**How to pass the false-belief task before your 4th birthday**

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*Abstract*

The experimental record of the last three decades shows that children under four fail all sorts of variations on the standard false-belief task, while more recent studies reveal that infants are able to pass non-verbal versions of the task. We argue that these paradoxical results are an artifact of the type of false-belief tasks that have been used to test infants and children: whereas non-verbal designs allow infants to stay with a protagonist's perspective over a course of events, verbal designs tend to disrupt the perspective-tracking process in various ways, making it too hard for younger children to demonstrate their capacity for perspective tracking. We report three experiments that confirm this hypothesis, showing that 3-year olds can pass a suitably streamlined version of the verbal false-belief task. We conclude that young children can pass the verbal false-belief task provided they are allowed to track the protagonist's perspective without too much disruption.

The intensely social lifestyle of our species requires that we are constantly second-guessing each other's intentions, beliefs, desires, and other mental states. Over the last three decades, developmental psychologists have been studying how mindreading skills begin to unfold in early childhood. The vast majority of these studies employ variations on the false-belief (FB) task pioneered by Wimmer and Perner (1983). In an FB task the child witnesses an agent interacting with an object and then storing it in location A. Next the agent leaves the scene, or is otherwise distracted, and the object is transferred to a second location, B. Once the object has been moved from A to B, the critical question is whether the child realises that the agent mistakenly believes that it is in location A. This can be tested in a variety of ways; e.g., by asking the child where the agent will look for the object (Wimmer & Perner, 1983; Baron-Cohen et al., 1985), by tracking the child's eye gaze to see whether he is looking at location A or B in anticipation (Clements & Perner, 1994; Southgate et al., 2007) or shows surprise if the agent heads for location B without further ado (Onishi & Baillargeon, 2005; Song & Baillargeon, 2008), or by engaging the child to help the agent (Buttelmann et al., 2009; Southgate et al., 2010).

FB tasks come in two main flavours: verbal and non-verbal. In verbal designs, like Wimmer and Perner's, the experimenter crucially relies on

linguistic means to interact with the child, present the story, and so on. In non-verbal designs, by contrast, language either isn't used at all, or it is merely supplementary to what is chiefly a non-linguistic mode of interaction and presentation.

Whereas literally hundreds of studies have shown that, by and large, children fail at verbal FB tasks until their fourth birthday, a considerable number of recent articles report that toddlers and even infants pass all manner of non-verbal FB tasks (see Baillargeon et al., 2010 for a review). What are we to make of this discrepancy? This question has been answered in various ways. Clements and Perner (1994) maintain that verbal and non-verbal tasks probe different kinds of understanding, one implicit, the other explicit, with the former preceding the latter in development. In a similar spirit, Apperly and Butterfill (2009) hypothesise that there are two 'mindreading systems': an early-developing system for tracking belief-like states that guides children's looking behaviour, and a later-developing system that guides children's explicit judgments about beliefs. Baillargeon et al. (2010) contend that verbal tasks involve two mental processes that aren't implicated in non-verbal tasks: a process of response selection and a process of inhibition of a prepotent tendency to answer the test question on the basis of one's own knowledge about the facts—what is sometimes called 'the pull of the real' (for a recent review of these and other dualist accounts, as well as a new proposal, see de Bruin & Newen, 2012).

All these explanations have two things in common. One is that they presuppose a qualitative difference between the mental mechanisms needed for solving verbal and non-verbal tasks. The second commonality is precisely that these explanations are cast directly in terms of mental processes and representations, and waste little time on a proper analysis of the tasks as such. In the following, we will adopt an alternative approach, which makes minimal assumptions about children's cognitive abilities, and focuses instead on the differences between the two types of FB task.

Our point of departure is that, at least by their first birthday, children are naturally inclined to track other people's perspectives. This ability allows young children to predict another person's actions, even when they are premissed on false information (cf., e.g., Kóvacs et al., 2010; Senju et al., 2011). This much is not controversial anymore. In contradistinction to the authors cited above, the assumptions we make about this ability are minimal. To say that children can track another person's perspective is merely to say that they can form expectations about her actions based on observations of her behaviour. What kinds of mental processes and representations underwrite this capacity is largely irrelevant to our story. For example, it is immaterial whether or not it involves explicit representations of beliefs (Perner, 1991, 2010), whether or not it undergoes a conceptual change around age four (Bartsch & Wellman, 1995; Wellman et al., 2001), or whether it involves just one system for mindreading or several (Apperly & Butterfill, 2009; Scholl & Leslie, 1999). The only assumption that is critical to our approach is that perspective tracking depends to some extent on cognitive resources and is therefore more susceptible to disruption in children than adults.

