Precursors of Mnemonic Strategies in Very Young Children’s Memory

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DeLoache, Judy S.; Cassidy, Deborah J.; and Brown, Ann L. Precursors of Mnemonic Strategies in Very Young Children’s Memory. Child Development, 1985, 56, 125–137. In 4 studies with 18–24-month-old children, evidence was obtained of strategy-like behaviors in a memory-for-location task in which the child had to remember in what natural location a toy had been hidden. The children exhibited behaviors that resemble the mature strategies of rehearsal and monitoring, including talking about the toy or its hiding place and looking or pointing at it during the delay interval. In Experiments 1 and 2, these strategy-like behaviors were engaged in differentially as a function of familiarity, both of the setting in which the task was embedded and of the task itself. Significantly more target behaviors occurred in an unfamiliar than in a familiar setting, and more target behaviors occurred on the first than on the second day of observation. In Experiment 3, when the basic memory task was modified to remove the memory demands from the child, very few of the strategy-like behaviors occurred, indicating that they were indeed memory specific. In the fourth experiment, the rehearsal-like behaviors were shown to be related to subsequent retrieval. We interpret these results as evidence of an early natural propensity to keep alive what must be remembered, a rudimentary and imperfect version of what will later become more elaborate and planful mnemonic strategies.

The existence of a rich variety of mnemonic strategies has been amply documented for adults and school-age children. When presented with challenging material to be remembered, a mature learner is likely to interact spontaneously with the material in a variety of ways to make it more memorable, for example, by rehearsal, organization, or elaboration activities. The decision to invoke a strategy and the selection of which particular one to use may be fully conscious and reasoned (as in a professional mnemonist’s selection of the method of loci to enable him to impress an audience), or the subject may be only dimly aware that he is doing anything special to learn or retain information. Whether or not a mnemonic strategy will be used depends, among other things, on the subject’s estimate of the task difficulty. Problems that are too easy or too difficult are less likely to elicit strategic behavior than problems that present a moderate degree of challenge. Which particular strategy is selected depends on the task demands: for example, one is more likely to use rehearsal than semantic elaboration to remember a digit string. Finally, the adoption of an appropriate mnemonic strategy typically improves memory performance.

The large body of research on the development of mnemonic strategies indicates that they are commonly employed by school-age children in a variety of situations, and that the sophistication of the strategies and their application increases steadily with age (Brown,

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Bransford, Ferrara, & Campione (1983). Much less is known about their origins and very early development, about the “early competencies that serve as building blocks for subsequent” mnemonic achievements (Flavell, 1979, p. 909).

We have been investigating the memory performance of 1½–2½-year-old children in an attempt to discover the precursors or rudimentary forms of mnemonic regulation. We want to know in which ways children’s earliest mnemonic efforts resemble mature strategies and in which ways they are different. This research has used a memory-for-location task—a version of a hide-and-seek game in which the child watches while a small toy (Big Bird, Snoopy) is hidden in a natural location (under a pillow, behind a chair). After a prescribed delay interval, the child is allowed to retrieve the toy. This task is comprehensible and highly motivating to children as young as 18 months, and performance is generally very good, even after protracted delay intervals (DeLoache & Brown, 1979, 1983, 1984). It thus seemed a promising task to use to look for evidence of early mnemonic regulation, since strategic behaviors are more likely to occur in tasks that a subject understands and is motivated to perform (DeLoache, 1980; Slatz, 1978).

DeLoache and Brown (1983) compared the performance of 22- and 27-month-old children in the basic hide-and-seek task and a more complex variant of it. They found no age differences in the basic task, but a substantial age difference in the more complex one. This pattern of results is reminiscent of that typically used to substantiate claims of mnemonic strategy development, that is, the presence of age differences in tasks that are amenable to strategic intervention and the absence of age differences in nonstrategic tasks. These data were interpreted as suggestive of simple strategic behavior on the part of the 2-year-old children, but as DeLoache and Brown (1983) noted, it would be desirable to have more direct evidence before concluding that such young children are capable of behaving strategically.

Direct evidence of deliberate memory behaviors by 3- and 4-year-old children has been reported by Wellman, Ritter, and Flavell (1975). Preschool children watched while an experimenter hid a toy dog in one of three cups. The experimenter then left the room for 40 sec, instructing the children either to “remember where the dog is” (remember condition) or simply to “wait here with the dog” (wait condition). The children in the remember condition engaged in several simple behaviors that appeared to serve a mnemonic function. They looked at, pointed to, and touched the baited cup more often during the delay period than did the subjects in the wait condition. One child provided a clear example of visual rehearsal (she looked at the baited cup and nodded her head yes, looked at the unbaited cups and shook her head no, then looked at the correct cup nodding affirmatively), and another ensured later retrieval by keeping his hand on the relevant cup during the entire delay interval. These simple behavioral strategies correlated positively with memory performance; children who produced more of them tended to achieve higher retrieval scores.

