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LYON, THOMAS D., and FLAVELL, JOHN H. *Young Children's Understanding of "Remember" and "Forget."* CHILD DEVELOPMENT, 1994, 65, 1357-1371. 3 studies examined young children's understanding that if one "remembers" or "forgot," one must have known at a prior time. In Study 1, 4-year-olds but not 3-year-olds understood the prior knowledge component of "forgot"; both groups understood that a character with prior knowledge was "gonna remember." Study 2 controlled for the possibility that good performance on "remember" might be due to a simple association of remembering with knowledge. A significant number of 4-year-olds but not 3-year-olds understood that when 2 characters currently knew, the one with prior knowledge remembered, and that when neither character currently knew, the one with prior knowledge forgot. Study 3 made prior knowledge more salient by making the remembered or forgotten item visible to the subjects throughout. 4-year-olds performed near ceiling on both verbs, whereas 3-year-olds' performance did not differ from chance. The results are discussed in relation to children's developing understanding of the mind.

An active area of research concerns young children's understanding of knowledge and other mental states. One means by which their understanding has been assessed is through testing their comprehension of mental verbs. A number of researchers have discovered that significant changes occur in children's understanding of the meaning of "know," "think," and "guess" in the preschool years (Abbeduto & Rosenberg, 1985; Johnson & Maratsos, 1977; Johnson & Wellman, 1980; Miscione, Marvin, O'Brien, & Greenberg, 1978; Moore, Bryant, & Furrow, 1989; Moore & Davidge, 1989; Perner, 1991). These changes parallel a growing awareness among young children of the processes by which beliefs and knowledge are formed, and an emergent understanding of the possibility that because of limited perceptual access or subjective interpretation, what we "think" may be false and what we "know" may be incomplete (for reviews, see Perner, 1991; Wellman, 1990).

Research on children's understanding of knowledge has emphasized their understanding of how beliefs are acquired and how those beliefs may not coincide with reality. Less attention has been paid to their understanding that beliefs and knowledge are sometimes retained and sometimes lost

over time—in other words, that people remember and forget. Moreover, little recent experimental work has attempted to explore the links between young children's metamemory and their broader conception of the mind.

Wellman (1990) is one of the few researchers who has considered the relation between children's understanding of memory and their conception of mental processes more generally. Wellman starts with the claim that 3-year-olds have a copy-container theory of the mind, in which beliefs are faithful copies of reality. Children understand that beliefs represent the world but have difficulty in understanding that beliefs can also misrepresent the world—that one can hold a false belief. Since remembering and forgetting do not require an understanding of misrepresentation, they are understood by children with a copy-container theory of the mind; copies may be successfully "maintained" in one's copy-container but may also "fade" over time (Wellman, 1990, pp. 307-308).

Criticism of Wellman's claims regarding 3-year-olds' copy-container theory of mind has neglected what young children understand about knowledge retention and retrieval. Instead, critics typically argue that

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3-year-olds have a poor understanding of the process by which mental copies are made—the acquisition of knowledge (Astington & Gopnik, 1991; Perner, 1991). These critics nevertheless feel compelled to acknowledge that 3-year-olds seem to understand something about acquisition (Gopnik, 1993; Perner, 1992): children at this age are quite good at identifying a person who has seen as a person who “knows” (Pillow, 1989; Pratt & Bryant, 1990; Woolley & Wellman, 1993).

It is possible for a child to understand that one who saw “knows” without conceptualizing knowledge as copies of reality that are retained and retrieved over time. To have a copy-container theory of mind, a child must not only associate perception with knowledge but also understand the differences between the two. Perception is a means by which mental copies are acquired, whereas knowing encompasses not only the acquisition of copies but also their retention and retrieval.

Research that explores children’s understanding of mental verbs that refer to retention and retrieval, rather than mere knowledge and ignorance, is one means by which we may uncover how children conceptualize the mind. One “remembers” or “forgets” only when one has known sometime in the past. “Remember” and “forget” are thus defined by reference to both one’s current and prior mental states. Remembering refers to knowledge that was previously acquired, retained, and is now being retrieved. Forgetting also refers to knowledge which was previously acquired, but which one has failed either to retain or to retrieve. An ability to distinguish between what one knows and what one remembers, and between what one does not know and what one forgets, reflects an understanding of the difference between the acquisition of knowledge and its retention and retrieval.

Interested in children’s understanding of knowledge in general and their early metamemory in particular, we assessed young children’s understanding of “remember” and “forget.” Previous work on children’s understanding of “remember” and “forget” suggests early use of these terms but late appreciation of the prior-knowledge component of their meanings. Naturalistic observations have shown that children spontaneously use the words before they are 3 years old (Bretherton & Beeghly, 1982; Limber, 1973; Shatz, Wellman, & Silber, 1983). Though it has been claimed that use of the words signifies an explicit awareness that

“persons can retain previous experience and structure their present behavior by it” (Bretherton, McNew, & Beeghly-Smith, 1981, p. 357), experimental research has found that it is not until the elementary school years that children correctly limit their use of “remember” and “forget” to situations in which the target character had prior knowledge (Johnson & Wellman, 1980; Wellman & Johnson, 1979).

Wellman and Johnson (1979) told 3–7-year-olds stories in which a character either remembered, forgot, never knew, or correctly guessed the location of an object. Three-year-olds did not discriminate between “remember” and “forget.” It was not until 5 years of age that subjects recognized that a correct guess was not remembering. A majority of children at every age group maintained that a character who had never known the location of an object had forgotten. Johnson and Wellman (1980) examined 4–9-year-olds’ understanding of the words “remember,” “know,” and “guess” when describing their own mental state. Objects were placed in one of two boxes, and the experimenters varied whether the child saw the object placed, and whether the child’s choice was correct (performance was manipulated with the use of trick boxes). A majority of both 4- and 5-year-olds claimed to “remember” when guessing correctly or when guessing without knowing the correctness of their choice. Moreover, subjects up to 6 years of age claimed to “remember” the object’s location when their knowledge was limited to current perception.