One rather blatant difference between verbal and non-verbal FB tasks is that the former are inherently more complex in that they require the

integration of linguistic information, while the latter do not. However, if our hypothesis is correct, that is not the only reason why under-4-year olds fail verbal FB tasks. As well as imposing weaker linguistic demands (if indeed they impose any), non-verbal FB tasks are normally designed to minimally interfere with children's natural ability to track events from the agent's point of view, while verbal FB tasks tend to disrupt this process in various ways. For example, while non-verbal FB tasks generally feature a single protagonist, verbal FB narratives typically include more than one character. Given that tracking two perspectives is more demanding than tracking one, this already goes some way towards explaining the difference between verbal and non-verbal tasks. Speaking more generally, we hypothesise that, for the child's perspective-tracking ability to work effectively, it should be disturbed as little as possible, especially in young children.[1]

To illustrate our key point, let us briefly compare the studies that have come to exemplify the two main experimental paradigms. The design of Onishi and Baillargeon's non-verbal FB task was quite sparse (2005). Apart from the protagonist and a few props, the stage was empty, the experimenter didn't interfere with the proceedings, and the target object moved from box to box of its own accord. In short, there was nothing to distract the children's attention and prevent them from staying with the protagonist's point of view. In stark contrast to this minimalist approach, Wimmer and Perner's (1983) scenario featured two protagonists (a little boy named 'Maxi' and his mother) in a rather elaborate story, told by a recorded voice and simultaneously acted out by the experimenter with dolls and various other props. During the story, Maxi disappeared for a considerable period of time while his mother was baking a cake. Finally, as Maxi returned from the playground, the experimenter intervened with the key question: 'Where will Maxi look for the chocolate?'

It will be evident that the complexity of Wimmer and Perner's experimental task was an order of magnitude greater than Onishi and Baillargeon's, which already goes a long way towards explaining why children perform so much better on the latter than the former. There are three features, in particular, that may have disrupted their perspective tracking: (*a*) it may not have been clear who was the main character of the story; then (*b*) Maxi left the scene for a while, during which his mother's held the stage with her baking; and finally, (*c*) the experimenter switched roles from puppeteer to interviewer to spring his question on the unsuspecting child. Each of these factors may have drawn the younger children away from tracking Maxi's perspective, and their combined effect may have been even greater. Other versions of the standard false-belief task impose similar demands and are therefore liable to the same sort of criticism.

In their influential meta-study, Wellman et al. (2001) discuss a number of task variations that have been found to improve children's performance on

[1] The foregoing is not to imply that introducing a second character will always cause the children to fail the task. For example, if the protagonist establishes a good rapport with the child first, thus allowing the child to identify with her perspective, the introduction of a second character may be less disruptive (cf., e.g., Southgate et al., 2010). The more general point here is that no single factor need be decisive across the board.

verbal FB tasks. Most of these are plausibly seen as facilitators for perspective tracking. For example, several studies report that success rates increase when children participate in misdirecting the agent, or the agent's mental state is made more explicit, or the target object is made less salient, thus reducing the pull of the real. It should be noted, however, that in isolation none of these factors will raise 3-year olds' performance above chance level (Wellman et al., 2001). In our view, for these and other task variations to be successful, the process of perspective tracking must be allowed to run its course throughout the task. This is precisely what we tried to do in our study.

**The Duplo task**

The protocol for this task was a variation on the standard FB task. The experimenter showed the child a set of Duplo toys (i.e., large Lego for small children) that she had on a table: a girl figure, a bunch of bananas and two little yellow cupboards that were referred to as 'fridges', one with a blue door and one with a red door. The child was told that the girl loved bananas and had one for breakfast every morning. This morning, she had already had a banana, so she wanted to return the remaining ones to the fridge. At this point the experimenter made the girl put the bananas inside one of the two fridges (refrigerator choice was counterbalanced between participants) and told the child that the girl now wanted to go for a walk. Up to this point, the procedure was the same as in a standard FB task.