A group of 2-year-olds observed by Wellman et al. (1975) in the same task gave no evidence of any of the deliberate behaviors described for the 3- and 4-year-olds. However, this negative result is inconclusive because, as the authors point out, the task was not appropriate for the 2-year-olds: Fully a third of them failed to complete even three trials, often because they were unwilling to remain alone in the testing room. We are left with the question of whether children younger than 3 years of age might be capable of some kind of mnemonic effort.

Our first positive evidence in this regard came from a study that had actually been designed for a different purpose. Cassidy (1980) compared 22-month-old children’s performance in the hide-and-seek task in two different settings—their own homes and a laboratory playroom. This experiment was designed to see if the excellent performance obtained in previous work with the hide-and-seek game (DeLoache & Brown, 1979, 1983, 1984) might be in part attributable to the fact that the children had always been tested in a highly familiar environment. Contrary to this hypothesis, there was no difference in the rate of errorless retrievals as a function of the environment in which the task was embedded. However, Cassidy observed two things—that the children engaged in several behaviors similar to those reported by Wellman et al. (1975), and that they seemed to do so more often in the unfamiliar laboratory than in their own homes.

The first study reported here followed up on these provocative findings. It was designed to collect systematic data on young children’s behavior during the delay interval of the memory-for-location task and to compare their behavior, as well as the level of errorless retrievals, in a familiar and an un-
familiar setting. Based on Cassidy’s (1980) study, we scored a set of target behaviors that resembled rehearsal or self-monitoring and that were similar to some of those reported by Wellman et al. (1975).

Experiment 1

Method

Subjects.—The subjects were 16 children between 18 and 23 months of age (M = 20 months). All parents indicated a willingness in the initial telephone contact for their child to be observed either in the lab or in their own homes. Children were randomly assigned to the two groups (home or laboratory observation) with the restriction that there were four boys and four girls in each. The mean ages for the home and laboratory groups were 19.9 and 20.3 months, respectively.

Procedure.—Each subject received four trials, each with a 4-min delay interval. This relatively long interval was used to provide ample opportunity for the target behaviors to occur. It was not expected to cause any problems, since DeLoache and Brown (1979) have reported that performance in the hide-and-seek task is high and stable over a wide range of delay intervals. The experimenter introduce the stuffed animal. (This was an approximately 6–9-inch toy of a familiar TV or cartoon character. The mother generally indicated which of a set of toys she thought her child would prefer.) She explained that Big Bird (or Snoopy, Mickey Mouse) was going to hide and that the subject should remember where he was hiding in order to find him when the bell rang. For each trial, the child accompanied the experimenter and watched while she hid the stuffed toy in a natural location. The child’s attention was always called to the act of hiding, but the hiding places were never named. After the toy was hidden, a timer was set for 4 min; when it rang, the child was encouraged to get the toy. A trial was scored as correct only if the subject went to the correct location without first searching anywhere else. However, if the child failed to retrieve the toy, he or she was encouraged to continue searching. The entire session was videotaped, and the experimenter also made written records of all the target behaviors during the delay interval.

Half the subjects participated in the hide-and-seek task in their own homes, while the others were observed in a laboratory playroom. For the home group, the hiding locations varied somewhat from one home to another, but included such places as under pillows or cushions, or behind doors or pieces of furniture. The lab playroom was furnished with standard home furniture, including a couch, an armchair, two child-sized chairs, a small dresser, floor pillows, and pillows on the couch and chairs. The room also contained a wooden apparatus used to present visual stimuli to infants and a zippered case for video equipment. The same locations were used for all subjects in the laboratory group: under a pillow on the couch, behind the armchair, behind the wooden apparatus, and inside the video case.1 The order of the four locations was counterbalanced, with each location used equally often for each of the four trials.

During the delay interval (after the toy was hidden and the timer set), each subject was brought to the center of the room and encouraged to play with various attractive materials furnished by the experimenter (toys, crayons and paper). Thus, to engage in any of the target behaviors the child had to interrupt an ongoing activity. The child was allowed to approach the vicinity of the hidden toy and even to peek at it, but was restrained from actually picking it up or from hovering for an extended period of time near the hiding location. After any retrieval attempt or hovering, the child was brought back into the center of the room and encouraged to play again. During the interval the experimenter usually engaged in low-level interaction with the child, at the same time watching for and recording any of the target behaviors.2

In pilot testing we had observed several delay interval behaviors that resembled rehearsal or self-monitoring activities. They all served to maintain or reestablish some kind of

1 The hiding locations in the laboratory were deliberately varied to be either relatively familiar (couch pillow, chair) or relatively unfamiliar (apparatus, video case) types, but this manipulation had no effect on the children’s behavior.

