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Brief article

Thinking about false belief: It's not just what children say, but how long it takes them to say it

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ABSTRACT

We examined 240 children's (3.5-, 4.5-, and 5.5-year-olds) latency to respond to questions on a battery of false-belief tasks. Response latencies exhibited a significant cross-over interaction as a function of age and response type (correct vs. incorrect). 3.5-year-olds' *in*correct latencies were faster than their correct latencies, whereas the opposite pattern emerged for 4.5- and 5.5-year-olds. Although these results are most consistent with conceptual change theories of false-belief reasoning, no extant theory fully accounts for our data pattern. We argue that response latency data provide new information about underlying cognitive processes in theory of mind reasoning, and can shed light on concept acquisition more broadly.

1. Introduction

False-belief understanding is typically measured using standard tasks such as the Change in Location (e.g., Wimmer & Perner, 1983) or Unexpected Contents (e.g., Gopnik & Astington, 1988). While 3-year-olds often have difficulty with these tasks, most 4- and 5-year-olds do not (Wellman, Cross, & Watson, 2001). For example, when 3-year-olds see that a crayon box contains candles, not crayons, they will state that they originally believed it contained candles, failing to acknowledge their false belief. Verbal responses are informative, but combining them with other measures would enhance our understanding of underlying cognitive processes. One candidate measure – response latency – has a long (Donders, 1969) and rich history in psychological science (Van Zandt, 2000), yet has received little attention in theory of mind research.

At first blush, one might predict that response latencies on false-belief tasks will decrease linearly with age, due to more efficient information-processing capacities. Yet, given existing theories about *why* younger children fail false-belief tasks, one might predict otherwise. We consider predictions from two prominent categories of theories: the conceptual change (e.g., Gopnik & Wellman, 1994; Perner, 1991) and processing accounts (e.g., Fodor, 1992; Leslie & Thaiss, 1992; Roth & Leslie, 1998). According to conceptual change theories, 3-year-olds fail false-belief tasks because they lack an understanding that the mind can misrepresent reality. Children are argued to acquire this understanding around age 4, accounting for their increase in performance on false-belief tasks. In contrast, processing theories situate 3-year-olds' failure on false-belief tasks in their limited processing capacities, not in their lack of an understanding of misrepresentation. With age, processing capacity increases, accounting for older children's higher success rate on false-belief tasks. Both categories of theories lead to unique patterns of predictions about response latencies.

According to conceptual change theories (see Fig. 1a), 3-year-olds appeal to their true belief about the world when responding to a false-belief task, because they do not yet understand that beliefs (theirs or another's) can misrepresent the world and thus what a person believes

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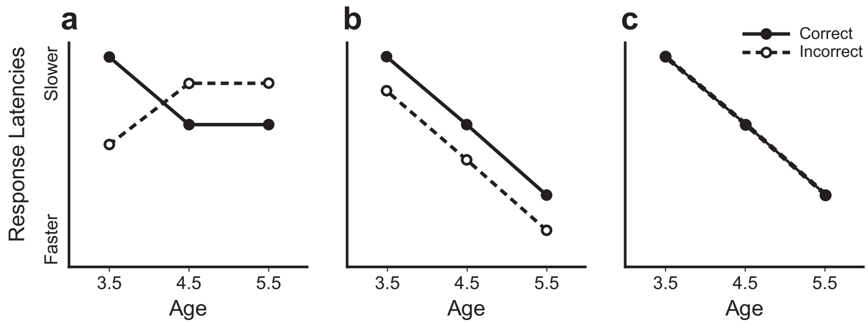

Fig. 1. Correct and incorrect response latencies predicted by conceptual change theories (Panel a), Leslie and colleagues' processing theory (Panel b), and Kikuno et al.'s (2007) processing theory (Panel c). The ages "3.5", "4.5", and "5.5" reflect the mean ages typically used in the literature, and map onto the mean ages in our study.

about the world can conflict with reality (i.e., be "false") (e.g., Wellman, 1990). Accordingly, at age 3, *in*correct responses should be produced quickly – and, importantly, more quickly than correct responses. This is because incorrect responses comport with how 3-year-olds understand the situation – what is in the other's mind must correspond to what is in the world. Conversely, at ages 4 and 5, *correct* responses should take less time to produce than incorrect responses. This is because children now understand mental misrepresentation, and correct responses only require their responding according to this framework. In contrast, incorrect responses would arise if children were unsure and were still actively weighing both the concept they have recently acquired (i.e., "false belief") and the reality of the situation.

Like conceptual change, most processing accounts would predict that incorrect response latencies be faster than correct response latencies at age 3. For example, Leslie, Friedman, and German (2004) argue that an early-developing theory of mind mechanism identifies both "true" and "false" belief contents concurrently. To answer a false-belief question correctly, a "selection processor" inhibits the true belief. This extra processing step should result in longer latencies for correct responses (Carlson & Moses', 2001, executive function account would predict similarly) (see Fig. 1b). This theory appears to make the unique prediction that incorrect response latencies at *all* ages should be faster than correct response latencies, because the former are due to inhibition failures. In contrast, Kikuno, Mitchell, and Ziegler (2007) hold a different processing account. Their account predicts *no* differences in latencies at all ages as a function of correctness (see Fig. 1c), because the reasoning processes underlying correct and incorrect responses are argued to be identical, save for the fact that incorrect responses result from a "reality" bias. Note, however, that by *both* processing accounts, response latencies should become faster with age due to more efficient processing capacities.

Kikuno et al. (2007) tested their account using response latencies with 3- and 4-year-olds.[1] They administered one standard false-belief task and several modified versions in Experiment 1, and only modified versions in Experiments 2 and 3. No differences in response latency were detected as a function of whether children were correct/incorrect on the tasks, and the authors interpreted this null pattern as support for their processing account.

Although Kikuno et al.'s (2007) study provides a good starting point to examine false-belief response latencies, there are several important limitations. First, children only received one standard false-belief task in Experiment 1, yielding one data point for the response latency analyses. This could have contributed to the null effect. Because children's response latencies can be highly variable (Eckert & Eichorn, 1977), multiple data points are preferable. Second, most of the children in their study were 3-year-olds, or young 4-year-olds – an age range that does not capture the progression from systematically failing to passing false-belief tasks. Therefore, their results do not provide a full developmental account of children's false-belief reasoning, nor do they allow us to evaluate the merit of the different theories and predictions that we outlined – our main goal here. Accordingly, the advances we made in this study beyond the previous literature were to assess latencies calculated separately for correct and *in*correct responses in 3.5-, 4.5-, and 5.5-year-olds on a battery of four standard theory-of-mind tasks.

2. Method

2.1. Participants

A total of 240 children participated: 85 3.5-year-olds (M = 41.75 months, SD = 1.72, Range = 37–47 months; 43 female); 51 4.5-year-olds (M = 54.35 months, SD = 0.60, Range = 53–56 months; 25 female); and 104 5.5-year-olds (M = 66.60 months, SD = 1.89, Range = 61–72 months; 47 female). Children completed these tasks as part of three theory-of-mind studies (Bernstein, Atance, Meltzoff, & Loftus, 2007; Sommerville, Bernstein, & Meltzoff, submitted for publication) and so the sample did not include equal numbers of children in each age group. Children came from a large city and were from predominantly middle– and upper–middle-class families.

[1] This study was published after we had collected our data. We have, however, accommodated our predictions to include Kikuno et al.'s processing account.