In the remainder of the task, two novel sets of variations were introduced, both intended to help the child keeping track of the girl's perspective. First, we made sure that the child could see the Duplo girl throughout the session. Hence, rather than making the girl figure disappear as in earlier studies, the experimenter made the girl walk in the direction of the child and turn her back on the scene.[2] Then the experimenter asked the child, in a secretive manner: 'Can the girl see me from where she is?' This was only a prompt: if the child didn't answer, the experimenter filled in, saying: 'She surely can't see me from over there.' Then, looking at the child with an expression suggesting connivance, the experimenter moved the bananas from one fridge to the other. At this point, the experimenter turned to the child and asked, pointing at the girl: 'She hasn't seen what I did, has she?' This, too, was only a prompt: if the child didn't answer, the experimenter would say: 'No, she hasn't seen what happened!' These prompts, too, were intended to help the

[2] While we believe that this manipulation facilitated perspective tracking, we don't want to suggest that removing the main character from the scene necessarily impedes children's performance. As several infant studies have shown, the mere fact that the protagonist temporarily leaves the child's field of vision does not result in his losing track of her perspective (see, e.g., Onishi & Baillargeon, 2005). It is important to note, however, that the disruptive effect of the protagonist's disappearance is likely to be greater in verbal FB tasks in which the experimenter continues with the story and shifts the focus of attention to the secondary character (e.g., Wimmer & Perner, 1983; Baron-Cohen et al., 1985).

child keeping track of the girl's perspective[3]. For the same reason, we had the experimenter move the bananas herself, rather than introducing a second character in the story, which might result in the child losing track of the protagonist's perspective.

The second set of task variations we introduced was intended to help the child to stay with the girl's perspective during the test phase. Once it had been established that the girl hadn't seen the experimenter move the bananas, the experimenter returned the Duplo girl back to the centre of the scene. She placed the girl figure in front of the two fridges, facing the empty space in between, and asked the child if he would like to play with the girl now. The experimenter then encouraged the child to take the lead by saying: 'What happens next? You can take the girl yourself if you want … What is she going to do now?'

Instead of asking the standard FB question, 'Where will the girl look for the bananas?', which requires a referential response, we used open questions, 'What happens next? What is she going to do now?', and encouraged the child to continue acting out the story. This approach deviates from the standard one in several ways that are relevant to our main hypothesis. First, the standard procedure may be an unnatural test for young children in that, up to the FB question, the experimenter was just telling them a story (why then start interrogating the child about the protagonist?). In our study, the experimenter adopted a more interactive stance throughout, and there was no abrupt break between narrative and response elicitation. Secondly, act-out responses are generally easier for younger children, partly perhaps because they make it easier for them to identify with the protagonist. Thirdly, unlike the standard question, ours did not confront children with a binary choice; a more open question should help the child to stay with the girl's perspective rather than having to consider alternative options. Finally, while the standard question focuses on the target object (in our case, the bananas), which might well reinforce the pull of the real, the questions we asked didn't mention the target object at all. For all these reasons, we expected that our procedure would minimise interference with perspective tracking.

Since the only link between the girl and the empty fridge was that she had put the bananas in that fridge before leaving, we assumed that if a child had the girl return to the empty fridge, it was because she wanted to fetch her bananas. Hence, children's responses were coded as correct if they moved the girl figure to the empty fridge, and incorrect if they moved her to the fridge with the bananas.

In our first experiment we tested 3-year olds on the task described in the foregoing. Then, in two follow-up experiments, we further investigated the effects of the two sets of task variations intended to help perspective tracking, during the displacement phase and during the test phase.

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[3] Previous studies suggest that introducing deception may help young children succeed in verbal FB tasks (Chandler et al., 1989; Sullivan & Winner, 1993; see Wellman et al., 2001). While the experimenter in our study was clearly acting behind the girl's back, this manipulation was very subtle compared to previous studies, in which children were asked to join a plot to deceive the protagonist. This is important since it entails that the issue of whether children really understand trickery doesn't apply here (see Sodian et al., 1991).

## Experiment 1

*Participants*

28 children were recruited from a local nursery in Salinas (Asturias, Spain). The nursery is part of a public primary school and serves middle-class families. The children had been attending nursery for three months. The group consisted of 15 girls and 13 boys and their mean age was 3;5 (range: 3;0-4;0).

*Design and Procedure*

Children were tested individually by the first author in a quiet area of their nursery. Each session lasted approximately 10 minutes. All children were tested on two verbal FB tasks: the standard 'Smarties task' (Hogrefe et al., 1986) and the Duplo task (in that order).

The Smarties task served as our benchmark since Wellman et al. (2001) report in their meta-study that children perform similarly in the Smarties task and the standard displacement FB task. Furthermore, since Wellman et al. showed that even those task variations that significantly improved children's performance on verbal FB tasks did not allow 3-year olds to go from below-chance to above-chance performance, the crucial measure in our a study was to compare children's performance on the two tasks relative to chance level.