2 The experimenters in all the studies reported were warned against cuing the child in any way, for example, by looking toward the hiding place. In Experiment 1, the videotapes were examined, and no examples were noted in the experimenter’s behavior. In Experiments 2, 3, and 4, the second observer monitored the experimenter’s behavior, and, on the one or two times she ever noticed the experimenter looking toward the relevant location, she brought this to the experimenter’s attention. We were satisfied that the awareness of the potential problem on the part of the experimenter and checking on her behavior were adequate controls.
contact with the hidden toy and/or its hiding place. The following target behaviors were scored from the videotapes: (1) verbalizing about the toy or its hiding place; (2) looking toward the hiding location; (3) pointing at the hiding location; (4) approaching the hiding location (sometimes the child walked toward or hovered near the hiding place without attempting to peek at or retrieve the toy); (5) peeking at the hidden toy; and (6) attempting to retrieve the toy early (actually reaching for it). All target behaviors that occurred subsequent to setting the timer and prior to the bell sounding were counted.\(^3\)

Half the videotapes from each group were randomly selected to be scored by a second observer. The level of agreement between the two observers was 81% for the target behaviors. After rechecking the tapes, the observers were able to resolve all disagreements but one. (That unresolved instance was omitted from the tabulations.) The most frequent reason for an initial disagreement was the failure of one observer to notice some behavior.

**Results**

There was no difference in the number of errorless retrievals for the two groups. The mean was 3.50 (88%) for the children tested in their own homes and 3.25 (85%) for the subjects observed in the laboratory. This high level of performance is comparable to that reported in other studies using the hide-and-seek task (DeLoache & Brown, 1979, 1983, 1984).

Table 1 shows the incidence of each of the different target behaviors, as well as the total number of target behaviors for the two groups. The aggregate scores were used for all the analyses. As can be seen from the table, the children observed in the laboratory produced substantially more of the target behaviors than did the children tested in their own homes. The main effect for setting (home, lab) was the only significant result of separate 2 (setting) \(\times\) 2 (sex) between-subjects mixed analyses of variance of the number of target behaviors, \(F(1,12) = 5.45, p < .04\). Inspection of the data showed no difference in the number of target behaviors over trials.

One of the main differences between the two groups concerned the number of looks at the hiding place. One possible problem with this measure is that the children observed in the laboratory might simply have been looking around the novel environment, so the fact that they looked more often at the hiding place could be an artifact of that visual exploration. Accordingly, a naive observer viewed a randomly selected half of the tapes and recorded any time a subject scanned around the room and looked at any environmental feature other than the hiding place. (The observer was instructed to disregard looks at the camera or the timer.) There was clearly no difference in the number of discrete looks (home, lab, 13) or in the number of broad scans (two scans occurred in each setting). Thus, the difference in number of looks toward the hiding place was not simply due to differing amounts of visual exploration.

There was no relation \((r = .16)\) of the sort reported by Wellman et al. (1975) between the number of errorless retrievals and the number of target behaviors. However, this could be due in part to a ceiling effect: 10 of the 16 subjects (six home, four lab) had perfect memory scores, and only two subjects had more than one error.

**Discussion**

Very young children, participating in a task that required them to remember the location of a hidden object, continued in various ways to occupy themselves with the memory demands of the task during the delay interval. The target behaviors we recorded and analyzed are quite similar to some of the deliberate mnemonic behaviors that Wellman et al. (1975) observed for 3- and 4-year-olds. Thus, the present data may represent very early rudimentary memory strategies.

The results also revealed that the 20-month-old subjects engaged in the target behaviors differentially, with more than three times as many occurring in the lab as in the home. This finding is important, because evidence that a behavior is exercised discriminatively is needed to support the claim that the behavior is strategic. The finding is also somewhat counterintuitive, since it is gener-

\(^3\) The individual target behaviors often occurred simultaneously or in rapid succession. For example, on one occasion a subject looked at the hiding place and got up and walked toward it while pointing and saying, "Big Bird, Big Bird." The stream of individual behaviors was divided into episodes, with each episode consisting of one or a series of behaviors that occurred temporally close together and temporally isolated from other target behaviors. Thus, if a child looked toward the hiding place and said, "Big Bird," then went back to coloring, then looked again and pointed toward it, his or her score for that trial would be four target behaviors but two episodes. The level of interobserver agreement for episodes was 82%. Analyses of the episodes produced the same results as the analyses of the individual target behaviors.
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*Includes Day 1 data only.

b Includes Day 1 data from Experiments 1 and 2 and from lab-lab group.

ally expected that young children will appear most sophisticated in a familiar setting where they know the spatial layout and where they are not distracted or intimidated by novel surroundings (Acredolo, 1979; Bronfenbrenner, 1979; DeLoache, 1980; Gelman, 1978). However, similar to our findings, Kienapple and Lange (1983) recently reported that the setting (home or laboratory) in which preschool children participated in a memory task interacted in complex and unforeseen ways with other task variables.

