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Maternal Provision of Structure in a Deliberate Memory Task in Relation to Their Preschool Children's Recall

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Abstract

Strategic remembering emerges gradually during the preschool years. Socialization practices, specifically mother-child social interactions, might provide the foundation for developing of skills necessary for effective organization of information in memory. In the present study, 48 mothers and their 40-month-old children were engaged in the process of remembering (i.e., study and recall) categorically related picture stimuli in a laboratory context. Children's recall was reliably predicted by the way mothers structured both the study and recall periods of the deliberate memory task. Specifically, maternal verbal and physical behaviors that focused on organization of items, such as sorting items into distinct groups or providing the name of a category, were most beneficial in supporting children's memory. Moreover, some mothers employed a number of different mnemonic techniques that emphasized categorical connections among items, suggesting systematic approaches in the manner in which mothers help children learn effective ways of remembering.

Keywords

preschoolers' memory; maternal support; memory development; socialization of memory; strategic remembering; sort-recall task

The emergence and development of a number of cognitive skills are facilitated by social interactions between children and parents (or other more competent partners). The critical role of parent-child interactions has been documented in such diverse domains as language (e.g., Farrar, 1990; Hoff, 2006), problem solving (Garton, 2004, Rogoff & Gardner, 1984), and memory, especially children's autobiographical memory skills (Fivush, Haden, & Reese, 2006; Nelson & Fivush, 2004). According to the sociocultural perspective formulated by Vygotsky (1978), development of children's cognitive abilities takes place in social context: parents, who constitute one such context, provide support and structure of activities that contribute to children's developmental outcome. In the present research, we examined relations between mothers' structuring of a deliberate memory task and the memory performance of their 3-year-old children.

The conceptualization for the present study was strongly influenced by research that emphasizes and provides evidence for social origins of autobiographical or personal memory. Autobiographical memory researchers have established that variations in the quality and

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quantity of social interactions in the form of parent-child conversations about past events are associated with individual differences in children's abilities to talk about their past experiences (e.g., Harley & Reese, 1999; Nelson, 1993). Specifically, multiple studies of autobiographical memory have demonstrated that mothers approach the activity of personal remembering remarkably differently. Mothers who are more elaborative when reminiscing with their preschool children provide complex and informationally dense narratives, often attempt to elicit information from their children, and positively acknowledge their children's participation. In contrast, mothers who are less elaborative tend to include fewer pieces of new information and repeat the same memory request over and over without incorporating or elaborating on children's responses (Fivush, 1991; Reese, Haden, & Fivush, 1993). Children of mothers who use an elaborative style tend to contribute more information to memory conversations and use more advanced narrative skills, relative to children of mothers who use a less elaborative style. Relations between maternal and children's behavior are apparent both concurrently and over time.

It has been argued that maternal behavior during reminiscing might provide a basis for children's construction not only of autobiographical memory skills but for development of memory more broadly. Support for this suggestion comes from studies in which children's memory was assessed in two different domains, namely, reminiscing and a deliberate task. For example, Rudek and Haden (2005) reported that mothers who used more mental terms in past-event conversations when their children were 30 months of age (e.g., talk about the process of remembering) had children who at 42 months engaged in more strategic behaviors in an object memory task (i.e., children were asked to remember a set of 12 familiar and unrelated objects). In the same sample, Haden, Ornstein, Eckerman, and Didow (2001) found that children who remembered more details of past personal experiences were able to recall more objects in a deliberate memory task. Because the researchers also observed relations between specific characteristics of mother-child joint talk and children's autobiographical memory, this work suggests an indirect link between narrative characteristics and children's memory for arbitrary material.

Maternal talk has been found to be instrumental not only when mothers are explicitly asked to reminisce with their children but in the course of everyday activities as well. For example, Ratner (1980) observed mothers and their 3-year-old children at home and found that the frequency of questions mothers asked about past events during naturally occurring conversations was positively related to children's performance on recall and recognition memory tasks in the laboratory. In contrast to these findings, Lange and Carroll (2003) examined children's memory for narrative and non-narrative materials in a laboratory setting and demonstrated a more differentiated effect of maternal verbal behavior. Specifically, maternal use of narrative messages during a picture book interaction task was related to children's memory for story materials, but was unrelated to recall of object names in an independent laboratory task. The discrepancy in findings might be partially explained by the substantial differences among the settings where mother-child interactions were observed (e.g., verbal behaviors during a specified event, conversations about a past experience, book-reading interactions, or naturally occurring conversation in the course of everyday interactions). Moreover, none of the previous investigations was a direct examination of interactions between mothers and their preschool age children during a deliberate memory task.