Given children’s early acquisition of these words, the results of these two studies are surprising. Indeed, there are at least four reasons to suspect that children’s understanding was underestimated. First, in each study children were asked a series of yes-no questions, a method which, as Johnson and Wellman (1980) recognized, is less sensitive to nascent understanding because it tests for categorical rather than relative understanding of the terms. Whereas Johnson and Wellman (1980) found that 4- and 5-year-olds did not reliably discriminate between “know” and “guess,” Sodian and Wimmer (1987) found that when 4-year-olds were given a forced-choice question between “know” and “guess,” they attributed “guessing” to a character who inferred an object’s location (without perceptual access). Johnson and Wellman (1980) themselves informally reported the results of a forced-choice procedure in which 4-year-olds were asked to

discriminate between knowing and remembering. The subjects understood that "remember" was more properly applied to personal past experiences than predictions about themselves or the past experiences of others.

Second, yes-no questions may confound lacking comprehension with a "yes" bias (Perner, 1991; Shatz et al., 1983; Sodian & Wimmer, 1987). Wellman and Johnson (1979) classified several 3- and 4-year-olds as exhibiting a yes bias and eliminated some subjects who always answered yes. The possibility of a yes bias among older subjects is suggested by the finding that almost a third of the 4-year-olds (combining young and old, mean 4-5) claimed that a character who always knew where an object was had forgotten its location. In contrast, Macnamara, Baker, and Olson (1976) found that 4-year-olds (mean 4-6) unanimously understood that forgetting implies performance failure. In Johnson and Wellman (1980) approximately 70% of both 4- and 5-year-olds claimed to "know" the location of an object when they had not seen the object hidden, a finding that Perner notes "is totally incompatible with all recent studies [on children's ability to correctly describe their knowledge state], even those with the most conservative results and not to mention those that found near ceiling performance in children a year younger" (Perner, 1991, p. 305).

Third, prior knowledge may not have been salient to the younger subjects. In Wellman and Johnson (1979) children had to infer prior knowledge from the fact that the character either saw or did not see where the object had been placed. In Johnson and Wellman (1980), prior knowledge may have been overshadowed by the child's act of choosing where he or she supposed the object was hidden.

Finally, children's desire to be knowledgeable in Johnson and Wellman (1980) may have inflated their judgments that they "remembered" or "knew"; research examining young children's understanding of the association between perception and knowledge frequently shows that children's errors in assessing their own knowledge tend to be claims of knowledge when perceptual access is lacking (Ruffman & Olson, 1989; Wimmer, Hogrefe, & Perner, 1988; Woolley & Wellman, 1993).

Both Johnson (1982) and Wellman (1985) have acknowledged that the methods in their two studies may have underesti-

mated the competencies of the younger subjects. In three studies, we tested children's understanding of the prior knowledge component of "remember" and "forget," utilizing what we hoped were more sensitive procedures than those in previous research. We asked forced-choice questions, attempted to highlight prior knowledge, held information about current performance constant, and asked subjects to make judgments about others. In Study 1, one story character remembered or forgot the location of an object whereas another character never knew it. We either asked subjects to predict which character would "remember," or we told the subjects neither currently knew and asked which character "forgot." To answer correctly, subjects had to distinguish between remembering or forgetting and never knowing. In Studies 2 and 3, subjects had to distinguish between remembering and current perception, and between forgetting and never knowing. Each study tested 3- and 4-year-old children, because pilot research suggested that understanding emerges at this age.

Study 1

METHOD

Subjects

The final sample consisted of 32 nursery school children, 15 boys and 17 girls, from a single nursery school serving largely upper-middle-class families. All subjects spoke English fluently; the race and ethnicity of subjects were not recorded. Sixteen children were in each age group. The 3-year-olds (six boys and 10 girls) ranged from 3-5 to 3-11 years (mean 3-8). The 4-year-olds (nine boys and seven girls) ranged from 4-0 to 4-11 years (mean 4-6).

Materials

Several types of materials were used, including a dollhouse, dollhouse furniture, a doll family, eight miniature objects, and a moon and sun made out of construction paper. The dollhouse consisted of three adjoining rooms with no walls between the rooms. Doll furniture was placed in each of the rooms, including four pieces under which objects could be hidden: a bed, a sofa, a kitchen table, and a kitchen sink. Pieces of cloth were attached to the furniture so that an object underneath was visible only when the cloth was lifted. The doll family was a realistic-looking set of four rubber dolls, consisting of two adults and two children, one male and one female of each. The minia-

ture objects were realistic-looking replicas of common items, such as a football, teddy bear, etc.

Procedure

All subjects were tested by the same male experimenter. The child sat next to the experimenter at a table with the dollhouse. The experimenter introduced the doll family to the child as the mommy, the daddy, the little boy, and the little girl. The child was shown that "when the sun comes up, it is morning," while the experimenter placed the picture of the sun so that it hung down from the wall of the kitchen, and that "when the moon comes out, it is night," while the experimenter hung the picture of the moon.

The child was told eight stories, four involving the word "forget" and four involving the word "remember." The stories were blocked so that the child heard two stories using one word and then two using the other word. Before each story, the experimenter showed the child one of the miniature objects, and while placing the object in its hiding place, said, "Let me show you that the [object] is under the [hiding place]." At the beginning of each story, the experimenter put up the sun, said that it was morning, showed the child two dolls (either two adults or two children), and then said that the two wanted to find the object.

One character then looked under the hiding place, making the object visible. The experimenter noted that the character found the object, could see the object, and knew where the object was. The experimenter then asked the child (*sotto voce*), "Does she [or he] know where the [name of object] is?" If the child answered incorrectly, the experimenter corrected the child, and then repeated the part of the story describing that character's actions. When the child answered correctly, the experimenter agreed and reiterated, "Yes, she [or he] knows where the [name of object] is." The other character then looked on top of the hiding place, and the story proceeded in a parallel yet opposite fashion regarding that character's knowledge.

The experimenter then said that it was time for work (for the two adult dolls) or school (for the two children dolls), and that the characters were gone the entire day, so that the moon came out, because it was night (replacing the sun with the moon). The experimenter then said that the characters wanted the object, and asked the child (*sotto voce*), "Where's the [name of object]?" In

the "forget" stories the experimenter noted, one character at a time, that "right now" the characters did not know where the object was and asked the child which character forgot where the object was. In the "remember" stories, the experimenter asked the child who was "gonna remember" where the object was, without giving the child any information about the characters' current knowledge.

