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Metamemory Development: Understanding the Role of Similarity in False Memories

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Research on the development of metamemory has focused primarily on children's understanding of the variables that influence how likely a person is to remember something. But metamemory also involves an understanding of why people occasionally misremember things. In this study, 5- and 6-year-olds (N = 38) were asked to decide whether another child's mistakes in a memory game were due to false memories or guesses. Some of the fictitious child's mistakes were similar to material he had seen earlier and some were not. Six-year-olds, but not 5-year-olds, consistently attributed more similar than dissimilar mistakes to false memories. Understanding the link between similarity and false memories improves significantly between 5 and 6 years of age.

A mature understanding of memory includes an awareness that memory can fail in two fundamentally different ways. One involves forgetting, or being unable to remember a particular piece of information despite one's best efforts. For example, you may recognize an acquaintance, but draw a blank when trying to remember her name. The other involves ''misremembering,'' or remembering something incorrectly. For example, after studying a list of words including *tired*, *bed*, *rest*, and *pillow*, many people claim (and really believe) that *sleep* appeared on the list (Deese, 1959; Roediger & McDermott, 1995). False memories can occur in both recognition and recall, and can be based on a variety of subjective experiences (e.g., Brainerd, Wright, Reyna, & Mojardin, 2001; Dodson, Darragh, & Williams, 2008; Lindsay, 2008). For example, they can occur because of familiarity—a feeling that material has been encountered previously, even though memory for the specific details of that encounter (e.g., when/where it occurred) are lacking. They can also occur because of false, illusory, or phantom recollections, in which specific (but erroneous) details of an event are remembered. False memories are a particularly pernicious kind of memory error: Whereas forgetting involves experiencing a gap in one's memory, a false memory can involve experiencing a vivid recollection of an event that never occurred.

In the literature on the development of metamemory, a good deal of work has focused on children's understanding of forgetting (for a review, see Schneider & Pressley, 1997). Surprisingly, however, to our knowledge, no one has yet addressed young children's understanding of false memories. In principle, children could operate with a binary conception of memory in which information is either retrieved correctly (''remembered'') or forgotten. On this view, false memories would be interpreted as guesses, for example, rather than as erroneous recollections. In the work described here, we asked whether 5- and 6-year-olds understand that memory is fallible not just because it is subject to forgetting, but also because it is subject to distortion.

To get at this question, we took advantage of the fact that false memories are usually ''near-misses'' rather than random errors. When people experience false memories, their errors are usually related in some way to events that were actually experienced (e.g., Chan & McDermott, 2006; Deese, 1959; Johnson, Bransford, & Solomon, 1973; Posner & Keele, 1968, 1970; Roediger & McDermott, 1995; Underwood, 1965). Thus, we asked whether children recognize that false memories are usually related to previously experienced events, but that guesses need not be. An example may help to

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make the distinction clear: To an adult observer, a participant who claims to have seen a picture of a cat after looking at pictures of several other animals seems more likely to have experienced a false memory than a participant who claims to have seen a picture of a sandwich after studying the same list. The sandwich error seems more likely to represent a guess (or perhaps a mischievous participant).

We focused on 5- and 6-year-olds for two reasons. First, we wanted to ensure that the children in our study already had a good grasp of the distinction between remember, forget, and guess. Some research suggests that it is not until around 4 or 5 years of age that children reliably understand that remembering involves the retrieval of a piece of information that was known previously (e.g., Johnson & Wellman, 1980; Lyon & Flavell, 1994; Miscione, Marvin, O'Brien, & Greenberg, 1978; Wellman & Johnson, 1979). For example, in Wellman and Johnson (1979) 3- and 4-year-olds claimed that a person who found a hidden item ''remembered'' where it was located even if that person had no knowledge of where it had been hidden. Five-year-olds, in contrast, recognized that one could only remember something known previously.