Boland, Haden, and Ornstein (2003) proposed a possible mechanism for relations between parent-child interaction and children's deliberate memory skills. They suggested that through adult-child conversational interactions during an event, children learn to focus their attention on specific aspects of the event, which potentially leads to more organized representations of relevant information. Later, when children co-construct narrative reports about the past, adults provide the organizational structure of recall, thus facilitating children's learning of essential

skills for planning to remember (Fivush et al., 2006). In the present research we examined the assumption that just as mothers demonstrate a variety of reminiscing behaviors, they also may differ in the behaviors they use to encourage deliberate remembering.

Deliberate remembering is associated with the use of memory strategies. In general, memory strategies refer to effortful, goal directed, and potentially conscious cognitive operations used to improve memory performance (Bjorklund & Douglas, 1997; Schneider & Bjorklund, 1998). Strategic remembering becomes especially important in the school setting. Moreover, researchers consider changes in memory strategy skills as a critical contributor to the clear improvements in children's memory performance observed between 5 and 15 years (Schneider, 2000). A variety of memory strategies are available for a competent user and the selection of strategies depends on many factors including the specific conditions of a particular memory task. For example, in sort-recall tasks, when to-be-remembered materials can be categorized and there is time to prepare for recall, the use of organizational strategies such as grouping of items into meaningful categories prior to recall and clustering during retrieval might be evident. In addition to organization, other memory strategies that have been frequently investigated in developmental memory research are rehearsal (repeating item's label) and elaboration (creating an association between two or more items). In sort-recall tasks, children have also been observed using less frequently occurring strategic behaviors, such as self-test (practicing recall by looking away or covering test items) and category naming (e.g., "those are vegetables, those are tools;" see Bjorklund, Dukes, & Douglas, in press, for a review).

The majority of research in strategy development has been conducted with school age children (see for e.g., Pressley & Hilden, 2006, for an exception). One of the reasons for this is that children become increasingly capable of intentional, strategic memorizing near the beginning of elementary school years. Improvement in strategy use continues well into adolescence (see Schneider & Pressley, 1997 for a review). For children younger than 6 years of age, there is relatively little evidence for spontaneous intentional, strategic remembering. However, although young children do not demonstrate the variety of memory strategies that older children do, they are not completely incapable of such behavior. For example, preschoolers and elementary school-age children demonstrate strategic-looking behaviors during sort-recall and free-recall tasks when presented with highly associated items (e.g., Sodian, Schneider, & Perlmutter, 1986). Preschoolers have been observed to selectively attend to stimuli that they were asked to remember, to spontaneously name items, and to physically manipulate them (e.g., Baker-Ward, Ornstein, & Holden, 1984). Moreover, strategic behaviors are especially obvious when children are tested in familiar environments and with familiar tasks. For example, children as young as 2 years employ intentional memory activities while playing hide- and- seek games (DeLoache, Cassidy, & Brown, 1985).

In short, strategic remembering gradually begins to emerge during the preschool years. It is reasonable to assume that one way of learning new strategies is through collaborations with another person (Vygotsky, 1978; Willatts, 1990). In the present investigation, we created a teaching situation that afforded mothers the opportunity to use any number of mnemonic techniques with their children, thus allowing us to examine systematically how mothers structure a memory task for their children. We selected the stimuli and task so as to create an optimal level of challenge for the dyads to work together. Specifically, we selected stimuli and a task that would be too difficult for the preschool-age children to perform independently but would be an appropriate level of challenge with mothers' assistance. In this case, children's performance would be especially sensitive to the level of support provided by their mothers. Previous research has shown that when children demonstrate a high level of independent task performance, suggesting some level of expertise for a relevant cognitive skill, the relation between maternal teaching behaviors and children's memory is difficult to assess. For example, Rogoff, Ellis, and Gardner (1999) investigated the effects of maternal teaching instructions on

the sorting performance of 6- and 8-year-old children during two laboratory categorization tasks. The authors found few relations between maternal teaching variables and children's test performance. One of the reasons for this finding, as suggested by the authors, might have been the high level of children's test performance.