Either a verbal response or a gesture was accepted. If the child merely pointed to or mentioned the hiding place, or said "both" or "I don't know," the experimenter would point to the dolls and say, "But look at the people and tell me [and repeat the question]." The hiding place was pointed to in lieu of an answer once, by a 3-year-old. "Both" responses were given 10 times among the 3-year-olds and nine times among the 4-year-olds. "I don't know" responses were given twice by 3-year-olds and twice by 4-year-olds. One 3-year-old responded "no one" on one occasion.

The set of eight stories was counterbalanced across subjects for order of type (either two "forget" stories first or two "remember" stories first), and within subjects both for order of looking (under the object first or on top of the object first), and for placement of dolls prior to questioning (doll with prior knowledge either to left of child and mentioned first or to the right of the child and mentioned last). For each subject the male doll was the correct choice in four stories and the female doll was the correct choice in four stories (equally distributed among the "forget" and "remember" stories).

RESULTS

Two 3-year-olds were replaced; one refused to complete the procedure, the other insisted that a character who could not find the object knew where the object was, even after hearing that part of the story repeated two times.

Preliminary analyses revealed no effects of sex or order within each age group; scores were therefore collapsed across sex and order. The 3-year-olds answered 42% of the "forget" story questions correctly ($M = 1.68$, $SD = 1.7$), the 4-year-olds 84% ($M = 3.36$, $SD = 1.09$). Both the 3-year-olds and the 4-year-olds answered 88% of the "remember" questions correctly (3-year-olds $M = 3.5$, $SD = .63$; 4-year-olds $M = 3.5$, $SD = 1.1$). The 3-year-olds' performance on the "forget" stories was not significantly differ-

TABLE 1
DISTRIBUTION OF INDIVIDUAL SUBJECTS'
PERFORMANCE WITHIN EACH AGE GROUP FOR
EACH TYPE OF STORY IN STUDY 1

| | NUMBER CORRECT | | | | |
|-------------------------|----------------|---|---|---|----|
| | 0 | 1 | 2 | 3 | 4 |
| "Who's gonna remember": | | | | | |
| 3-year-olds | 0 | 0 | 1 | 6 | 9 |
| 4-year-olds | 1 | 0 | 1 | 2 | 12 |
| "Who forgot": | | | | | |
| 3-year-olds | 6 | 3 | 1 | 2 | 4 |
| 4-year-olds | 0 | 2 | 1 | 2 | 11 |

ent from chance (50% correct), $t(15) = -.73$, N.S., in contrast to the 4-year-olds' performance, $t(15) = 5.06$, $p < .001$. On the "remember" stories, both the 3-year-olds and the 4-year-olds performed better than chance, 3-year-olds $t(15) = 9.49$, $p < .001$, 4-year-olds $t(15) = 5.48$, $p < .001$.

A two-way repeated-measures ANOVA, with age as the between-subjects factor and mental verb as the within-subjects factor, revealed a significant interaction between age and mental verb, $F(1, 30) = 8.12$, $p < .01$, and significant main effects for both age, $F(1, 30) = 7.93$, $p < .01$, and verb, $F(1, 30) = 10.7$, $p < .005$. The interaction is due to the fact that the 4-year-olds performed better than the 3-year-olds on the "forget" stories, $t(25.5) = 3.34$, $p < .005$, whereas the two groups performed equally well on the "remember" stories.

The distribution of individual subjects' performance within each age group is shown in Table 1. Although the 3-year-olds' overall performance on the "forget" stories did not differ from chance, inspection of individual performance reveals that they were not responding randomly. Four answered all four "forget" stories correctly, significantly different from chance by a binomial test (with the chances of a single subject answering four of four correctly by chance at .0625), $p < .005$, and six answered all four forget stories incorrectly, binomial $p < .001$. In contrast, 11 of the 4-year-olds answered all four "forget" questions correctly, binomial $p < .001$, and none missed all four questions.

DISCUSSION

These results provide some evidence that young children's understanding of "remember" and "forget" has been underestimated by prior research. Both 3-year-olds

and 4-year-olds recognize that "remember" more appropriately applies to a character with prior knowledge than to a character who never had knowledge. Four-year-olds understand that, of two characters who are currently ignorant, the one with prior knowledge "forgot."

One might be tempted to conclude that 3- and 4-year-olds understand the prior knowledge component of "remember." However, a child who merely associates remembering with knowledge could successfully identify the character with prior knowledge as the one who was "gonna remember," without any understanding that "remember" specifically refers to knowledge originally acquired in the past.

A number of 3-year-olds consistently chose the character who never knew as the one who "forgot." These children might simply have associated forgetting with ignorance. Though they would tend to believe that both characters "forgot" (since both characters were ultimately ignorant), faced with a forced-choice question, they would choose the character who never knew (since that character was ignorant consistently).

An association of remembering with knowledge and forgetting with ignorance is consistent with the 3-year-olds' performance in Wellman and Johnson (1979). The authors interpreted their results as suggesting that 3-year-olds evinced no understanding of "remember" or "forget," either responding indiscriminately or "yes" to all questions. Closer examination of the 3-year-old subjects' responses, however, reveals that they may have utilized a rule that if a character ever knew or performed correctly, she remembered, and if she ever was ignorant, she forgot. Although this leads to a yes response to most of the stories (making it difficult to distinguish from a yes bias), a majority of the 3-year-olds' responses were "no" to two types of stories: If the character never knew, 67% of the 3-year-olds correctly responded that she did not "remember," and if the character always knew, 60% of the 3-year-olds correctly denied that she "forgot."

In Study 2 we wished to follow up on the finding that children understand the prior knowledge component of "forget" by 4 years of age and to determine whether 3- and 4-year-olds understand that remembering specifically refers to knowledge that was originally acquired in the past. We therefore constructed tasks in which both characters

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had current knowledge, but only one knew because he or she remembered.

