or false. For this reason, beliefs and other similar mental states are called propositional attitudes (Schwitzgebel, 2019). In other words, propositional attitudes are those mental states whose intentional contents are propositional. In the classical false belief tasks, attribution of a belief was explicitly asked for. For example, in the classical Maxi chocolate task (Wimmer & Perner, 1983), the participants had to say what Maxi, the character, believed. This involved attributing to Maxi an attitude (believing) and a propositional content. Thus, if "Maxi believes that his chocolate is in the green cupboard," Maxi is said to have some attitude or stance (belief) toward a proposition or state of affairs (that his chocolate is in the green cupboard). The attribution involves both dimensions, and both presuppose mastering the relevant concepts. As it is well known, these attributions have the interesting semantic property that the attribution can be true (or false) regardless of whether the proposition attributed is true (or false). The chocolate might not be in the green cupboard, but it may still be true that Maxi believes this to be the case.

**TABLE 1** Descriptive information and results of indirect false belief tasks

| Authors | Year of publication | Evidence on false belief attribution | Age (in months) | Agent | Situation |
|---|---|---|---|---|---|
| Violation of expectation paradigm | | | | | |
| Onishi & Baillargeon | 2005 | Yes | 15 | Person | Real |
| Surian, Caldi, & Sperber | 2007 | Partial | 13 | Animal | Videotape |
| Song, Onishi, Baillargeon, & Fisher | 2008 | Yes | 18 | Person | Real |
| Song & Baillargeon | 2008 | Yes | 14.5 | Person | Real |
| Scott & Baillargeon | 2009 | Yes | 17 | Person | Real |
| Träuble, Marinovi, & Pauen | 2010 | Yes | 15 | Person | Real |
| Scott, Baillargeon, Song, & Leslie | 2010 | Yes | 18 | Person | Real |
| Luo | 2011 | Yes | 10 | Person | Real |
| Yott & Poulin-Dubois | 2012 | Partial | 18 | Person | Real |
| Poulin-Dubois, Polonia, & Yott | 2013 | No | 16 | Person | Real |
| Scott, Richman, & Baillargeon | 2015 | Yes | 17 | Person | Real |
| Yott & Poulin-Dubois | 2016 | No | 16 | Person | Real |
| Moriguchi, Ban, Osanai, & Uchiyama | 2018 | Yes | 18 | Person | Real |
| Dörrenberg, Rakoczy, & Liszkowski | 2018 | No | 24 | Person | Videotape |
| Powell et al. | 2018 | No | 18 | Person | Real |
| Burnside, Severdija, & Poulin-Dubois | 2019 | Yes | 16 | Crane | Real |
| Total: 16 | | | | | |
| Anticipatory looking paradigm | | | | | |
| Southgate, Senju & Csibra | 2007 | Yes | 25 | Person | Videotape |
| Senju et al. | 2011 | Yes | 18 | Person | Videotape |
| Meristo et al. | 2012 | Yes | 23 | Animal | Videotape |
| Surian & Geraci | 2012 | Yes | 11<br>17 | Geometric shape | Videotape |
| Thoermer et al. | 2012 | No | 18 | Person | Videotape |
| Zmyj, Prinz, & Daum | 2015 | No | 18 | Person | Videotape |
| Sodian et al. | 2016 | No | 18 | Person | Videotape |
| Dörrenberg, Rakoczy, & Liszkowski | 2018 | Partial | 24 | Person | Videotape |
| Grosse Wiesmann et al. | 2018 | Partial | 25 | Person | Videotape |
| Kulke, Reiß, Krist, & Rakoczy | 2018 | Partial | 24 | Person | Videotape |
| Schuwerk, Priewasser, Sodian, & Perner | 2018 | No | 25 | Person | Videotape |
| Kulke, Johannsen, & Rakoczy | 2019 | No | 23 | Person | Videotape |
| Surian & Franchin | 2020 | Partial | 15<br>20 | Geometric shape | Videotape |
| Total: 13 | | | | | |
| Active helping paradigm | | | | | |
| D. Buttelmann, Carpenter, & Tomasello | 2009 | Yes | 16<br>18 | Person | Real |
| Southgate, Chevallier, & Csibra | 2010 | Yes | 17 | Person | Real |
| Knudsen & Liszkowski | 2012a | Yes | 18 | Person | Real |
| Knudsen & Liszkowski | 2012b | Yes | 18<br>24 | Person | Real |

(Continues)