The task we selected was sort-recall: the stimuli were three categories of four related items (e.g., clothing, fruits, places). In previous research on strategic behavior and recall during free recall or sort-recall tasks, preschool children have often been presented with small attractive objects as the to-be-remembered stimuli (e.g., Baker-Ward et al., 1984; Perlmutter & Myers, 1979; Sodian et al., 1986). In the present study, rather than objects, we used black and white line drawings of objects, each presented on a separate card. We used pictures rather than 3-dimensional objects to minimize "play behaviors" that we thought might emerge as mothers and their children worked on the task of remembering and that would distract from the deliberate memory task. Presentation of memory stimuli on cards (either as pictures or printed words) has traditionally been used with school-age children (second graders and older; e.g., Coyle & Bjorklund, 1996, 1997). Yet, pictures of categorized objects have been used successfully with children 5 to 6 years of age (Moely, Olson, Halwes, & Flavell, 1969; Schneider, Kron, Hunnerkopf, & Krajewski, 2004).

By presenting mothers and their 3-year-old children with items that could be organized into categories and observing maternal behavior during both a study period and a recall period, we were able to examine the kinds of memory strategies mothers used to support their children's encoding and later retrieval. Previous studies examining children's independent memory performance during memory tasks with categorically related items have indicated that young children rarely try to organize (by sorting or clustering) information spontaneously, either during encoding or retrieval, and in general children's level of recall is poor (e.g., Bjorklund, et al., in press; Perlmutter & Myers, 1979). However, specific manipulations of task conditions, such as providing explicit instruction to group items according to their meanings at the time of encoding (e.g., Lange & Jackson, 1974; Moely et al., 1969), or providing category clues at the time of testing (Schneider & Pressley, 1997), seem to produce beneficial effects on preschoolers' levels of recall. Thus, the results from the experimental and training studies suggest that under highly structured conditions, young children are capable of implementing intentional remembering.

In the present study, mothers were asked to use whatever means they might find helpful to assist their children in remembering related items. Therefore, mothers potentially might have used a variety of different approaches. We examined maternal behavior in terms of the types of verbal instructions and physical manipulations that mothers performed to engage their children in the process of remembering. We were especially interested in (a) the kinds of maternal memory instructions that would work most effectively in this particular context, (b) whether mothers would select to focus on the organization of to-be-remembered material highlighting semantic relations among items, (c) relations among maternal strategic behaviors, and (d) the relative contributions of maternal support during the study and recall periods to children's levels of remembering. To determine whether maternal behavior, children's recall, or both, were related to children's language, we included an independent assessment of children's language skill.

Method

Participants

Forty eight mother-child dyads participated. There were 23 girls and 25 boys in the sample. Children were approximately 40 months of age ($M = 40.20$ months, range = 39.00 to 42.20 months). Six additional dyads were excluded from the analyses because the child participated

with her or his father rather than mother ($n = 4$), recording equipment failure ($n = 1$), and failure to complete any trial of the task ($n = 1$). Children were drawn from a pool of families who had expressed interest in participating in research at the time of their children's birth. The majority of the families were Non-Hispanic, Caucasian, and of middle- and upper-middle class socioeconomic status. Specifically, 42 children were reported to be of Caucasian descent, 2 children were reported to be of African-American descent, and 4 mothers chose not to specify their children's race. On average, mothers had 16.90 years of education ($SD = 2.56$), 38 mothers (79.16%) had a college degree or higher, 8 mothers had a technical degree or some college education, and 1 mother had a high school education. Fathers had, on average, 17.25 ($SD = 2.61$) years of education, 40 fathers (83.33%) had a college degree or higher, 6 fathers had a technical degree or some college education, and 2 fathers had a high school education. The dyads were participating in a short-term longitudinal memory study and visited the laboratory twice, a year apart between the sessions. Only the first visit is relevant for the present research. Informed consent to participate was obtained prior to initiating the research. All dyads were seen by one of two female experimenters (one experimenter tested 20 children, and another experimenter tested 28 children). At the end of each session, children received a small toy and parents were given a gift certificate.

Materials

Two sets of 12 categorically related items were used. A list of items was adapted from Bjorklund, Coyle, and Gaultney (1992). Stimuli were modeled after Coyle and Bjorklund (1997) with the exception that each item was depicted on a card in black and white line drawing instead of a printed word. Each set contained three categories with four exemplars per category. The categories used were clothing, fruits, and places (Set 1) and sports, appliances, and vegetables (Set 2; see Appendix for a complete list of items).

Procedure

Dyads took part in a 1.5 hour testing session. Children completed a variety of tasks, including mother-child and experimenter-child autobiographical memory interviews, theory of mind tasks, a story-telling task, and measures of language.