We also sought to eliminate some of the possible confounds in Study 1. First, subjects may have assumed that both characters knew at the beginning of each story. We attempted to control for this possibility in Study 1 by letting the child watch us position the object and then telling the child that both characters wanted to find the object, implying that they did not know where it was. However, this may not have been sufficiently clear to the children, particularly since the characters either looked on or in the hiding place. Therefore, in Study 2 we explicitly mentioned the fact that the characters could not see the target objects (colored balls), we allowed the child to choose the ball on each trial, and we began each story by announcing that the characters wanted to know the ball's color.

Second, we attempted to control for apparent differences between the characters' relation to the target object other than their prior knowledge. Children may have chosen the character with prior knowledge as the one who remembered or forgot simply because that character was more closely associated with the object. They may have assumed that the person who found the object owned it or liked it better. In Study 2, we structured the tasks so that who had prior contact was not left up to the characters, minimizing the chances that children would associate prior contact with ownership or preference.

Third, children may simply have forgotten which subject had prior knowledge (though the uniformly good performance on the "remember" stories suggested this was not a problem). We therefore added control questions to ensure that children remembered which character had previous knowledge. Finally, we added a task testing children's ability to associate "remember" with knowledge and "forget" with ignorance, in order to ensure that unfamiliarity with the words would not explain differences in performance.

Study 2

METHOD

Subjects

The final sample consisted of 48 nursery school children, 25 boys and 23 girls, drawn

from the same nursery school as in Study 1. All subjects were fluent in English; the race and ethnicity of the subjects were not recorded. None of the children in Study 1 participated in this study. Twenty-four children were in each age group. The 3-year-olds (12 boys and 12 girls) ranged from 3-5 to 4-1 (mean 3-9). The 4-year-olds (13 boys and 11 girls) ranged from 4-3 to 4-11 (mean 4-8).

Materials

The materials included four dolls (a red boy, red girl, blue boy, and blue girl), seven brightly colored rubber balls, each a different color, a "special" plastic box painted black so that the contents were visible only from one side, an opaque plastic box for holding the balls, and a paper sun and paper moon.

Procedure

All subjects were tested by the same male experimenter, who sat to the left of the child. The experimenter first introduced the child to the four dolls and the "special" box (with a ball already inside), explaining that they would play a game where they hid a ball in the box and the boys and girls "sometimes remember and sometimes forget what color the ball is." The experimenter then demonstrated to the child that if she looked at the box from the clear side she could see the ball, but not if she looked at the box from the painted side. Each subject was then told two types of stories.

"Does she (or he) know" stories.—These stories tested for children's understanding that one who remembers knows and that one who forgot does not know. The experimenter placed the two boy dolls of different colors in front of the child, remarking that "Before, both boys saw the ball in this box," while placing the box so that the clear side faced away from the dolls and the child. The experimenter then touched the red boy doll and said, "Right now, the red boy remembers what color the ball is," and asked the child, "Does he know what color the ball is?" The experimenter then touched the blue boy doll and said, "And right now, the blue boy forgot what color the ball is," and asked the child, "Does he know what color the ball is?" The experimenter then repeated the story with the two girl dolls, first mentioning the girl who forgot.

"Which one remembers/forgot" stories.—These stories tested for children's understanding of the prior knowledge component of "remember" and "forget." In the "re-

member" stories, both characters ultimately knew the color of a ball, but only one knew because he or she remembered. In the "forget" stories, neither character ultimately knew the color of a ball, but only one did not know because he or she forgot. The child was told six stories, in blocks of three "remember" stories and three "forget" stories. Before the first story, the child was shown a box containing all of the balls for the remaining stories and told, "While the boys and girls are over here [on the side of the table], so that they can't see, I'll let you decide what ball to put in the box."

At the beginning of each block, the child was told, "Here are some stories about boys and girls who remember [forget]." At the beginning of each story, the experimenter placed the dolls on the side of the table, saying, "Let's keep the boy and girl over here so they can't see." The experimenter let the child choose a ball and then hid that ball in the "special" box.

The "remember" and "forget" stories were structured identically for the first half of each story. The experimenter first propped up the paper sun, announcing, "It's morning time, and the sun comes up. The boy and girl want to know what color the ball is." The experimenter then stood the boy doll facing to the right, noting, "The boy stands here," and stood the girl doll to the right of the boy doll and facing to the left, noting, "The girl stands here." The "special" box was then placed between the boy and girl so that its clear side faced one of the dolls. The experimenter then noted whether the boy saw inside the box and asked the child, "Does he know what color the ball is?" If the child answered incorrectly, the experimenter corrected the child and then repeated the information regarding the doll's ability to see inside the box. If the child answered correctly, the experimenter would reinforce the child's response; for example, if the boy saw inside the box and therefore knew, the experimenter would add, "Yes, he does know." Then the experimenter would proceed in a similar yet opposite manner regarding the girl doll's knowledge. Four 3-year-olds persistently answered these questions incorrectly within a single story and were replaced.

The experimenter then moved the dolls

to the left of the table and put the box in his lap. He announced, "Now they go to school. They stay all day long, so that the moon comes out, because it's night," replacing the sun with the moon. The experimenter then asked the child, "Now tell me, which one did not know in the morning?" If the child missed this question, the experimenter said, "Oh, I must have told the story wrong," and would repeat the first part of the story. Stories were repeated 20 times (out of 144) for the 3-year-olds and 12 times for the 4-year-olds. Four 3-year-olds failed this question three times within a single story and were replaced.

The second part of the story varied depending on whether it was a "remember" or "forget" story. In the "remember" stories, the boy was again placed facing right and the girl facing left, and the experimenter placed the box so that the clear side faced the doll who had not seen before and so that the doll who saw the ball before could not see inside the box. The experimenter then noted whether the boy saw inside the box and added, "He says, 'I know what color the ball is.'" Then the experimenter commented on the girl's ability to see and added, "She says, 'I know what color the ball is.'" The experimenter concluded, "So both of them know what color the ball is. But one of them knows because they remember. Which one remembers?"¹

In the second half of the "forget" stories, both the boy and girl were placed facing right (side by side). The experimenter placed the box so that the clear side faced to the right, so that neither the boy nor the girl could see the ball. The experimenter noted in turn that neither doll could see, adding for each, "She [or he] says, 'I don't know what color the ball is.'" The experimenter concluded, "So both of them don't know what color the ball is. But one of them doesn't know because they forgot. Which one forgot?" If the child answered "both" in response to either the "remember" or "forget" stories, the experimenter would repeat the question, emphasizing the word "one." Three-year-olds answered "both" 19 times, 4-year-olds six times.