A second reason we focused on 5- and 6-year-olds is that, as will be described below, we used the phrase ''really thought he saw it'' in our procedure as a gloss for ''experienced a false memory.'' It was therefore important that our participants understand the difference between actually seeing something and just thinking about it. Sluzenski, Newcombe, and Ottinger (2004) documented a dramatic improvement between 4 and 6 years of age in children's ability to engage in this type of reality-monitoring. They found that 4-year-olds were just slightly above chance at remembering whether they had actually carried out a series of actions a week earlier or had simply imagined them, whereas 6-year-olds were nearly perfect at making this distinction (but see Foley, Johnson, & Raye, 1983, for evidence that 6-year-olds may also have difficulty).

In the study presented here, children heard about a boy who had earlier played a memory game. In that game, he studied an array of pictures and then was given a recognition test consisting of those pictures and a few distracters. On each of several trials, the boy correctly recognized a few pictures, but he also claimed to have seen one of the distracters. The boy's mistakes were explicitly pointed out to the children, and they had to give a reason for each error: Was it due to a false memory (''he really thought he saw it'') or a guess (''he was just guessing'')? It is important to note here that we use the term *false memory* to refer exclusively to false recollections—instances in which an individual falsely recollects having seen something earlier.

We manipulated two variables. We varied the *kind of error* that the boy made: Sometimes he claimed to have seen an item that was similar to those he had actually seen earlier, and sometimes he claimed to have seen an item that was unrelated. The question was whether children would distinguish between these two types of errors: Would they be more likely to attribute a recognition error involving a related than unrelated item to a false memory?

It is possible that an understanding of the link between similarity and false memories emerges in a gradual fashion, depending on the type of similarity involved. For example, children might understand that seeing a boot on a recognition test could make one think of previously seen boots before understanding that seeing a table could make one think of previously seen furniture. The boot example involves a one-to-one relation between the presently seen item and things seen previously, a link that even 3-year-olds may understand (e.g., Gordon & Flavell, 1977; Lagattuta, Wellman, & Flavell, 1997). In contrast, the table example requires forming a gist-like representation of a semantically related set of items (e.g., pieces of furniture), which may not be common until early adolescence or later (e.g., Bjorklund & Hock, 1982; Brainerd, Reyna, & Forrest, 2002).

Thus, we also manipulated the *type of similarity* involved. On one type of trial, the boy studied abstract shapes and in the subsequent recognition test, he claimed to have seen either a perceptually similar or dissimilar shape. On a second type of trial, he studied line drawings, all of which were related to a theme (e.g., furniture), and he later claimed to have seen either something that was semantically similar (e.g., table) or dissimilar (e.g., baseball cap). Finally, on a third type of trial, he studied photos of common objects from a particular basic-level category (e.g., boots), and he later claimed to have seen either an object that was both perceptually and semantically similar (e.g., another boot), or one that was dissimilar on both dimensions (e.g., a lightbulb).

Method

Participants

Twenty 5-year-olds (M = 5 years 6 months; range = 5;0–5;11; 10 females) and eighteen

6-year-olds (M = 6; 4; range = 6;0–6;10; 9 females) participated. Three additional 5-year-olds participated, but their data are not included because they got bored and asked to stop. Children were recruited from a database of interested families, and were primarily White and from middle-class backgrounds.

Materials

We created 18 study arrays. Each one consisted of six 2 × 2 in. items, printed in black and white onto an 8.5 × 11 in. piece of paper. As will be described below, four items in each array were either perceptually, semantically, or both perceptually and semantically related to each other, and two items were unrelated to them or to each other. The four related items were arranged in a row above the two unrelated items, with the position of each item in its respective row randomly determined. We included the two unrelated items in each study array in order to make it plausible that, when subsequently given a recognition memory test, someone might guess that they had seen an unrelated item (see below). The left column of Figure 1 shows examples of study arrays.

We also created 18 corresponding test arrays. Each one showed eight items: the six from a particular study array, an additional related item (''similar lure''), and an additional unrelated item (''dissimilar lure''). These eight items were randomly arranged in two rows and printed in black-and-white onto an 8.5 × 11 in. piece of paper. The right column of Figure 1 shows examples of test arrays. Study and test arrays were inserted onto facing pages in a three-ring binder so that a particular study–test pair could be displayed simultaneously.