Structural teaching memory task—The task of interest, a collaborative memory task, was administered in the middle of the session. Dyads were asked to complete two trials in immediate succession. Three dyads completed only one trial because the children declined to continue. During each trial, mothers were given a set of 12 picture cards (three categories per list, four items per category). Both the items and categories were different at each trial, and the sets were presented in counterbalanced order across all dyads.

Mothers were instructed to help their children remember the pictures on the cards in any way they deemed appropriate. The experimenter recommended a 3-minute study period and left the room. If the mothers stopped their teaching before the end of the 3-minute period, the experimenter returned to the room. Six dyads finished the study period in less than 3 minutes. For the other dyads, the experimenter returned to the testing room after the 3-minute period. If the dyads were still engaged in the task activities, mothers were reminded that the study period had ended. However, mothers were permitted to finish their ongoing activities even if the study period extended beyond 3 minutes. Because mothers rather than experimenters determined the actual length of the study period, it ranged across dyads from 2.25 to 3.5 minutes ($M = 3.25$, $SD = 0.30$, $Mode = 3.00$). At the end of the study period, mothers collected the cards and waited a 30-second buffer period before they asked their children to recall as many pictures as possible. During the recall period, mothers were told to first read the instruction: "I'm just going to listen quietly until you have told me all the pictures that you remember." After that, mothers were allowed to do whatever they desired to help their children recall the pictures. In

actuality, many mothers ignored the instruction for what was, by design, a free-recall followed by a supported-recall period. That is, they began supporting their children's recall virtually immediately (see below for behavioral categories of maternal support). The mothers were not constrained by time limits during retrieval period. Trial 2 was administered in the same way.

Language assessment—Children' language skill was assessed using the Picture Vocabulary Test from the Woodcock Language Proficiency Battery - Revised (WLPB-R; Woodcock, 1991). This is primarily an expressive semantic task, though there are a few receptive items at the beginning of the test. The test was individually administered, and it has no time limits. For 3 children the language score was not available: for 2 children the test was not administered due to the time constraint on the session, and 1 child refused to finish the test. The children's average language score was 20.53 ($SD = 2.40$), which corresponds to an age level of 45 months in the normative sample for the test.

Coding

Physical and verbal behaviors during study and recall periods were coded from videotape. To develop coding categories of maternal behavior, we adapted coding schemes used in the literature on children's strategy development. However, we made some changes to reflect the fact that mothers were using strategies to support their children's rather than their own memory performance. For example, in terms of physical behavior we differentiated between two sorting behaviors: one behavior when mothers separated the picture cards into categorical groups but kept them in piles, and another behavior when mothers sorted the cards by the categories and kept all the cards face up. In terms of verbal behaviors, verbalization of the list of items is typically coded as rehearsal. In the present investigation, when mothers labeled the item, they either received credit for *label*, at the time of introducing the item for the first time, or *repeated single label*, when the item label was repeated. Both of the labeling behaviors contrast with *repeated categorically* labeling, when the items from the same category (e.g., sport) were labeled together rather than when the individual item (e.g., football or golf) was labeled. Some coding categories, especially for maternal verbal behavior, were modeled after coding categories used to evaluate maternal elaboration during mother-child conversations about the past. *Association* or *general probes* are examples of such codes. Other coding strategies, such as *task goal*, were created specifically for this task.

Study period—Videotapes were coded for the occurrence of target physical and verbal maternal teaching behaviors. The codes were not mutually exclusive, and thus the mothers could be credited with production of multiple strategies simultaneously.

Mothers' verbal utterances were classified into 10 different verbal categories. Each instance of these behaviors was counted. *What* was recorded if the mother asked the child "What is this?" for a particular picture card. *Label* was assigned if the mother introduced the item by using noun labels (e.g., "This is an orange"). In addition to credit for labeling, if the mother repeated a label, she was credited with one of two categories of behavior. *Repeated single label* was recorded if the mother repeated a label for a single card multiple times either successively or at different intervals. *Repeated categorically* was granted if the mother repeated the labels of at least three out of four cards of the same taxonomic category. In addition, the mother may have formed her own thematic category (e.g., "Things we have in our kitchen: TV, refrigerator, carrot, and corn"), from which she would need to mention at least three cards. *Category naming* was recorded when the mother identified the name of category to which the items belonged (e.g., "These are all fruits." "These are things we have in our living room"). *Description* was given if the mother explained the perceptual details of the objects depicted in the pictures (e.g., "Look, there is a swing at the park." "There are three buttons on this skirt"). *Association single* was credited if the mother related information in *one* of the pictures to