Half of the subjects heard the "Does she [or he] know what color the ball is" stories before the "Which one remembers/forgot"

¹ We used the word "they" for want of a genderless pronoun. Although "they" might suggest that more than one person remembered or forgot, the word was preceded and followed by an emphasis on the fact that "one" doll was the correct doll.

stories; half in the reverse order. Half of the subjects received three "remember" stories first and half received three "forget" stories first. For each subject the boy was the correct choice in three stories and the girl was the correct choice in three stories. The stories were distributed among subjects so that equal numbers of boy dolls and girl dolls remembered and forgot.

RESULTS

Nine 3-year-olds had to be replaced: eight for reasons mentioned above, one because he refused to sit down at the game table.

Preliminary analyses revealed no effects of sex or order within either age group; scores were therefore collapsed across sex and order. On the "Does she (or he) know" stories, in which the child was tested for her understanding that one who remembers knows and one who forgets does not know, both the 3-year-olds and the 4-year-olds performed near ceiling on both verbs. The 3-year-olds answered 88% of the "forget" stories correctly ($M = 1.75$, $SD = .53$) and 88% of the "remember" stories correctly ($M = 1.75$, $SD = .61$), whereas the 4-year-olds answered 94% of the "forget" stories correctly ($M = 1.88$, $SD = .34$) and 83% of the "remember" stories correctly ($M = 1.67$, $SD = .57$). Sixteen of the 3-year-olds and 16 of the 4-year-olds answered all four questions correctly.

On the "Which one remembered/forgot" stories, the 3-year-olds answered 39% of the "forget" story questions correctly ($M = 1.17$, $SD = 1.05$), the 4-year-olds 60% ($M = 1.79$, $SD = 1.1$). The 3-year-olds answered 35% of the "remember" questions correctly ($M = 1.04$, $SD = .91$), whereas the 4-year-olds were at 85% correct ($M = 2.54$, $SD = .88$). The 3-year-olds' performance on the "forget" stories was not significantly different from chance (50% correct), $t(23) = -1.56$, N.S., but neither was the 4-year-olds', $t(23) = 1.3$, N.S. On the "remember" stories, the 3-year-olds' performance was significantly *below* chance performance, $t(23) = -2.47$, $p < .05$; the 4-year-olds were above chance, $t(23) = 5.78$, $p < .001$. If the 16 3-year-olds and the 16 4-year-olds who answered all four "Does she [or he] know" questions correctly are considered, the 3-year-olds answered 35% of the "remember" questions correctly ($M = 1.06$, $SD = 1.06$), whereas the 4-year-olds answered 85% correctly ($M = 2.56$, $SD = .81$); on the "forget" stories, the 3-year-olds were 35% correct ($M = 1.06$, $SD = 1.06$), whereas the 4-year-olds were 58% correct ($M = 1.75$, $SD = 1.29$).

A two-way repeated-measures ANOVA, with age as the between-subjects factor and mental verb as the within-subjects factor, revealed a significant interaction between age and mental verb, $F(1, 46) = 4.74$, $p < .05$, and a significant main effect for age, $F(1, 46) = 27.30$, $p < .001$, but not for verb, $F(1, 46) = 2.42$, N.S. The interaction can be understood by examining performance on the stories within and between age groups. Considering scores within age groups, 3-year-olds' performance on the "forget" and "remember" stories did not differ, $t(23) < 1$, whereas 4-year-olds performed significantly worse on the "forget" stories than on the "remember" stories, $t(23) = -2.92$, $p < .01$. Comparing scores between age groups, the 3-year-olds performed significantly more poorly than the 4-year olds on both the "forget" and "remember" stories, "remember" $t(46) = 5.8$, $p < .001$, "forget" $t(46) = 2.01$, $p = .05$.

The distribution of individual subjects' performance within each age group is shown in Table 2. With the chances of a single subject answering three of three questions correctly by chance at .125, one would expect to see six or more out of 24 subjects answering three of three correctly less than 5% of the time, by the binomial distribution. It would be equally unlikely to find six or more out of 24 missing all three questions. Three of the 24 3-year-olds answered all three of the "forget" stories correctly, whereas eight answered all three incorrectly. The respective scores for the 4-year-olds were eight all correct and four all incorrect. On the "remember" stories, two of the 3-year-olds answered all three correctly, and seven answered all three incorrectly. Seventeen of the 4-year-olds answered all three "remember" stories correctly, and two missed all three. Therefore, a significant number of 3-year-olds consistently chose the incorrect character on the "remember" and "forget" stories, whereas a significant number of 4-year-olds performed at ceiling on both verbs.

DISCUSSION

The results clearly suggest that, although 3-year-olds understand that "remember" signifies knowledge and "forget" signifies ignorance, they do not appreciate the prior knowledge components of the words. Indeed, they show a tendency toward preferring the character with current knowledge as the one who remembers and the character who never knew as the one who forgot. Four-year-olds, on the other hand, are near ceiling in understanding the prior knowledge component of "remember," and

TABLE 2

DISTRIBUTION OF INDIVIDUAL SUBJECTS' PERFORMANCE WITHIN EACH AGE GROUP FOR EACH TYPE OF STORY IN STUDY 2

| | NUMBER CORRECT | | | |
|------------------------|----------------|--------|-------|---------|
| | 0 | 1 | 2 | 3 |
| "Which one remembers": | | | | |
| 3-year-olds | 7 (6) | 11 (5) | 4 (3) | 2 (2) |
| 4-year-olds | 2 (1) | 0 (0) | 5 (4) | 17 (11) |
| "Which one forgot": | | | | |
| 3-year-olds | 8 (7) | 7 (2) | 6 (6) | 3 (1) |
| 4-year-olds | 4 (4) | 5 (3) | 7 (2) | 8 (7) |

NOTE.—The performance of the subjects (16 3-year-olds and 16 4-year-olds) who answered all four "Does she or he know" stories correctly is shown in parentheses.

a significant number of 4-year-old children understand the prior knowledge component of "forget."