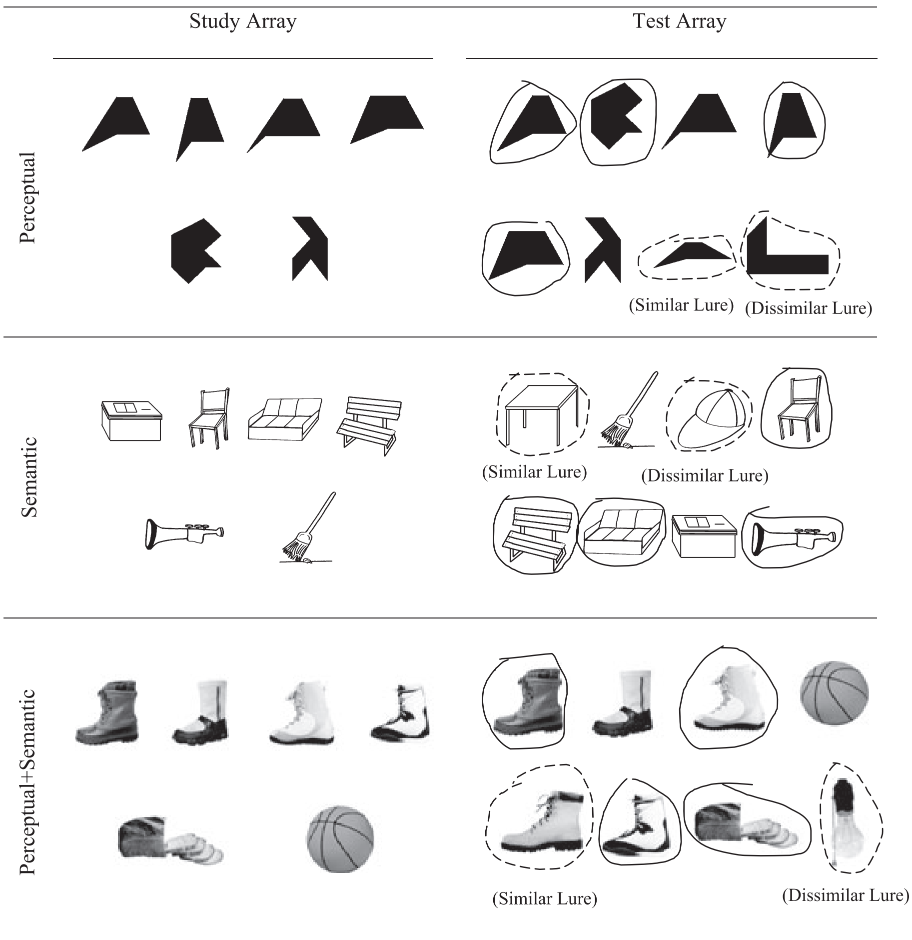

Figure 1. Sample study and test arrays.
Note. In each test array, children saw five of the eight items circled with a solid line: four items from the corresponding study array and either the similar or dissimilar lure (the lures are shown here circled with dashed lines for illustrative purposes only).

There were six study–test pairs for each of three types of array: (a) perceptual arrays composed of abstract shapes (Attneave, 1957), (b) semantic arrays composed of line drawings from Deese–Roediger–McDermott lists (Israel & Schacter, 1997), and (c) perceptual + semantic arrays composed of photographs of common objects (Hemera Technologies, Gatineau, QC, Canada). Related items in each perceptual array were created using the same algorithm and so looked like each other; unrelated items were created using a different algorithm and so looked different. Related items in the semantic arrays were closely associated with a particular concept (e.g., sleep), but they did not look alike; unrelated items were not related to the target concept semantically or perceptually. Finally, perceptual + semantic arrays were typical exemplars from the same basic-level category (e.g., boots) and so were both perceptually and semantically similar. The unrelated items were from a different basic-level category, and so were both perceptually and semantically different. Figure 1 shows an example of one study–test pair for each of the three array types.