children's own experiences or requested general knowledge from the child (e.g., "Remember we got gas from the gas station on the way here." "What color is an orange?"). *Association multiple* was assigned if the mother related at least two items to each other, often creating a story (e.g., "Momma had a skirt on, daddy had pants with a belt, and you had a coat"). Pictures did not need to be members of the same taxonomic category (e.g., in the utterance "Remember, we have carrots and corn in our refrigerator," items from two different taxonomic categories, vegetables and appliances, were mentioned together). *Test* was credited if the mother covered the recently studied cards and asked the child to remember them during the study period. *Task goal* was given if the mother identified the goal of the task for the child (e.g., "Try to remember the pictures because I am going to ask you about them later").

Maternal physical behavior refers to how the mother physically presented the cards to the child. Five different physical behaviors were identified: stack, sort/stack, sort/layout, layout, and sequential touching. Credit for a physical behavior was given if it occurred within a 30-sec interval. Interval, rather than instance, coding was adopted for physical behavior because they are "mass" rather than "count" behaviors. For example, sequential touching occurs on a number of items; it is not possible to count one sequential touch. *Stack* was credited when the mother kept the cards in one stack and as she was going through the cards she returned each one to the stack. *Layout* was given if the mother randomly placed the cards on the table without any kind of grouping. *Sort/stack* was recorded if the mother grouped the cards by stacking the categorically related cards on top of each other and created piles of different categories. *Sort/layout* was assigned if the mother placed the cards face up on the table in discrete groups indicative of categories. *Sequential touching* was recorded if the mother sequentially touched at least three out of the four cards from the same category without physically rearranging the cards.

Taking into consideration the exploratory nature of the present investigation and the fact that the coding scheme had not been used in any prior studies, the first two authors (ML and EG) coded all videotapes independently from each other. Interrater agreement calculated on 25% of videotapes prior to discussion averaged 84% (range: 73% to 95%). Although reliability was in an acceptable range, it was lower than we desired. For this reason, we compared all codes of the two coders and resolved disagreements through discussion. These resolved codes were used in the analyses.

Recall period—Mothers were credited with four different behaviors as they were eliciting recall from their children. Each instance of these behaviors was counted. *Spatial reminder* was assigned when the mother pointed to a specific location on the table and asked the child what picture or group of pictures was in that location. *General prompt* was given when the mother prompted for additional recall without providing any specific cues (e.g., "What else do you remember?" "Anything else?"). *Category-level probe* was credited if the mother provided the name of the category (e.g., "Do you remember the fruits?"). *Item-level probe* was assigned if the mother provided associative or descriptive cues for a particular item (e.g., "Remember, there was a picture of a flower that grows in our garden?"). Children were given 1 point for each item recalled. Only accurate recall (items that were presented at the particular trial) was considered for each trial.

Interrater agreement on recall period behavior calculated on 25% of videotapes averaged 90% (range = 87% to 97%).

Results

We explored relations between maternal teaching behavior and children's memory performance during a memory task with categorically related items. As a first step in the

process, we described children's memory performance. Second, we examined the variability of maternal behavior. Then, we investigated patterns of relations among maternal study behaviors by conducting a series of Pearson correlation analyses and exploratory factor analysis. Finally, we assessed the relations between maternal behaviors during the study and recall periods and children's memory performance. We addressed the relation by determining the contributions of maternal study strategies and recall strategies to children's memory independently for each phase of the memory task and in a relation to one another.

Children's Memory Performance

Preliminary analysis indicated that children's memory performance did not vary from Trial 1 to Trial 2. First, as a group, the children were consistent in their performance. The average recall score at Trial 1 ($M = 3.15$, $SD = 3.02$) did not differ significantly from the average recall score at Trial 2 ($M = 3.20$, $SD = 2.96$), $t(44) = 0.35$, $p = 0.73$ (two-tailed, $d = .02$). Second, there was a significant correlation between children's recall scores at Trial 1 and their recall scores at Trial 2, $r(45) = .51$, $p < .05$. Thus, the average recall scores (mean of Trial 1 and Trial 2) were used in all further analyses. There was substantial variability in the number of items the children recalled, with a mean of 3.07 ($SD = 2.63$) and a range of 0 to 10. On each trial 29.17% of the children recalled no items (i.e., recall score of 0); 16.67% of the children recalled no items on both trials. At the same time, 12.50% of the children recalled six or more items across trials (18.75% and 20.83% on Trial 1 and Trial 2, respectively). Children's recall scores were not significantly correlated with their language scores ($r = .14$, $p = .34$). However, a one-way between-subjects analysis of variance (ANOVA) showed that girls recalled significantly more items than boys, $F(1, 46) = 4.87$, $p < .05$ ($M = 3.91$ for girls; $M = 2.30$ for boys, $\eta^2 = .09$).