**TABLE 1** (Continued)

| Authors | Year of publication | Evidence on false belief attribution | Age (in months) | Agent | Situation |
|---|---|---|---|---|---|
| D. Buttelmann, Over, Carpenter, & Tomasello | 2014 | Yes | 18 | Person | Real |
| F. Buttelmann, Suhrke, & Buttelmann | 2015 | Yes | 18 | Person | Real |
| Fizke, Butterfill, van de Loo, Reindl, & Rakoczy | 2017 | Partial | 26 | Person | Real |
| Crivello & Poulin-Dubois | 2018 | No | 18<br>24 | Person | Real |
| Poulin-Dubois & Yott | 2018 | No | 18 | Person | Real |
| Powell, Hobbs, Bardis, Carey, & Saxe | 2018 | Partial | 18 | Person | Real |
| Powell, Hobbs, Bardis, Carey, & Saxe | 2018 | Yes | 25 | Person | Real |
| Priewasser, Rafetseder, Gargitter, & Perner | 2018 | Partial | 25 | Person | Real |
| Dörrenberg, Rakoczy, & Liszkowski | 2018 | No | 24 | Person | Real |
| Király, Oláh, Csibra, & Kovács | 2018 | Partial | 18 | Person | Real |
| Total: 14 | | | | | |

Similarly, even if the green cupboard is his mother's preferred piece of furniture, it does not follow that Maxi believes that his chocolate is in his mother's preferred piece of furniture. This semantic feature of beliefs—that their contents are specified under specific aspects—is called opacity or aspectuality (Rakoczy, Bergfeld, Schwarz, & Fizke, 2015). Belief attribution requires specifying how the attribute conceives of the relevant situation.

This makes beliefs a much more complex state than many other mental states. Take "like" for instance and consider "John may like you". In this case, the content of the mental state of liking is much simpler: It is the referent of the "you" that it is used demonstratively, it is just a pointer. There is no need in this case for going into the aspectuality of John's thoughts about you. In addition, it is much easier to ascribe this state because the concept of this mental attitude is also perceptually recognized, as it involves some practical dimension, while beliefs can be covert, without a public dimension.

Therefore, for a beholder to attribute a false belief to Maxi, it is required that he/she has the concept of a belief plus the conceptual resources to articulate the content of Maxi's belief through the concepts Maxi entertains. In addition, the concept of belief is more difficult to grasp than liking. Mastering the concept of belief involves understanding that beliefs cannot be directly observed, that they come in clusters, that which belief gets activated upon observation of a stimulus depends on other beliefs already accepted—think of the believer that the Earth is flat and what she comes to believe upon looking at a picture of the Earth taken from space (Zawidzki, 2011). As regards the propositional content, the attributer has to capture the nonveridical aspect of the belief *and* the specific way the agent conceives of the situation: she must take into account the relevant state of affairs and how it is conceptualized, or represented, by the agent (Zawidzki, 2011).

Once clarified what it takes to attribute a false belief, it is clear that the indirect "false belief" tasks we reviewed in the previous section come short to count as false belief tasks in a strict sense. The evidence they provide comes short of proving that a propositional content was attributed to the agent or that the infants already mastered the concept of belief.

As for the content, infants do not need to articulate how the agent is representing the situation to pass the task; that is, they do not need to understand aspectuality. In fact, it makes no difference to the participants' performance whether the change of object location also involves a change in the object identity. The participants do not need to attribute whether the agent thinks of the object as a bunny puppet or as a carrot toy, or as "this object," or simply as "this" (Fizke et al., 2017). The participant can succeed at the tasks with a much simpler form of content attribution, one that does not involve aspectuality not even a propositional structure. Some kind of demonstrative is enough to keep track of the object, both by the participant and the agent.

As a matter of fact, independent evidence shows that attribution of propositional contents emerges when children acquire the sentential complement structure in language (J. G. de Villiers, 2007; J. G. de Villiers & de Villiers, 2003; P. A. de Villiers, 2005). Mental state verbs, like believe, take sentential complements: The clause that complements the

mental verb is itself a complete sentence (e.g., Maxi thinks that his chocolate is in the green cupboard). The complement structure enables the language user to represent in a transparent way the content of someone's mind and differentiate it from reality, while contrasting the truth value of the two clauses within a single sentence. For instance, Maxi can actually believe that his chocolate is in the green cupboard, but the content of Maxi's belief may or may not be true depending on what happened when he was absent. According to this view, reasoning about propositional attitudes is contingent upon the mastering of the required representational format, one that allows for the truth of the attributed mental state without commitment to the truth of the content of that state (Gomila, 2012). It is not until the age of 4 or 5 that children master the sentential complement structure (Tomasello, 2018).