*Results and Discussion*

Of the 28 children who participated in the study, 6 failed to give a response in the Smarties task. Of the remaining 22 children, 5 passed the task while 17 failed it (22.7% success rate). In the Duplo task, 1 child failed to cooperate and data from another 2 children were removed because they gave two responses (i.e., they first moved the girl towards the empty fridge and then moved it to the fridge with the bananas). Of the remaining 25 children, 20 passed the task while 5 failed it (80% success rate)[4].

The critical test of our hypothesis is a comparison between children's performance on the two FB tasks. A McNemar test with continuity correction revealed a significant difference in their performance, $\chi^2(1, N = 19) = 6.750$, $p < .01$. Moreover, while children performed significantly below chance level in the Smarties task ($p < .042$, two-choice binomial test, two-tailed), they were significantly above chance in the Duplo task ($p < .005$, two-choice binomial test, two-tailed).

In order to test the assumption underlying the correct responses (i.e., that according to the child, the girl was going back to the empty fridge to fetch her

[4] In order to see whether the older children in our sample performed better than the younger ones, we divided them into two age groups: under 3;6 and 3;6 or above. The performance of the two groups did not differ significantly in any of the four FB tasks administered in the study (all *p* values > .270, Chi-square tests, two-sided).

bananas), we ran a control True-Belief condition in which the girl herself moved the bananas from one fridge to the other. We tested 14 children from the same nursery (6 girls and 8 boys; mean age: 3;10; range: 3;7-4;2). Two children didn't cooperate and a third child was eliminated from the analyses because he gave two conflicting answers (i.e., he said the girl was going to get her bananas but then moved the girl figure to the empty fridge). Of the remaining 11 children, 10 moved the girl figure to the fridge containing the bananas and 1 moved it to the empty fridge. The preference for the fridge with the bananas was reliable ($p < .012$, two-choice binomial test, two-tailed), which supports our interpretation of the FB data.

Our results support the hypothesis that 3 year-old children are able to pass a verbal FB task provided that they are allowed to keep track of the protagonist's perspective. The question remains, however, as to which of the two sets of variations introduced to the standard FB task were more effective in allowing children to succeed in the task.

**Experiment 2A**

*Participants*

19 children were recruited from the same nursery as in Experiment 1. Children in this group had been attending nursery for two months. The group consisted of 10 girls and 9 boys and their mean age was 3;5 (range: 2;10-4;0).

*Design and Procedure*

Testing conditions were the same as in Experiment 1. A similar set of Duplo toys was used and the protocol was the same in all but one respect: after the Duplo girl had put the target object in one of the two locations on the table, the experimenter made the figure disappear from the scene by suddenly dropping it into a bag of toys under the table. The experimenter didn't comment on the girl's disappearance, and instead engaged the child's attention by continuing to play with the remaining toys on the table. Based on our main hypothesis, we expected that this manipulation would interfere with children's ability to track the girl's perspective, and thus diminish their performance.

Importantly, as she was displacing the object, the experimenter acted as secretively as she did in Experiment 1. However, since no explicit reference was made to the girl (or to whom was being deceived), the element of deception wouldn't presumably facilitate children's perspective-tracking in this version of the Duplo task.

*Results and Discussion*

Of the 19 children who participated in the study, 2 did not cooperate when they were asked to play with the girl. Of the remaining 17 children, 3 passed the task while 14 failed it (17.6% success rate). These results reveal below-chance performance ($p < .014$, two-choice binomial test, two-tailed). A Chi-

square test with Yates correction comparing children's performance on the Duplo task in Experiments 1 and 2A revealed a significant difference, $\chi^2(1, N = 42) = 13.464$, $p < .001$.

These results confirm that the perspective-tracking variations introduced in the displacement phase of the Duplo task were crucial for the children's success. Apparently, the perspective-tracking variations in the test phase did not suffice for 3-year olds to recover from the disruptive effect of the girl's sudden disappearance.

As we had expected, having the experimenter act secretively did not prevent children from performing below chance level when their perspective tracking had been disrupted. We would like to suggest that to the extent that deception facilitates FB reasoning (as it may have done in Experiment 1), it is because it helps children stay tuned into the perspective of the protagonist who is being deceived.

Having established that the perspective-tracking variations in the displacement phase of the Duplo task enhanced children's performance, it remains to be seen whether these variations alone would suffice to enable 3-year olds to pass a verbal FB task using the standard probe question.

## Experiment 2B

### *Participants*

18 children were recruited from the same nursery as in Experiments 1 and 2A. The children in this group had been attending nursery for two months. The group consisted of 10 girls and 8 boys and their mean age was 3;4 (range: 2;10-3;9).