Procedure

Children participated individually in the lab. They sat at a small table with the researcher next to them. The researcher explained that she had earlier played a memory game with a boy named John. In that game, she showed John several pictures and told him to try to remember each one. At this point, the researcher opened the binder to reveal the first study array. For semantic arrays or perceptual + semantic arrays, she labeled each item (e.g., ''Look, here's a boot, and here's another boot, . . .''), thus ensuring that children recognized what each picture was meant to depict. For perceptual arrays, she drew attention to each item by referring to it neutrally (''Look, here's one, and another one, . . .'').

Next, the researcher explained to participants that she had later shown John another set of pictures, some of which he had seen before, and some of which he had not. John's task was to circle the pictures he had seen earlier. The researcher revealed the test array, which showed that John had circled five items: three related items from the study array, one unrelated item from the study array, and either the similar or dissimilar lure (see Figure 1). The study array was still visible, and the researcher noted the correspondence between the four correctly circled items in the test array and the same items in the study array (e.g., ''Look, he remembered this boot, and this boot, . . .''). She then pointed to the incorrectly circled lure in the test array and frowned, saying, ''But look! Here's one he got wrong! He circled this [boot/lightbulb], too, but it's not one he saw earlier, is it? It's not here [pointing to the study array]. . . Hmmm, that's interesting. He didn't see this [boot/lightbulb] earlier, but he circled it anyway. I wonder why he did that?''

When the error involved the similar lure, she added, ''It's kind of like these,'' and traced her finger around the four related items in the study array. When it involved the dissimilar lure, she added, ''It's not like these,'' and traced her finger around the four related items in the study array. Finally, she asked, ''Do you think he circled this one because he really thought he saw it earlier, or because he was just guessing?'' If children recognize the link between similarity and false memories, we expected them to say ''really thought he saw it'' more often when the errors involved similar lures than when they involved dissimilar ones.

There were 18 trials, 6 each involving perceptual, semantic, and perceptual + semantic arrays. Two random orders of these 18 trials were created, with the constraint that no more than 2 trials involving a particular array type occurred in a row. For each order, the similar lure was circled on three randomly selected test arrays of each array type, and the dissimilar lure was circled on the other three of that type. Thus, on 3 trials of each array type, children were asked whether a dissimilar lure represented a guess or a false memory, and on 3 trials of each array type, they were asked whether a similar lure represented a guess or a false memory. Additionally, children were yoked in pairs so that half of the children in each order and at each age were asked why John circled the similar lure in a particular test array, and the other half were asked why John circled the dissimilar lure in that array.

Finally, the order of the two response options was counterbalanced within each array type so that children heard the ''really thought he saw it'' option first on one or two of the three trials of a particular array type where the circled lure was similar and on one or two of the three trials of that array type where the circled lure was dissimilar. This was also counterbalanced across children so that for each array type-circled lure combination, approximately equal numbers of children at each age heard ''really thought he saw it'' and ''just guessing'' first.

Results

Figure 2 shows how often children indicated that errors involving similar and dissimilar lures were due to a false memory (''really thought he saw it''), as a function of array type. Recall that children chose between ''really thought he saw it'' and ''just guessing.'' Thus, a function close to 0.50 indicates that children were about as likely to attribute that type of error to a guess as to a false memory, and a function lower than 0.50 indicates that they were more likely to attribute it to a guess. Most functions in Figure 2 are at or below 0.50, suggesting that children may have had a general bias to attribute John's errors to guessing. (Indeed, 6 children said ''guessing'' on all 18 trials; no child said ''really thought he saw it'' on all 18 trials.) Importantly, however, our interest was in the relative levels of attributions, not in the absolute levels. If children recognize the link between similarity and false memories, we expected that they would be more likely to indicate that errors involving similar than dissimilar lures were due to false memories.