As for the concept of belief (the attitude), it is not independently proved either that participants already mastered the concept of belief so that they can attribute beliefs to the agents involved in the story. For example, to master the concept of belief it is required to understand that beliefs come in clusters, that any belief ascription implicitly involves the attribution of many more—what is called the "holism" of beliefs (Quine, 1951). Therefore, any action, by itself, undermines the belief of the agent, in the sense that different sets of attitudes may account for the same action. Similarly, beliefs do not cause behavior by themselves but only if some conative state is also in place. Even if the agent searches for the object where she left it, it does not follow that she believes it is there: Perhaps she is searching for something else in this box (Zawidzki, 2011). Or maybe the agent heard that something happened (another person retrieving an object from a box and moving it to a new location certainly makes some noise) and now she believes the object is not where she left it anymore, but pretends to hold the belief that the object is still in the box where she left it for the sake of the experiment. Independent evidence that infants master the concept of belief before the age of two is lacking.

Therefore, indirect false belief tasks do not require the attribution of a belief state to pass the tasks. What is required is the ability to track the position and trajectory of the relevant object in the situation, and the gaze of the agent, and keep that integrated system of information active in working memory. What they all do require is that participants understand the agent's behavior as goal-directed, as intentional. The concept of intention is more similar to liking than to believing. Its content does not need to be propositional. It can be an intentional object that can be demonstratively characterized, in a nonaspectual, transparent way.

It is remarkable the parallelism of infants' capacities with the proven mentalistic abilities of apes. Thus, they can recognize intentions in behavior (D. Buttelmann, Carpenter, Call, & Tomasello, 2007; D. Buttelmann, Schütte, Carpenter, Call, & Tomasello, 2012; Krupenye, Tan, & Hare, 2018; Yamamoto, Humle, & Tanaka, 2012; for a recent review, Krupenye & Call, 2019) and they are also able to follow gaze and understand it as a referential pointer (for a review, Call & Tomasello, 2008). In addition, recent studies show that apes pass some indirect false tasks (D. Buttelmann et al., 2017; Kano et al., 2019; Krupenye et al., 2016, 2017).

It can be said, then, that a parsimonious account of indirect false belief tasks, when they get positive results, is that infants can familiarize to a pattern of intentional events, that require keeping track of the location of an object and the gaze of an agent for some time—an ability that allows them to show surprise when the pattern changes, or to anticipate what comes next in a script of events.

As a matter of fact, infants are sensitive to others' mental states from very early on in development, even in the first year of life (Gómez, 1998; Hobson, 1993; Trevarthen, 1979, 1998). Specifically, they anticipate others' intentional actions and react when adults disrupt the intentional communication directed to themselves, as well as other forms of intentional interaction, showing a kind of coordination between subjectivities that is grounded in emotional and expressive responses (Murray & Trevarthen, 1985; Reddy, 2008; Reddy & Morris, 2004; Tronick, Als, Adamson, Wise, & Brazelton, 1978). They are also able to follow the gaze of another and jointly attend to an object (Gómez, 2005; Trevarthen & Hubley, 1978). This basic form of intentional attribution, developed in and through intentional interaction, has been called the second-person perspective of psychological attribution. In the next section, we specify the characteristics of this sort of attributions according to our understanding of the second-person stance and propose an interpretation of the experimental results reviewed in terms of second-person attributions.

## 4 | SECOND-PERSON ATTRIBUTIONS

The notion of a second-person perspective of psychological attributions was first proposed in 1996 in a couple of BBS commentaries (Gómez, 1996; Reddy, 1996); was articulated in the first decade of this century (Carpendale & Lewis, 2004; Gallagher, 2001; Gómez, 2005; Gomila, 2001, 2002, 2008; Reddy, 2008; Scotto, 2002), and has been gathering momentum in recent years (De Jaegher, Di Paolo, & Gallagher, 2010; Moore & Barresi, 2017; Pérez & Gomila, 2021;

Redcay & Schilbach, 2019; Schilbach et al., 2013; Siposova & Carpenter, 2019). All versions of the second-person approach agree that interaction works differently from observation and that it is through interaction with others that social cognition emerges and develops. However, not all of them understand that intentional interaction is mediated by a genuine form of psychological attribution, distinctively second-personal.