### *Design and Procedure*

Testing conditions were the same as in Experiments 1 and 2A. The Duplo toys were the same as in Experiment 1 and so was the protocol, except that at the end of the narrative, instead of inviting the child to play with the girl, the experimenter kept hold of the figure and asked the child the standard FB question: 'Where will the girl look for the bananas?' As in a standard FB task, children in Experiment 2B had to answer the probe question either verbally or by pointing to one of the two locations.

### *Results and Discussion*

Of the 18 children who participated in the study, 4 passed the task while 14 failed it (22.2% success rate). Children's performance was below chance ($p < .032$, two-choice binomial test, two-tailed). A Chi-square test with Yates correction comparing children's performance on the Duplo task in Experiments 1 and 2B revealed a significant difference, $\chi^2(1, N = 43) = 11.920$, $p < .002$. Moreover, children's performance in Experiments 2A and 2B was comparable, $\chi^2(1, N = 35) = 0.114$, $p = .735$.

These results show that the high performance observed in Experiment 1 was contingent on our perspective-tracking variations in the displacement phase as well as the test phase. Presumably for the reasons discussed above, the standard FB question, 'Where will x look for y?' throws young children off track. This is an important finding, since hundreds of studies have used this question as a diagnostic for FB understanding[5].

## General Discussion

The aim of our study was to investigate the paradoxical results found in the Theory of Mind literature, where it has been reported that infants are able to pass non-verbal versions of the FB task (Onishi & Baillargeon, 2005; Baillargeon et al., 2010) while children under four fail myriad versions of the verbal FB task (Wimmer & Perner, 1983; Wellman et al., 2001). We hypothesised that these differences were caused, at least partly, by accidental differences between the tasks that have been used to tests these two age groups: while non-verbal versions of the FB task allow infants to track a person's perspective during a sequence of events, verbal versions of the task tend to disrupt the perspective-tracking process in various ways, which may be critical for younger children.

In our study we used a new verbal FB task designed to minimise these disruptions. As expected, 3-year olds (mean age 3;5) were able to pass this task, with a success rate of 80%. Moreover, their performance in the new FB task was significantly better than in a standard task, going from below-chance to above-chance. Two follow-up experiments confirmed that allowing the children to keep track of the protagonist's perspective during the FB narrative was crucial for their success. Furthermore, instead of making the child choose between the two possible answers to the standard probe question, using open questions inviting him to continue acting out the story was also important.

Rather than trying to solve the Theory of Mind paradox by drawing a distinction between different types of mindreading systems or knowledge available to infants and young children (Clements & Perner, 1994; Apperly & Butterfill, 2009; Baillargeon et al., 2010; de Bruin & Newen, 2012), we have only assumed what is evident from the infant studies; namely, that from a very early age, children are able to track other people's perspectives. This fundamental ability allows them to anticipate other people's actions, even when they are based on false information. What our study shows, in addition, is that it is relatively easy to interfere with young children's perspective-tracking ability. In a laboratory setting, it is in fact necessary to take measures to minimise the disruption of the perspective-tracking process for 3-year olds to pass a verbal FB task.

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[5] In their meta-study, Wellman et al. (2001) suggest that future research should put together those variations of the FB task which have been shown to independently improve children's performance up to chance level. We would like to stress that our study wasn't intended to implement Wellman et al.'s suggestion. In fact, when our own task variations were used separately, children performed below chance. Our aim was to facilitate perspective tracking throughout the experiment, and our results indicate that, indeed, no single factor was decisive.

The old debate about what changes between ages three and four in Theory of Mind development can be re-evaluated in the light of our findings. How does the perspective-tracking ability of 3-year olds develop in order to pass the standard FB task at around age 4? One possibility is that with an increase in their executive control comes an improved ability to stay tuned to the protagonist's perspective. While this is highly likely (with school children having generally a better capacity to concentrate than pre-schoolers), we have found further evidence suggesting that even adults can see their perspective tracking momentarily interrupted by subtle task manipulations (Rubio-Fernández & Geurts, in preparation). The differential performance of 3- and 4-year olds in the standard FB task is therefore more likely to result from an improvement of their capacity to recover from the disruption of their perspective tracking by task manipulations.

In the foregoing we have shown how the standard FB task can be streamlined so as to allow 3-year-old children to track a protagonist's perspective and thus make correct predictions about her actions, even though they are predicated on false premisses. The reason why 3-year olds have been failing the verbal FB task for nearly three decades is that this task was always implemented in such a way that it prevented children from showing their adeptness at perspective tracking.

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