A 2 × 3 × 2 (Age × Array Type × Lure Type) mixed analysis of variance (ANOVA) on the data in Figure 2 revealed a main effect of lure type: Children were more likely to say that John experienced a false memory when his mistake involved circling a similar lure than when it involved circling a dissimilar one, $F(1, 36) = 13.93$, $p = .0007$, $\eta_p^2 = .28$. However, this was qualified by an interaction between lure type and age, $F(1, 36) = 4.64$, $p = .04$, $\eta_p^2 = .11$. Simple main effects analyses revealed that 6-year-olds attributed more errors involving similar than dissimilar lures to a false memory, $F(1, 36) = 5.48$, $p = .02$, $\eta_p^2 = .13$, but 5-year-olds were as likely to attribute errors involving similar and dissimilar lures to a false memory, $F(1, 36) < 1$. In other words, 6-year-olds tended to make different attributions for errors involving the two lures, but 5-year-olds did not.

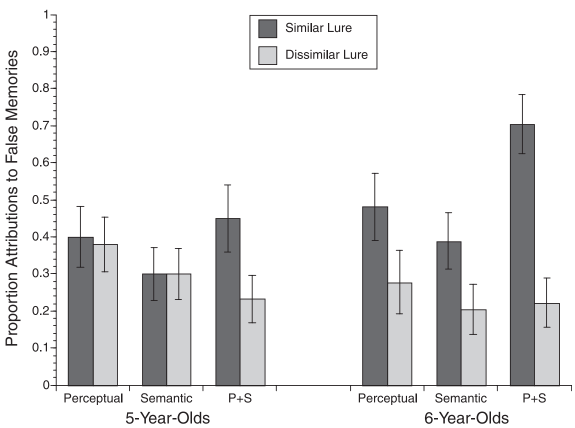

Figure 2. Proportion of trials on which children said that John ''really thought he saw'' the circled lure.
Note. P + S represents stimulus sets containing items that were both perceptually and semantically related. Error bars show standard error of the mean.

The omnibus ANOVA also showed a main effect of array type: Children were more likely to say that John experienced a false memory on the perceptual + semantic arrays than on the perceptual or semantic ones, $F(2, 72) = 5.13$, $p = .008$, $\eta_p^2 = .12$, and Tukey's honestly significant difference (HSD) ps < .05. But this was qualified by an interaction between array type and lure type: Children were most likely to make different attributions for the two types of errors on the perceptual + semantic arrays, $F(2, 72) = 7.50$, $p = .001$, $\eta_p^2 = .17$. No other effects or interactions were significant.

In sum, the omnibus ANOVA shows that 6-year-olds consistently attributed more errors involving similar than dissimilar lures to false memories, but 5-year-olds did not. One possibility is that the 5-year-olds simply failed to understand the difference between the two response options: ''really thought he saw it'' and ''just guessing.'' However, this seems unlikely. As Figure 2 shows, on the perceptual + semantic arrays, 5-year-olds did attribute more errors involving similar than dissimilar lures to a false memory, although this difference was only marginally significant, paired $t(19) = 1.90$, $p = .07$, $d = .43$. If 5-year-olds had not understood the two response options, we would not have expected them to make different attributions for errors involving the similar and dissimilar lures on any of the three types of arrays.

Another explanation for the difference between 5- and 6-year-olds' performance could be that the 5-year-olds had difficulty detecting the similarity between the lures and the studied items in the perceptual arrays and the semantic ones. For example, if the younger children saw a table and baseball cap as equally similar to the studied pieces of furniture, they could not be expected to systematically attribute an error involving the table to a false memory and one involving the baseball cap to a guess. Although the researcher explicitly stated whether each circled lure was ''like'' or ''not like'' the studied items before asking children to decide why John had mistakenly circled it, it is possible that they did not understand what this meant.

To investigate this possibility, we conducted a control study in which we showed a different group of 5- and 6-year-olds (Ns = 8 and 9) the similar and dissimilar lures from each of the 18 test arrays and simply asked them which one was ''like'' or ''not like'' the four related items from the corresponding study array. On all three types of stimulus arrays, both 5- and 6-year-olds identified the similar lures as ''like'' the related items and the dissimilar lures as ''not like'' the related items at least 89% of the time. Thus, 5-year-olds' failure to make different attributions for errors involving the similar and dissimilar lures was not because they failed to recognize the similarity or dissimilarity between the lures and the studied items.