According to our characterization of the second-person perspective, it is through face-to-face interactions that infants acquire the mental concepts that they can later attribute to each other. In this way, interaction involves a basic and genuine form of mental attribution, limited to the class of states that can be perceptually recognized through their expressive cues, and whose contents are transparent, implicit and nonpropositional. Thus, Gomila (2001, 2002, 2008) has emphasized that second-person attributions are not semantically opaque or aspectual. They are transparent and context-dependent: The contents attributed are demonstrative, and the mental states are just of those states that involve an expressive dimension. Belief attribution comes much later.

In our view, the performance of infants and apes in the indirect false belief tasks can be explained in terms of this elemental form of mental attribution. It appears that the same abilities displayed in joint attention (Bard & Leavens, 2009; Eilan, Hoerl, McCormack, & Roessler, 2005) and basic intentional understanding (Carpenter, Nagell, & Tomasello, 1998; Meltzoff, 1995; Reddy, Markova, & Wallot, 2013; Woodward, 2009) are recruited in indirect false belief tasks as they require that the infant can identify the object that is the focus of attention of the agent, and track the object, locations, and gazes for some time in working memory (for a comprehensive view on rival accounts of joint attention, see Maye, Isern-Mas, Barone, & Michael, 2017). Being able to temporally integrate these sources of information is enough to pass these tasks, provided the interacting agent is viewed as intentional, as we have shown in the previous section. Our present view agrees with Tomasello (2018) in pointing to the relevance of joint attention (even if in a different way), but differs from it by introducing a detailed notion of attribution which is not propositional, whereas he talks about "imagining or tracking epistemic states" (p. 3).

Although VoE and AL paradigms place the infant in a detached position and avoid eye contact between him and the agent because she wears a cap that blocks her eyes, he promptly follows the agent's attention by tracking her head/body position, movements, and actions and detecting her intention in the context of the test. In fact, the structure of the experimental setups is similar across the different paradigms as infants first track the agent's visual attention toward an object which is in a definite position in the space (one of two boxes). Familiarization trials delineate the specific expectations in each task (in VoE and AL paradigms): Familiarization or habituation processes address task-specific, but not abstract expectations, that are created in the context of each test.

Passing indirect false belief tasks will then happen when the participant notices that the agent's attention got disconnected (or not) from their common focus of attention, even if they are not involved in an interactive situation. During the false belief induction phase, the agent's visual attention is interrupted (the triadic structure of joint attention momentarily breaks). The infant thus tracks the object's change of location and that the agent did not update the new information (signs of this are infants visually checking to the spot where the agent was). On the other hand, the agent's visual attention is not interrupted during the true belief induction phase. In such cases, infants track the object's transfer, its new location and that the agent has seen it (the triangulation continues all along).

Infants' responses, in the test trial, are specific and context-dependent. In the VoE paradigm, the infants see the agent acting either congruently or incongruently with the particular expectations formed and the information they had previously tracked. In the false belief conditions, infants displayed shorter looking time when the agent approached the location she had last been linked to the object before she left (congruent event), and a longer looking time if she reached to the box they had not jointly attended to when the object was moved (incongruent event). In the true belief conditions, infants looked longer if the agent went to the empty box and shorter when the agent approached the box where they jointly attended the object as it was placed there.

However, in AL tasks, the agent does nothing in the test trial: She just appears at the scene and infants spontaneously look to one of the two windows through which she can try to recover the hidden object. In our view, the stronger effect of VoE task is due to the fact that the agent is active.

In helping tasks, the agent unsuccessfully tries to open the empty box in both conditions. Given an intentional understanding of the agent as "trying" to do something, children help her. In the false belief condition, since she lost track of the object's new location, infants spontaneously attributed her the intention to get the toy and thus opened the full box. In the true belief condition, since the agent jointly attended with the child while the object was transferred to the other box, infants detected the intention to open *that* specific box and thus unlocked the empty box.