A plausible interpretation of these data is that playing the game in an unfamiliar setting made the children uncertain of their ability to remember the location of the toy. Although the actual difficulty of the task did not appear to differ between the familiar and unfamiliar settings (rates of errorless retrievals were the same), the children’s perception of the difficulty of finding the toy may have differed. A sense of uncertainty might lead them to periodically reestablish contact with the hidden toy, to strive to keep alive the information that must be remembered during the delay. Thus, situating the task in an unfamiliar environment may not have affected the children’s ability to remember the location of a single hidden toy, since that ability is extremely robust (DeLoache, 1984; DeLoache & Brown, 1979, 1983), but it may have set the stage for the appearance of primitive strategies by making the child less confident of being able to remember the location.

Because of the unusual nature of these data (i.e., the fact that the apparently more mature behavior occurred in the unfamiliar setting), a replication study was conducted that was essentially the same as Experiment 1, except that a within-subjects design was used to provide a more stringent test of the setting effect. Each subject was observed in the hide-and-seek game in his or her home on one day and in the laboratory on a different day, with the order of the two conditions counterbalanced across subjects. This design also enabled us to see if the number of target behaviors changed from one day to the next as the child became more familiar with the task.

### Experiment 2

#### Method

**Subjects.**—The subjects were 16 children between 20 and 24 months of age (M = 22 months). Four boys and four girls were randomly assigned to each of two orders—lab on Day 1 and home on Day 2, or the opposite. The mean ages for the lab-home and home-lab groups were 22.2 and 22.4 months, respectively.

**Procedure.**—All aspects of the procedures were the same as in Experiment 1, with the following exceptions. Each subject participated in 2 days of testing, one in the home and one in the laboratory. On each day the subject received five trials of the hide-and-seek task, each with a 3-min delay interval. In the laboratory playroom, the same hiding locations were used for all subjects (behind the couch, behind a chair, under a beanbag chair, in a cabinet, and under a pillow on the couch).

Instead of videotaping, two observers (one of whom was naive with respect to the purpose of the study) were present and independently recorded the target behaviors. Only individual behaviors (and not episodes) were scored for analysis. The median agreement between the two observers was 100% for each of the six target behaviors, and the overall mean level of agreement was 87%. To be conservative, only behaviors that both observers had recorded were included in the analyses.
Results

Errorless retrievals averaged 75%, which is similar to the level of performance reported in Experiment 1. Retrievals did not differ as a function of setting, order, or day of observation. Table 1 shows the mean number of target behaviors observed in the two settings in Experiment 2, and Figure 1 shows target behaviors broken down by day for the two groups (lab-home and home-lab). Both variables affected the children’s behavior. More target behaviors were observed in the laboratory than in the home setting, thus replicating with a within-subjects design the between-subjects finding of Experiment 1. More target behaviors occurred on the first than on the second day of testing. These effects combined such that the highest number of target behaviors occurred for those subjects who were observed in the laboratory on Day 1 and the lowest number for the same subjects observed at home on their second day of testing.

Separate analyses of settings and days confirmed these effects. In the first, a 2 (groups—lab-home vs. home-lab) × 2 (setting) mixed analysis of variance, the main effect for setting was significant, $F(1,14) = 8.48, p < .02$. In addition, setting interacted significantly with group, $F(1,14) = 4.72, p < .05$. Subjects in both the home-lab and lab-home conditions displayed more target behaviors in the laboratory, but the difference between the two settings was much larger for subjects tested first in the laboratory than for subjects who were first observed in their homes.

The second analysis compared the number of target behaviors on the first and second days. The main effect for days was significant in a 2 (groups) × 2 (days) mixed analysis of variance, $F(1,14) = 4.72, p < .05$, and this variable also interacted with group, $F(1,14) = 8.48, p < .02$. The days effect was more pronounced for those subjects who were first observed in the lab. Post hoc t tests comparing the two groups revealed that the difference between settings was significant on Day 1, $t(14) = 2.55, p < .05$, but not on Day 2. Inspection of the data revealed no systematic changes over trials on either day.

As in Experiment 1, there was no relationship between the incidence of target behaviors and memory performance. A nonsignificant correlation was again obtained between the number of errorless retrievals and target behaviors ($r = .12$).

Discussion

The results of Experiment 2 replicate those of Experiment 1, showing that the effect of setting on the target behaviors is stable. In addition, they indicate that degree of experience with the task also affects the incidence

![Figure 1](image-url)

**Fig. 1.**—Mean number of target behaviors as a function of setting and days. The data for the lab-home and home-lab groups come from Experiment 2, proper; the lab-lab group was observed separately.
of the target behaviors. Inspection of the data for the lab-home and home-lab groups plotted in Figure 1 suggests that the experience and setting effects combine additively. Familiar environment plus familiar task elicited the fewest target behaviors, while an unfamiliar task in an unfamiliar environment elicited the most; the mixtures of familiar and unfamiliar task and setting were intermediate.

