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# Memory and inferential processes in false-belief tasks: An investigation of the unexpected-contents paradigm

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ABSTRACT

This study investigated the extent to which 3- and 4-year-old children may rely on associative memory representations to pass an unexpected-contents false-belief task. In Experiment 1, 4-year-olds performed at chance in both a standard Smarties task and a modified version highlighting the secrecy of the contents of the tube. These results were interpreted as evidence that having to infer the answer to a false-belief question (without relying on memory representations) is generally difficult for preschool children. In Experiments 2a, 2b, and 2c, 3-year-olds were tested at 3-month intervals during their first year of preschool and showed better performance in a narrative version of the Smarties task (chance level) than in the standard version (below-chance level). These children performed even better in an associative version of the narrative task (above-chance level) where they could form a memory representation associating the protagonist with the expected contents of a box. The results of a true-belief control suggest that some of these children may have relied on their memory of the protagonist's preference for the original contents of the box (rather than their understanding of what the protagonist was expecting to find inside). This suggests that when 3-year-olds passed the associative unexpected-contents task, some may have been keeping track of the protagonist's initial preference and not only (or not necessarily) of the protagonist's false belief. These results are interpreted in the

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light of current accounts of Theory of Mind development and failed replications of verbal false-belief tasks.



## Introduction

Since researchers discovered that infants were able to pass suitably adapted false-belief tasks, the main debate in Theory of Mind has concerned how babies are able to pass such tasks; that is, whether infants are indeed able to attribute false beliefs to others (e.g., Baillargeon, Scott, & He, 2010; Carruthers, 2013; Helming, Strickland, & Jacob, 2014) or they pass false-belief tasks by relying on lower-level abilities (e.g., Apperly & Butterfill, 2009; Low & Perner, 2012; Ruffman, 2014). This question, however, is relevant not only to the interpretation of infant studies but also to young children's performance on verbal false-belief tasks. The current study investigated whether 3- and 4-year-old children may rely on associative memory processes to pass such tasks.

The Sally–Anne task is the archetypal change-of-location false-belief task (Baron-Cohen, Leslie, & Frith, 1985). In this task, a puppet named Sally puts a marble in a box before going out to play. In her absence, a puppet named Anne moves the marble to a basket. The child is then asked the standard test question: "When Sally comes back, where will she look for her marble?" Hundreds of Theory of Mind studies during the past 35 years have shown that children are not able to pass change-of-location tasks before their fourth birthday, with younger children predicting that Sally will look for her marble in its current location rather than in the container where she left it (Wellman, Cross, & Watson, 2001).

Another standard false-belief task is the unexpected-contents task. In the Smarties task (Perner, Frith, Leslie, & Leekam, 1989), for example, children are shown a tube of Smarties (a familiar box of chocolates) whose actual contents is unconventional (e.g., pencils), and they need to predict what somebody else would say is inside the tube (e.g., "When the next kid comes in and we ask him what's in here, what is he going to say?"). As in change-of-location tasks, children under 4 years of age tend to fail unexpected-contents tasks, predicting that the next kid will say that there are pencils in the tube (as if the kid were knowledgeable).

Because 3-year-old children perform comparably in change-of-location and unexpected-contents tasks (Wellman et al., 2001), these two types of false-belief task are often treated as equivalent tests and have often been combined in Theory of Mind studies for a more robust measure of belief understanding. However, although both tasks were designed to investigate belief attribution, these two tasks pose very different demands, potentially affecting young children's performance differentially.

One difference previously discussed in the literature is that the two possible responses to the false-belief question are not equally salient in change-of-location and unexpected-contents tasks (Freeman & Lacohée, 1995; Mitchell & Lacohée, 1991; Rubio-Fernández & Geurts, 2016). Whereas in the Sally–Anne task children must choose between two locations in the scene when predicting where Sally will return for her marble, in the Smarties task, only the wrong response is physically present in the setting; that is, there are no Smarties in the scene, only pencils. Early studies have shown that physically representing the two possible responses to the false-belief question in an unexpected-contents task improves performance in younger groups, probably because it reduces the salience of the wrong response (Freeman & Lacohée, 1995; Mitchell & Lacohée, 1991).

Another difference between change-of-location and unexpected-contents tasks is that in the former, but not in the latter, children must follow a series of events in a narrative and adopt the protagonist's perspective during the test phase. By contrast, in unexpected-contents tasks, children need to predict what another child would say when the child is asked the test question, but this other child was not previously introduced to the participant and did not play any role in the task up to the test phase. Thus, the design of change-of-location tasks should in principle allow children to track a protagonist's perspective throughout the narrative, whereas this would not be possible in unexpected-contents tasks.

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