The second-person perspective allows us also to understand why infants extend the limits of intentional agency to include geometric shapes (Heider & Simmel, 1944; Surian & Geraci, 2012), blobby creatures (Tauzin & Gergely, 2018, 2019),

and cranes (Burnside et al., 2020). Agents are defined by their disposition to pursue goals (Surian & Franchin, 2020) and when infants detect goal-directed behaviors, they try to interact with those agents. But as the relevant reciprocal contingencies that characterize interaction fail to happen, as these pseudoagents cannot reciprocate, epistemic states are not attributed (Barone, Bedia, & Gomila, 2020). Further evidence in support of our account comes from studies showing a link between performance in intention tasks and VoE tasks at 18 months of age (Poulin-Dubois & Yott, 2014; Yott & Poulin-Dubois, 2016). Our account also predicts correlations between infants' capacities in joint attention and their performance in indirect false belief tasks.

Critically, and in contrast to the alternative theoretical accounts (briefly summarized in Section 2.4), our account can explain the high variability and fragility of the effect. In fact, a considerable number of elements are involved in the tests, whose perturbation likely facilitates or hinders children's capacity to jointly track past and present positions of objects with past and present viewings and intentions of the agent. Given the context dependency of intentional attributions, they probably rely on a flexible system sensitive to the salience of different features over time like the type of object, the number, and salience of hiding locations, the distance between relevant locations, the number of displacements, the delay between hiding and the child's response, the type of elicited response (looking versus reaching), etc., as it has been shown for Piaget's "A-not-B error" task (Thelen, Schöner, Scheier, & Smith, 2001), the naming task (Samuelson, Smith, Perry, & Spencer, 2011), as well as a proper understanding of infant habituation and dishabituation (Schöner & Thelen, 2006). In general, a dynamic systems account helps explain the need for a familiarization phase in the procedure and the sensitivity of the infant system to the many situational variables. Thus, for instance, although the child himself does not perform the repetitive searches in the false belief tasks, seeing another agent reaching repetitively toward a location likely activated a stronger memory of this event. Plausibly, the activation values in the infant's planning motor field will depend on the previous events perceived and the salience of different contextual features. Yet, specific and methodical manipulations in the indirect false belief tasks have not been performed to know in detail the importance of each input to obtain the effect in those tasks or fade it away.

In other words, the basic sensorimotor, bodily interaction reveals a capacity to understand others while being sensitive to perceptive cues with nonpropositional content. This basic level comprises second-person mechanisms like intersubjectivity, joint attention, intentional and emotional attribution. Recognizing these second-person attributions as different from the third person attributions of propositional attitudes (paradigmatically, beliefs), helps to overcome the puzzle of false belief attribution.

## 5 | CONCLUSION

In summary, passing the indirect "false belief" tasks can be accomplished by a subject already capable of joint attention and working memory to keep track of the contingencies involved in the experimental paradigms. Infants only need to keep track of the object's trajectories and positions and the agent's attention, given an intentional understanding of the agent. In our view, joint attention already involves a basic form of second-person attribution. However, such indirect tasks provide no evidence of the capacity to attribute propositional states, that is, proper belief mental states. Second-person attributions can also provide an account of nonhuman primate mentalizing abilities (Krupenye & Call, 2019), suggesting an evolutionary continuity. As a matter of fact, evidence of joint attention in apes is available (Gómez, 2005, 2010; Leavens & Bard, 2011; Leavens & Racine, 2009).

Certainly, the second-person perspective plays a prominent role in development and provides the ground for further attributions of other kinds of mental states with more complex, noncontext dependent, contents. Language transforms this basic ability into a conceptually structured one, which gives rise to a higher level of cognition: linguistic development provides propositional structure to thought in a systematic and productive way (Gomila, 2012). However, it does not disappear later in development. In adults' face-to-face interactions, second-person attributions remain as the natural and spontaneous stance to intentionally interact with other people (Gomila, 2002).

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## AUTHOR CONTRIBUTIONS

**Pamela Barone:** Conceptualization; data curation; writing-original draft. **Antoni Gomila:** Conceptualization; supervision; writing-review and editing.

## CONFLICT OF INTEREST

The authors have declared no conflicts of interest for this article.

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## ENDNOTE

[1] In fact, the indirect false belief tasks are being increasingly used with toddlers and children, obtaining a similar pattern of mix results (Burnside, Ruel, Azar, & Poulin-Dubois, 2018; Gliga, Senju, Pettinato, Charman, & Johnson, 2014; Grosse Wiesmann, Friederici, Singer, & Steinbeis, 2017; He, Bolz, & Baillargeon, 2011; Low, Drummond, Walmsley, & Wang, 2014; Low & Watts, 2013; Oktay-Gür, Schulz, & Rakoczy, 2018; B. Wang, Hadi, & Low, 2015; L. U. Wang & Leslie, 2016).

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