Discussion

We asked 5- and 6-year-olds to decide whether each of another child's mistakes in a memory game was a guess or a false memory. Two key findings emerged. First, there appear to be some circumstances under which even 5-year-olds recognize the distinction between false memories and guesses. When the fictitious child in the memory game claimed to have seen a particular boot, for example, after looking at photos of several other boots, 5-year-olds were marginally more likely to attribute this error to a false memory than when he claimed to have seen a picture of a lightbulb after looking at the same photos.

The second key finding, however, was that 5-year-olds' understanding of the link between similarity and false memories was limited. They did not seem to recognize that when John claimed to have seen an abstract shape that looked like some shapes he had seen earlier, for example, or a drawing of a table after seeing drawings of several other pieces of furniture, he was more likely to have experienced a false memory than when he claimed to have seen items that were unrelated to those he had seen earlier. Six-year-olds, in contrast, made different attributions for mistakes involving similar and dissimilar lures regardless of the type of similarity involved.

Why did 5-year-olds fail to discriminate between the two mistakes when similarity was only perceptually or semantically based? Their success on the perceptual + semantic arrays rules out the possibility that they failed to understand the difference between ''really thought he saw it'' and ''just guessing.'' Additionally, the control study showed that it was not because they failed to recognize that the similar lures were more similar to the studied items than the dissimilar ones.

Because this is the first study, to our knowledge, to document an improvement in children's understanding of the link between similarity and false memories, our explanation is necessarily speculative. We suspect that it is because 5-year-olds have only a tenuous grasp of the active, interpretive nature of the mind. Although children this age can pass classic false belief tasks (involving, e.g., unexpected contents or locations), a number of studies have shown that children younger than about 6 years do not seem to understand that our minds actively process information in light of our knowledge, biases, expectations, and previous experiences (e.g., Carpendale & Chandler, 1996; Eisbach, 2004; Flavell & Flavell, 2004; Gordon & Flavell, 1977; Pillow, 1991; Pillow & Henrichon, 1996; Pillow & Mash, 1998; Taylor, 1988). For example, Pillow and Mash (1998) found that 4- and 5-year-olds did not take into account a puppet's prior experience when predicting how he would interpret an ambiguous picture, but 6-year-olds did.

In our study, when deciding why the fictitious child made a particular mistake in a memory game, 5-year-olds did not consistently take into account the similarity between the items he had seen earlier and his mistake. The only case in which they did so was when the arrays were both perceptually and semantically similar. Their success in this case was likely driven by the fact that the similarity (and dissimilarity) between the two lures and the studied items on perceptual + semantic arrays was especially salient; by design, the related items and the similar lure were common objects from the same basic-level category, and they looked alike. The related items and the dissimilar lure were not from the same basic-level category, nor did they look alike. The understanding of the mind as an active processor of information, where memories are subject to distortion as well as forgetting, is likely to be easiest to recognize in the most supportive contexts. Indeed, 6-year-olds were also most likely to discriminate between the two lures on the perceptual + semantic arrays.

So far, we have emphasized 5-year-olds' incomplete understanding of the relation between similarity and false memories, but 6-year-olds' relative success is also noteworthy. The 6-year-olds did not perform at ceiling on our task, but they did consistently make different attributions for errors involving the similar and dissimilar lures. This suggests that they recognize that: (a) people can misremember past events, and (b) such errors are likely to be related to events that were actually experienced.

Research on the development of metamemory has focused primarily on children's understanding of the variables that influence how likely a person is to remember something (e.g., Schneider &

Pressley, 1997). But metamemory also involves an understanding of why people occasionally *misremember* things. Understanding that memories can be distorted is fundamental because it provides an explanation for why well-meaning people sometimes claim to have a memory for something that did not occur. It is not that they are guessing or lying—in some cases, memories for events that did not occur can seem as (or even more) vivid to the person experiencing them as memories for events that did. We have shown that 5-year-olds have a nascent understanding of the role that similarity plays in false memories, and that this understanding improves significantly over the course of the next year.

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