This suggests that if a group of children were observed twice in the laboratory, we would expect a high level of target behaviors on Day 1, comparable to the Day 1 performance of the lab-home subjects, followed by a significant decrease on Day 2, as both the setting and the task lost some of their novelty. The amount of the decrease should, however, be less than that observed for the lab-home group. To test the prediction, an additional group of eight subjects (four males and four females, \( M = 22.7 \) months) was observed on 2 successive days in the laboratory. (A home-home condition was not run since the rate of target behaviors was so low in the home to begin with that very little decrement could occur.) All procedures were identical to those described in Experiment 2, except that additional hiding places were used on Day 2.

Errorless retrievals averaged 85% in the lab-lab condition, with 90% on Day 1 and 80% on Day 2 (a nonsignificant difference). The mean number of target behaviors per trial for this group is shown in Figure 1. The apparent decline over days in the incidence of the target behaviors was significant. The main effect for days, \( F(1,14) = 5.38, p < .05 \), was the only significant result in a 2 (sex) \( \times \) 2 (days) mixed analysis of variance. All but one subject had fewer target behaviors on Day 2 than on Day 1, and that single exception had an equal number on both days. These data agree with those from the lab-home and home-lab groups in indicating that the familiarity effects for both task and setting combine.

The data presented so far thus provide clear, reliable evidence that very young children's behavior during the delay interval of a memory task varies as a function of the setting in which the task is embedded. In an unfamiliar environment, the children remain more preoccupied with the task demands than they do in a familiar setting, and they also seem to return their attention to the task more often when it is new to them than when it is familiar. The set of target behaviors we have recorded is thus exercised discriminatively as a function of some aspects of the memory task.

Experiment 3

The third experiment in this series was designed to gain additional information about the extent to which the target behaviors are in fact memory-specific behaviors. A crucial criterion for considering some behavior to be even a rudimentary memory strategy is that it should occur in a memory context, but not in a situation in which there are no memory demands made upon the subject.

To see if the target behaviors are engaged in as a function of the memory demands of the task, we tested two more groups of children in variations of the hide-and-seek task that removed the memory burden from the child. In one case the toy remained visible throughout the delay interval, and in the other case the experimenter instead of the child was to retrieve the toy at the end of the interval. In both these situations there is no need for the child to remember the toy's location in order to retrieve it later. If the target behaviors are emitted in response to the memory requirements of the task, then they should occur much less frequently when the memory demands are removed.

Method

Subjects.—The subjects were 16 children between 20 and 24 months of age (\( M = 22.2 \) months). Four boys and four girls participated in each condition, and the mean ages for the toy-visible and experimenter-retrieves-toy groups were 21.8 and 22.1 months, respectively.

Procedure

Visible toy.—The main modification of the hide-and-seek task was that the toy remained visible throughout the delay interval. At the beginning of each trial, the experimenter told the child that "Big Bird needs to take a nap now. When the bell rings, you can go and get him up." The toy was then placed in a location similar to the hiding places used in the preceding experiments, but it was not concealed (e.g., instead of hiding the toy under a cushion, the experimenter placed it on top of the cushion). When the bell sounded at the end of the interval, the experimenter said, "Go wake up Big Bird."

Experimenter retrieves toy.—Everything about this condition was the same as the standard hide-and-seek task except that the experimenter instead of the child retrieved the toy at the end of the interval. At the time of hiding, the experimenter said, "I'm going to hide Big Bird, and when the bell rings, I'll go and find him." The child accompanied the experimenter to the hiding place, both at hiding and retrieval.
Hidden toy.—For purposes of comparison, the Day 1 data from the eight lab-lab subjects (reported in Experiment 2) were used to represent the average level of target behaviors for the standard memory task. (Notice that this was a conservative choice: the lab-lab and the lab-home subjects in Experiment 2 had almost exactly the same mean number of target behaviors on Day 1, and both were lower than the mean level for the lab condition of Experiment 1.)

All observations took place in the laboratory. Since we anticipated that the experimental manipulations would substantially decrease the incidence of target behaviors, we did not test comparable groups in the home where we had already found the level of target behaviors to be extremely low. Two observers (one was the experimenter, and the other was naive to the purpose of the study) independently recorded all instances of the target behaviors. The median agreement between them was 100% for each of the six target behaviors, and their overall mean level of agreement was 93%.

The experimenter tried to make sure that the level of motivation in the visible-toy and experimenter-retrieves-toy conditions was comparable to that typical of the regular hide-and-seek tasks. Each subject was rated on a 3-point scale for degree of involvement in the game. An analysis of these ratings for the two nonmemory conditions and for the lab-lab subjects revealed no differences.

Results and Discussion

Substantially fewer target behaviors occurred when there were no memory demands placed on the child than when he or she was required to remember the location of the hidden toy. As shown in Figure 2, the mean number of target behaviors was much lower in the experimenter-retrieves-toy and the visible-toy conditions than in the standard task with the toy hidden.