The 4-year-olds' excellent performance on the "remember" stories demonstrates that they recognize that remembering not only requires knowledge but also requires knowledge that was acquired at a previous time. The only previous test of this understanding was in a "present sight" condition in Johnson and Wellman (1980), in which the child could see which box contained an object at the time the child was asked to find the object. Subjects did not significantly prefer "know" to "remember" until they were in first grade (mean age 6-9), and it was not until third grade (mean age 9-1) that a majority denied they "remembered" where the object was located.

The 4-year-olds' somewhat poorer performance on the "forget" stories in this study compared to the "forget" stories in Study 1 could be due to a number of factors. It might be that one of the potential confounds mentioned previously was operating in Study 1, artificially inflating children's performance. We speculated, however, that it was primarily due to the differing salience of prior knowledge in the two studies. In Study 1, very little was said about the current state of

the characters. Since the current perceptual access of the two characters in the "remember" stories differed in Study 2, we placed more emphasis on the current access of the characters in both the "remember" and "forget" stories. Prior knowledge may also have been more salient to children in Study 1 than in Study 2 because in Study 1, prior knowledge consisted of actively finding the object, whereas prior knowledge in Study 2 consisted of passively standing in a position from which the object was visible. In Study 2, the "forget" stories may have been particularly difficult because the identity of the character with prior knowledge could not be inferred from the characters' current access, in contrast to the "remember" stories. That is, the character who did not have current access in the "remember" stories was always the character who did have prior access, and vice versa, whereas in the "forget" stories neither character had current access, making it impossible to infer who had prior access on the basis of who had current access.²

Study 3 highlighted prior knowledge. We created stories in which a character either remembers or forgets an animal that he or she saw in the morning. The stories were told to the child so that the picture of the animal seen in the morning remained visible

² It is possible that children could do well on the "remember" tasks without understanding that remembering requires prior knowledge, if they associate "remember" with correct performance that is unaccompanied by current perception. We feel such an association is highly unlikely, however, for two reasons. First, "remember" often refers to recognition, in which what was previously known is currently perceived. It would be odd, to say the least, for children to believe that recognizing is not remembering. Second, our findings suggest that children initially associate "remember" with current perception. It seems less probable that the next step in development would be to acquire the opposite association ("remember" with the lack of current perception), than that the child would acquire an appreciation of the prior knowledge component.

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throughout the story, and the child was asked what had been seen before being shown the final frame. If children understand the prior knowledge component of "remember" and "forget" but simply had trouble in Studies 1 and 2 remembering who had prior knowledge, Study 3 ought to uncover such an understanding.

Study 3

METHOD

Subjects

The final sample consisted of 48 nursery school children, 24 boys and 24 girls, drawn from the same nursery school as in Studies 1 and 2. All subjects were fluent in English; the race and ethnicity of the subjects were not recorded. None of the children in Study 1 or Study 2 participated in this study. Twenty-four children were in each age group. The 3-year-olds (12 boys and 12 girls) ranged from 3-4 to 3-11 (mean 3-9). The 4-year-olds (12 boys and 12 girls) ranged from 4-2 to 5-0 (mean 4-7).

Materials

The materials consisted of six stories, each story made up of three drawings. Squares of brightly colored felt were attached to some of the drawings, as described below.

Procedure

Subjects were tested by one of three experimenters, two females and one male. Each experimenter tested equal numbers of subjects at each age. The experimenter sat at a table across from the child and first told the child that he or she would tell the child stories about some animals and then ask the child questions. The experimenter added, "In these stories, there are boys and girls, and these boys and girls sometimes remember and sometimes forget." Each subject was then told six stories, three involving "remember" and three "forget." The stories were blocked in groups of three, and before the first block, the child was told, "Here are some stories about girls and boys who remember [forget]." Before the second block, the child was told, "These stories are different. Here are some stories about girls and boys who forget [remember]."

Each story consisted of three drawings. The first drawing pictured a story child facing away from the viewer and toward two cages, one on each side of the story child. One of the cages was covered with a piece of brightly colored felt. The second drawing

of each story pictured the story child sitting at a table and eating food. The third drawing of each story was identical to the first drawing, except for the placement of the felt. In the "remember" stories, the placement of the felt was reversed; the cage previously covered was now uncovered, and vice versa. In the "forget" stories, both cages were covered with felt. Across the six stories, the gender of the story child alternated, and the location of the cages (zoo, aquarium, pet store, etc.) changed from story to story, as did the animals in the cages (bear, pig, turtle, fish, etc.). All subjects received the same ordering of story character, location, and animals.

The first halves of the "remember" and "forget" stories were structured identically. For example, one version of the first story ran as follows. The experimenter placed the first drawing in front of the child and noted, "This girl goes to the zoo." The experimenter then pointed to the cage on the child's left (covered by felt) and said, "She does not see inside this cage. She says, 'I don't know what's in this cage.'" The experimenter then pointed to the cage on the child's right and said, "She does see inside this cage. She says, 'I know what's in this cage. I see a _____';" the experimenter then paused, allowing the child to name the animal, and said "Yes! She says, 'I see a pig.'" Putting down the second drawing, to the right of the first drawing (from the child's perspective), the experimenter commented that the story child ate lunch and noted what she ate. Then the experimenter asked, "Now, [subject's name], which animal did this girl see before lunch?" while gesturing to the first drawing of the story. If the child refused to respond, or responded incorrectly, the experimenter would say, "Look at the cages and tell me which animal she saw before lunch." The question was repeated 10 times for the 3-year-olds and five times for the 4-year-olds. The experimenter then said, "After lunch, she wants to visit the animals again."