This difference in number of target behaviors as a function of memory condition was shown to be significant in a 3 (condition) \( \times \) 2 (sex) analysis of variance. The main effect for condition was significant, \( F(2,18) = 7.34, p < .005 \). Subsequent \( t \) tests revealed that both the visible-toy and experimenter-retrieves-toy conditions differed significantly from the hidden-toy condition, \( t(14) = 4.62, p < .001 \), and \( t(14) = 2.45, p < .05 \), respec-

![Fig. 2.—Mean number of target behaviors when memory demands are placed on the child (toy-hidden) and when no memory demands are made (experimenter-retrieves-toy and toy-visible).](image-url)
tively. The two nonmemory conditions did not differ from each other.

The differential behavior we observed indicates that children below the age of 2 years are sensitive to memory demands. When the toy was visible during the interval, they ignored it; when the toy was invisible, so they had to retain its location in memory, they remained preoccupied with it. And when they did not bear the responsibility for retrieving the toy, they seemed uninterested with its whereabouts. Thus, in a memory task in which very young children adopt the goal of retrieving a hidden object, they exhibit primitive mnemonic strategies. When the child does not have a memory goal, either because remembering is not necessary or because the child is not the one required to do the remembering, very few of these behaviors occur.

Experiment 4

Although the target behaviors are reminiscent of the mature strategies of rehearsal and monitoring and similar to the deliberate mnemonic behaviors reported by Wellman et al. (1975) for preschool children, they did not seem to facilitate memory performance in Experiments 1 and 2. In neither study did the correlation between target behaviors and errorless retrievals approach significance. However, more than half of the children in those experiments had perfect performance, and a majority of the remainder committed only one error. It could be that the target behaviors do facilitate remembering an object's location, but that the ceiling effects on performance obscure the relationship.

Experiment 4 was designed to examine the relationship between the target behaviors and memory for location in the absence of ceiling effects. A multiple-hiding task was used that produces a substantially lower rate of errorless retrievals than the standard hide-and-seek task (Brown & DeLoache, 1978). On each trial, three attractive toys are sequentially hidden, each in a different natural hiding place. After the delay interval, the child is encouraged to find all the toys. This task should make possible an assessment of the general relationship between the total number of target behaviors and retrievals without problematic ceiling effects. Also, because of the increased number of errors generated, it should allow us to ask a more detailed question about the relationship between target be-

haviors and memory: What are the sequelae to attending to versus ignoring a given toy during the delay interval? In other words, are more target behaviors directed toward those toys that are subsequently retrieved than to those that the child fails to find?4

Method

Subjects.—The subjects were 24 children, half male and half female, between 21 and 25 months of age (M = 22 months).

Procedure.—The procedures were essentially the same as in the first two experiments, with the major exception that three toys (Mickey Mouse, Snoopy, Garfield) were hidden on each trial. The child accompanied the experimenter as she hid the three toys. Each was hidden in a different natural hiding place, with the three locations for a given trial spread out around the room, so that finding one toy would not be a powerful cue for retrieving another one near to it. After the third toy was hidden, the timer was started for a 3-min delay interval. At the bell, the child was encouraged to retrieve all toys. If the subject retrieved one, he or she was encouraged to continue searching for the others. Each subject received two trials: Since three toys were hidden and retrieved per trial, additional trials would have made the session unacceptably long.

All subjects were tested in one of two laboratory playrooms that were furnished quite similarly. The same six hiding places were used for all subjects. Eight subjects were randomly assigned to one of three orders of toy hidden and hiding place. Overall, each toy was hidden first, second, and third equally often, and each hiding place was used on the first trial half the time and on the second trial the other half.

As in the preceding studies, the child was occupied in play with attractive materials during the delay interval, so that he or she had to interrupt an ongoing activity to engage in any of the target behaviors. Two observers scored the target behaviors for 12 of the subjects. Their median level of agreement was 100% for all the target behaviors, and their overall mean agreement was 96.1%.

Results

The average rate of errorless retrievals was 53%, that is, 1.58 toys per trial. This is considerably lower than the level of performance in Experiments 1 and 2; there is clearly no problem with ceiling effects in this

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4 Because the error rates in Experiments 1 and 2 were so low, it was not possible to make this comparison between target behaviors for retrieved and nonretrieved toys.
study, and, in fact, only one subject had a perfect retrieval score. The mean number of errorless retrievals decreased from the first to the second trial, as shown by a significant main effect for trials, $F(1,18) = 5.16, p < .05$, in a $2$ (sex) $\times$ $3$ (order) $\times$ $2$ (trials) mixed analysis of variance.

A mean of 1.84 target behaviors occurred per trial, with an average of .61 for each individual toy per trial. Thus, the overall number of target behaviors per trial was similar to that reported in Experiment 2, although a given toy was the focus of fewer behaviors. Even though there was no ceiling effect for retrievals, the number of target behaviors was not significantly correlated with the number of errorless retrievals, $r = .17$. Thus, children who exhibited more target behaviors were not generally more successful at retrieving the toys.