Putting down the third drawing, to the right of the first and second drawings, the experimenter noted, "So she goes back." The experimenter then reviewed the visibility of each animal and the story child's knowledge of the animal's identity. In the "remember" stories, the animal that was visible was now covered, and vice versa. In this example, the experimenter pointed to the cage on the child's left and said, "Now she does see inside this cage. And she says, 'I know what's in this cage. I see a _____,'"

reinforcing the child's response in a similar fashion as before. The experimenter then pointed to the cage on the child's right and said, "And now she does not see inside this cage. And she says, 'I know that there's a pig in that cage.'" The experimenter would conclude, "So she knows about these animals (making a "V" with his or her fingers and pointing to both cages). Well, she knows about one of the animals 'cause she remembers. Which animal does she remember?"

In the "forget" stories, both cages were covered with felt in the third drawing of the story. The experimenter discussed each cage in turn, as in the "remember" stories, except that for the cage that was covered in both the first drawing and the third drawing, the experimenter used the word "still" (i.e., "And she *still* does not see inside this cage"). For both drawings, the story child would say, "I don't know what's in this cage." Then the experimenter concluded, pointing to the two cages, "So she does not know about these animals. Well, she doesn't know about one of the animals 'cause she forgot. Which animal did she forget?" If the child failed to pick an animal in either type of story or answered "both," the experimenter would add, "Look at the cages and tell me, which animal does she remember [did she forget]?" "Both" responses were given four times by the 3-year-olds, and zero times by the 4-year-olds.

The stories were counterbalanced between subjects so that half of the subjects at each age received a block of "remember" stories first and half a block of "forget" stories first. The position of the first story's "correct" cage was counterbalanced between subjects, and within subjects the position of the correct choice alternated story by story, with half of the correct cages on the child's right and half on the child's left.

RESULTS

Six 3-year-olds had to be replaced, due to their persistent failure to respond correctly to the question regarding which animal the story child had seen "before lunch."

Preliminary analyses revealed no effects of sex or order within each age group; scores were collapsed across sex and order. The 3-year-olds answered 54% of the "forget" stories correctly ($M = 1.63$, $SD = .71$), whereas the 4-year-olds were at 81% ($M = 2.42$, $SD = 1.02$). The 3-year-olds answered 53% of the "remember" stories correctly ($M = 1.58$, $SD = 1.18$), the 4-year-olds 90% ($M = 2.7$,

$SD = .62$). The 3-year-olds did not perform differently from chance on either the "forget" stories, $t(23) = .86$, N.S., or the "remember" stories, $t(23) = .35$, N.S. In contrast, the 4-year-olds performed better than chance on both types of stories, "forget" $t(23) = 4.41$, $p < .001$, "remember" $t(23) = 9.49$, $p < .001$. A two-way repeated-measures ANOVA, with age as the between-subjects factor and mental verb as the within-subjects factor, revealed no significant interaction between age and mental verb, and no significant main effect for verb, but a significant main effect due to age, $F(1, 46) = 23.97$, $p < .001$. Planned comparisons revealed that the 4-year-olds did better than the 3-year-olds on "forget," $t(46) = 3.12$, $p < .005$, and on "remember," $t(46) = 4.14$, $p < .001$.

The distribution of individual subjects' performance within each age group is shown in Table 3. The probability that six or more of 24 subjects would answer three of three questions correctly by chance is less than 5%, as is the probability that six or more would answer three of three questions incorrectly by chance. Two of the 3-year-olds answered all three "forget" stories correctly; one answered all three "forget" stories incorrectly. Among the 4-year-olds, 17 answered three of three "forget" stories correctly, whereas two of them missed all three questions. Regarding the "remember" stories, seven of the 3-year-olds answered all three stories correctly, and six answered all three incorrectly. Nineteen of the 4-year-olds scored perfectly on the "remember" stories, and none answered all three stories incorrectly. A nonsignificant number of 3-year-olds thus performed at ceiling on the "forget" stories, compared to a majority of the 4-year-olds. On the "remember" stories, a significant number of 3-year-olds performed at ceiling, and a significant number were consistently incorrect, preferring the animal last seen. Most of the 4-year-olds performed at ceiling on "remember."

General Discussion

Taken together, the three studies reported here suggest that understanding of the prior knowledge component of "remember" and "forget" emerges at about 4 years of age, much younger than previously estimated (Johnson & Wellman, 1980; Wellman & Johnson, 1979). Although both 3- and 4-year-olds understood that "remember" refers to knowing, 4-year-olds showed near-ceiling performance on the tasks in Studies

TABLE 3

DISTRIBUTION OF INDIVIDUAL SUBJECTS' PERFORMANCE WITHIN EACH AGE GROUP FOR EACH TYPE OF STORY IN STUDY 3

| | NUMBER CORRECT | | | |
|---|----------------|---|----|----|
| | 0 | 1 | 2 | 3 |
| "Which animal does she or he remember": | | | | |
| 3-year-olds | 6 | 5 | 6 | 7 |
| 4-year-olds | 0 | 2 | 3 | 19 |
| "Which animal did she or he forget": | | | | |
| 3-year-olds | 1 | 9 | 12 | 2 |
| 4-year-olds | 2 | 3 | 2 | 17 |

2 and 3 that required an understanding that "remember" specifically refers to knowledge acquired in the past. Similarly, though 3- and 4-year-olds recognized that "forget" refers to ignorance, 4-year-olds in all three studies showed significant improvement over the 3-year-olds in understanding the prior knowledge component of "forget." As a group, they struggled with the "forget" tasks in Study 2, but a significant number nevertheless performed at ceiling. In Study 3, the age differences persisted even when the item seen previously remained visible, making it unlikely that the development in understanding is due simply to improvements in memory for what was previously perceived.

Based on our results, and those of previous research, it is possible to outline young children's developing understanding of "remember" and "forget." Children first use the words at about 2½ years of age (Bretherton & Beeghly, 1982; Limber, 1973; Shatz et al., 1983). At least by 3½ years (the youngest children we tested), children understand that "remember" is associated with "know" and "forget" with "doesn't know." Moreover, 3-year-olds recognize that "remember" refers to successfully finding an object, looking at an object, naming an object's color, and naming an object's identity, and that "forget" refers to the failure to do any of these things. On the tasks that require understanding of the prior knowledge component for successful performance, some 3-year-olds do well; however, a significant minority associate "remember" more strongly with current perception and "forget" with persistent ignorance, and are therefore consistently incorrect in their responses to the stories. Such a pattern of responding is easily explicable if we assume a simple association of "remember" with look-

ing and naming and "forget" with failure to do so: given a forced choice between characters, the one who "remembers" is the one who both looks and names at this moment (as opposed to names now and looked and named before), and the character who "forgot" is the one who never looked or named (as opposed to looked and named before).

This characterization of 3-year-olds' understanding is not unlike Wellman and Johnson's characterization of older children's early understanding as based on present performance, performance defined as naming or seeing an object's location or identity (Johnson & Wellman, 1980; Wellman & Johnson, 1979). Moreover, as we discussed above, our description of 3-year-olds' understanding is consistent with our reinterpretation of the 3-year-olds' responses in Wellman and Johnson (1979), who affirmed "remember" if a character ever performed correctly and "forget" if a character ever failed. Unlike Wellman and Johnson, however, we believe that, by 4 years of age, most children are aware of the prior knowledge component of these words.

That the transition in children's understanding of these words occurs at about 4 years of age is significant in light of the debate over whether 3-year-olds conceptualize the mind as a copy-container holding faithful copies of reality. Although Wellman (1990) has argued that 3-year-olds' difficulty with understanding representational mental states is limited to a failure to understand beliefs that are actively constructed by the mind, our results suggest they have similar difficulty in understanding that beliefs are stored and retrieved.

The understanding that "remember" and "forget" do not merely refer to knowledge and ignorance but also describe the

conjunction of current and prior knowledge states may be an important part of a developing understanding of memory as involving the acquisition, retention, and retrieval of knowledge. Without understanding memory as involving at least two episodes, the child cannot adequately distinguish between the initial acquisition of knowledge and its subsequent retrieval. Such a child would appreciate that remembering involves some sort of deliberate attention to and perhaps communication about an object but fail to understand that the two actions are separated in time and that initial attention serves the function of acquiring knowledge while subsequent naming demonstrates that the knowledge was successfully retained and retrieved. Separation of remembering and forgetting into current performance success or failure and prior performance success is therefore one step toward distinguishing between current attempts at retrieval and the prior acquisition of knowledge. Similarly, the child for whom memory is merely isolated success or failure would not appreciate that remembering and forgetting involve the retention and loss of knowledge over time. Such a child would not share the intuition that memories are stored in the mind until recall or that, when we forget things, as one child explained, they "fall out of your brain."

One might argue that the children in our studies who understand the prior knowledge component of "remember" and "forget" have no real understanding of the retention of knowledge. They might associate remembering and forgetting with prior knowledge, but they might not envision knowledge as retained in the interval between the two points in time. Recent research, however, has suggested that 4-year-olds understand that whether one remembers or forgets depends in part on the temporal interval be-

tween one's prior knowledge and one's current attempts to remember. In other words, it is at about 4 years of age that children first appreciate the fact that, as the retention interval increases, so do the chances that one will forget (Lyon & Flavell, 1993).

Our findings are also important insofar as they suggest a possible reinterpretation of much of the literature on young children's metamemory. Several studies have shown that preschool children, some as young as 18 months, behave differently and/or remember more when told to remember rather than merely look at, play with, or interact in some other fashion with to-be-remembered items (Baker-Ward, Ornstein, & Holden, 1984; DeLoache, Cassidy, & Brown, 1985; Galbraith, Olsen, Duerden, & Harris, 1982; Newman, 1990; Wellman, Ritter, & Flavell, 1975; Yussen, 1974; Yussen, Kunen, & Buss, 1975). When subjects of this age are told to remember items, those items are more often looked at (Baker-Ward et al., 1984; Wellman et al., 1975; Yussen et al., 1975), named (Baker-Ward et al., 1984; DeLoache et al., 1985), and marked or touched (Wellman et al., 1975).

Although Wellman (1990) has claimed that these studies document an awareness of remembering and forgetting among very young children, children's behavior in these tasks need not reflect any understanding of remembering as the retention of knowledge over time. A child who believes that "remembering" refers to attending to and communicating about a target object will exhibit what appears to be strategic behavior when told to "remember." That is, in the mind of the child, naming and other strategy-like behaviors may not be strategies for future remembering but what remembering is.³

Children's failure to differentiate among remembering, attending to, and communicating about a target object would explain

³ Even assuming that children sometimes appreciate that the requested remembering will occur only after a delay, their strategy-like behaviors in the interim do not necessarily reflect understanding of memory storage. As Wellman has acknowledged (Wellman, 1988), the child's interest in the task may lead her to perform "anticipatory goal responses," which are incompletely inhibited moves to name or retrieve the to-be-remembered item. These responses are indistinguishable from strategy-like behavior. Moreover, the one study that attempted to control for anticipatory goal responses is difficult to interpret. DeLoache, Cassidy, and Brown (1985) compared young children's behavior in a hide-and-seek game involving a stuffed toy to a situation in which the child was told the toy was going to take a nap. In both cases, the child anticipated interaction with the toy after a delay. The researchers found that children tended to look at, name, and attempt to retrieve the napping toy less than the hiding toy. The absence of strategy-like behavior in the napping condition could reflect the child's awareness that since the toy was in plain view, memory strategies were unnecessary, but could equally be due to differences in a child's reactions to one who is actively hiding in an ongoing game and one who wishes to remove himself from interaction and take a nap.

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the finding that their understanding of the impact of person and task variables on memory, attention, and communication is "remarkably similar" across the three cognitive activities. (Yussen & Bird, 1979, p. 311; see also Miletic, 1988). It could also explain the findings of several studies that preschoolers often choose looking at and naming to-be-remembered items as more effective means of remembering those items than categorization, rehearsal, or the creation of cues (Justice, 1986, 1989).

In sum, much of the research to date on young children's metamemory has failed to distinguish between the understanding of memory as the retention of knowledge over time and an association of remembering with present performance. Our research suggests that children first understand the prior knowledge components of the words "remember" and "forget" at about 4 years of age. These findings contribute to an emerging picture of the preschool child's growing awareness of knowledge acquisition, retention, and retrieval over time.

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