The more detailed assessment of the relation between target behaviors and subsequent retrievals did reveal a significant relationship, however. For each child, the mean number of target behaviors directed toward those toys that the child later retrieved was compared to the mean number directed toward toys that the child failed to retrieve. The toys that were later retrieved elicited significantly more target behaviors ($M = .86$) during the interval than did the toys that the child did not retrieve ($M = .36$). This difference was shown in a $2$ (sex) $\times$ $3$ (order) $\times$ $2$ (retrieval vs. nonretrieval) mixed analysis of variance, in which only the main effect for retrieval versus nonretrieval was significant, $F(1,17) = 5.20, p < .05$.

Discussion

The results of Experiment 4 reveal a relation between the incidence of the strategy-like behaviors and memory performance. Toys that were subsequently retrieved had had more target behaviors directed toward them during the delay interval than had toys that were not retrieved. Thus, for any given child, the toys that he or she attended to during the interval were more often retrieved than were the toys the child ignored. There was, however, again no relation between the total number of target behaviors and overall memory performance, so it was only the fine-grained analysis that revealed their relation to memory performance. This result is consistent with the expected effect of mnemonic strategies, namely, that engaging in them facilitates remembering. However, a note of caution is in order. It is also possible that the children tended to exhibit target behaviors toward those toys that they remembered. The direction of causality differs in these two accounts, but in either case, there is a link between the target behaviors and memory.

General Discussion

The four studies reported here provide evidence of very rudimentary mnemonic strategies in very young children. The first two experiments established a set of strategy-like behaviors that occur differentially as a function of familiarity of setting and task. The third experiment demonstrated that these strategy-like behaviors were sensitive to the presence or absence of memory demands, and the fourth demonstrated that they were related to subsequent memory performance.

During the delay intervals of the memory-for-location task used in these studies, the 18–24-month-old subjects were engaged in playing with a set of very attractive toys. Nevertheless, they periodically interrupted their activities and returned their attention to the ongoing memory task. They frequently referred to the toy (“Big Bird”), the fact that it was hidden (“Big Bird hiding”), the hiding place (“Big Bird chair”), or their later retrieval of it (“Me find Big Bird”). They sometimes made visual contact with the hiding locations, either by looking or pointing at the hiding place or hovering near it. Some children also peeked at the toy or attempted to retrieve it before the end of the interval.

In what ways do these rehearsal-like behaviors qualify as mnemonic strategies? They do bear a striking resemblance to the more complex mnemonic strategies displayed by older subjects, especially to rehearsal and self-monitoring or checking. The subject who “talks about Big Bird or its hiding place, or who looks or points at the hiding location, is bringing the to-be-remembered information to mind and keeping it activated, just as in rehearsal. Similarly, the child who hovers in the general area seems to be trying to keep in touch (literally or figuratively) with the correct location. Peeking at the toy could be a way of checking one’s recollection or seeking reassurance that it is still there. Early retrieval attempts would help the child escape the memory demands altogether.

The interpretation of the target behaviors as simple strategies is supported by the critical evidence that they were engaged in differentially, both as a function of the setting in which the task was embedded and as a function of the presence or absence of memory demands. Substantially more of the target behaviors were initiated in the laboratory than
in the children's own homes. This setting effect is stable and replicable: it was found for both the between-subjects design in Experiment 1 and the within-subjects design in Experiment 2, and the same pattern of results was also obtained in two earlier pilot studies (Cassidy, 1980).

Why should very young children be more oriented to a hidden toy in an unfamiliar laboratory than in their own homes, especially since there was no evidence that embedding the hide-and-seek task in the laboratory increased its actual difficulty? One hypothesis is that the unfamiliarity of the setting may diminish the children's confidence that they will be able to remember where the toy is hidden. The resulting uncertainty induces them to engage in a variety of activities to keep alive their memory for the location of the toy until they are permitted to retrieve it. Ceci and Bronfenbrenner (1983) make a similar argument with respect to their finding that in a time-monitoring task, children who were observed in an unfamiliar laboratory were more vigilant (i.e., checked the passage of time more often) than children observed in their own homes.

Familiarity within settings is also important: Significantly more target behaviors occurred on the first day than on the second, suggesting that in their initial exposure to a memory task, young children are more attentive to the information that must be remembered than they are on subsequent occasions. Thus, in two situations where very young children might be expected to feel less secure or less confident—performing in an unfamiliar setting and being tested with an unfamiliar task—they actively monitor the situation and themselves.

The children's behavior was also responsive to the presence of memory demands. The incidence of target behaviors was much higher when the basic hide-and-seek task required the child to remember the toy's location than in variations of the task that removed the memory requirement.

Young children's delay interval behaviors thus meet some of the criteria for mnemonic strategies: They resemble mature strategies in the sense that they keep alive the information to be remembered, they are engaged in differentially (as a function of the familiarity of the task and the setting in which it is embedded), they occur in response to memory demands (and rarely in the absence of memory demands), and they are related to subsequent retrieval.

What then is the status of these behaviors? A very liberal interpretation would be that they represent full-blown mnemonic strategies. A very conservative interpretation would be that they are simply by-products of the child's enthusiastic participation in the game. We suspect that the truth lies somewhere in between these extreme views of the young child's behavior as fully conscious and planful strategies versus mere epiphenomena of the hide-and-seek game.

There are two alternative interpretations of the target behaviors that we would like to discuss. Each of them offers a nonmemorial interpretation of some of the data, but neither offers an adequate account of all the data from the four studies. One is that the target behaviors simply reflect the children's enthusiasm for the hide-and-seek game. According to this view, the children in the memory condition in Experiment 3 found their central role in the task more exciting or arousing than did the children in the nonmemory conditions. This excitement or enthusiasm led them to exhibit significantly more of the target behaviors. One argument against this interpretation is the fact that the experimenter's ratings of the children's involvement in the three conditions did not differ significantly. In addition, this interpretation only addresses the findings of Experiment 3; it cannot account for the home/laboratory difference reported in the first two experiments. Furthermore, it is not clear why greater excitement would lead the children to engage in the kind of task-relevant behaviors that they exhibited rather than some less directed forms of general exuberance.

A second alternative interpretation of the target behaviors is that they are just components of the "terminal responses" that the child plans or envisages making at the end of the interval (Harris, in press). For example, the child imagines going to the hiding place to retrieve the toy, so he or she approaches the hiding place during the interval and maybe even hovers there or tries to retrieve the toy early. By this view, the target behaviors may simply reflect the young child's inability to inhibit the anticipated goal behav-

5 Considering the individual target behaviors, the setting effect achieved significance for the two most frequent target behaviors—verbalizations and looks. That is, in analyses of the combined data for the individual target behaviors, significantly more verbalizations, $F(1,36) = 9.86$, $p < .005$, and looks, $F(1,36) = 5.42$, $p < .05$, occurred in the laboratory than in the home.
iors. We think that the target behaviors are more than mere anticipatory goal responses for at least three reasons. First, it is not clear why "terminal responses" should occur more frequently in unfamiliar than in familiar settings. Second is the fact that the most common target behavior is verbalization about the toy or the game. Unlike some of the other behaviors, verbalization is not one of the components of the terminal or retrieval response. Finally, it does not seem reasonable to require that, to be considered strategic, a given behavior should not resemble the behavior that is to be carried out at the conclusion of the interval. If this requirement were enforced, the whole body of verbal rehearsal studies would have to be rejected as evidence of mnemonic strategies. Thus, we do not think that the target behaviors observed in these four experiments can be readily explained as due to excitement or lack of inhibition.

On the other hand, we do not wish to interpret the target behaviors as full-fledged memory strategies for several reasons. First, their occurrence is probably limited to memory tasks in which there is considerable external support for the young child's mnemonic efforts. It is doubtful that the target behaviors we observed would have any contemporaneous counterparts in internal (i.e., verbal) memory tasks (Perlmutter & Myers, 1979). Second, these strategy-like behaviors are imperfectly tuned to task demands. The differentiation between the presence and absence of memory demands seems to be made quite early, but more experience may be required before the child is capable of accurately judging task difficulty and adjusting his or her behavior accordingly. The child has to learn what is and what is not relevant to determining the type and amount of effort required. To the extent that young children's task analysis is imperfect, then the use of strategies may not be perfectly adaptive. Finally, although our data establish that the target behaviors are memory-related, it seems to us unlikely that such young children consciously adopt them with the expectation that doing so will make future retrieval more probable.

In summary, the target behaviors described here can be interpreted as evidence of a very early natural propensity to keep alive what must be remembered. These memory-related behaviors occur spontaneously in the context of a memory-based search task in which the child has adopted the goal of retrieving a hidden object. They are appropriately sensitive to the presence of memory de-

mands, but not yet finely tuned to task difficulty. It seems quite reasonable that the young child's fledgling mnemonic efforts would meet some, but not all, of the criteria for mature strategies. In particular, it is not surprising that these early efforts would be elicited by the immediate situation, rather than emitted in a more planful fashion, and that they would require further modulation to be highly adaptive.

Ornstein and Baker-Ward (1983) have made a similar argument about the early development of mnemonic skills. They suggest that memory development should be seen "as a broad continuum of mnemonic skill rather than a dichotomy of production or nonproduction of specific mnemonic mediators. . . . The picture suggested is that of a continuum from the first tentative application of various strategies (perhaps without mnemonic advantage) in certain highly salient stimulus situations to the efficient use of many mnemonic skills in a quite broad range of mnemonic contexts" (pp. 9–10).

Later more elaborate mnemonic strategies may harness and build upon the spontaneous activities we observed in the studies reported here, transforming these simple precursors into increasingly deliberate and planful behaviors in the service of memory. What is needed now is to examine in more detail, either microgenetically or longitudinally, the evolution of mature strategies from these early roots.

References