Preliminary Analyses of Maternal Behavior

As described in the Method section, most mothers and children participated in two trials of the memory task; 3 dyads completed only one trial. Mothers were consistent in their use of teaching strategies during the study and recall periods across trials. Paired t -tests, with 44 degrees of freedom, comparing mean scores of maternal behaviors on Trials 1 and 2 revealed that the mothers used more descriptions and more general recall prompts at Trial 1 than at Trial 2 (t s are 2.81 and 3.07, respectively). There were no significant differences in any other categories. Most maternal behaviors were significantly correlated across trials (r s ranged from .38 to .85, p s $< .05$). Of the 19 coded behaviors, only 2 behaviors, description and task goal, were not significantly correlated across trials. Based on the results of these analyses, we averaged across trials and used the mean scores in all further analyses. Averaged scores provided more representative samples of maternal behavior. For the 3 dyads with only one trial, performance on that trial was analyzed.

In light of gender differences in children's behavior, we evaluated the possible effect of child gender on maternal behavior. A one-way between-subjects ANOVA revealed that only one maternal behavior, task goal, was used significantly more often with girls than with boys, $F(1, 46) = 4.21$, $p < .05$ ($M = 0.65$ for girls; $M = 0.30$ for boys, $\eta^2 = .10$). For further analyses, girls and boys were analyzed together. Finally, although children's behavior was not related to their own language skills, we examined potential relations between children's language and maternal behavior. Across the study and recall periods, only one maternal behavior, task goal (study period), was significantly correlated with language scores ($r = .38$, $p < .01$). Because of the relative lack of relations between children's language and either their own or their mothers' behavior, child language skill was not considered further.

Maternal Behaviors during the Study Period

Description of behavior—Descriptive statistics, including the number and the percentage of mothers who used a particular strategy, and the means and standard deviations for all

maternal behavior, appear in Table 1. As reflected in the table, we found substantial variability in the number and type of behaviors mothers used during the study period. The mothers differed in the strategies they used to help their children to remember from simply asking children to name a card to a more “sophisticated” organizational strategy, such as identifying the name of categories. In addition, the mothers differed in the frequency of use of the same behaviors. For instance, even though all mothers provided labels of the items to their children, some mothers named only 3 items in contrast to other mothers who named all 12 items in the set.

Relations between maternal study behaviors and children’s recall—To examine the relation between maternal help (i.e., maternal strategic variables) and children’s memory (i.e., number of items recalled), we conducted a series of Pearson correlation analyses. The results of these analyses are shown in Table 2. Six maternal behaviors were significantly associated with children’s memory. Sort/layout, sequential touching, repeated categorically, category naming and task goal were positively related to children’s recall, whereas stack was negatively related. The length of the study period varied across dyads: the actual time during the study period ranged from 2.25 to 3.50 minutes ($M = 3.25$). The length of the study period significantly related to the number of items children recalled, $r(46) = .31, p < .05$. Therefore, we reexamined the relations between maternal teaching strategies and children’s recall with the study time controlled. After controlling for study time all strategies except sort/layout and repeated categorically continued to be related to children’s recall (partial correlations also appear in Table 2).

Relations among maternal strategies during study period—We examined the relations among maternal study strategies using correlational and factor analyses. We found broad patterns of correlations among maternal behaviors. The significant correlations are provided in Table 3 (details on non-significant correlations are available from the first author). Specifically, organizational strategies, such as sort/layout, sequential touching, repeated categorically, and category naming, were positively related to each other. The strategies that did not highlight the categorical relations among to-be-remembered items, such as stack, what, description, and repeated single label, were negatively related to explicit organizational behaviors. Moreover, some strategies, such as association single and test, did not relate to any other strategies.

To further examine the patterns of relations among maternal study behaviors, we used principle components analytic techniques (with varimax rotation). This statistical procedure was used to make sense of patterns of relations among numerous variables in an attempt to identify common sources of variance. This analysis also allows numerous intercorrelated variables to be considered into fewer dimensions, reducing the number of variables used in further analyses. All 15 maternal study behaviors were included in the analyses. Seven factors had eigenvalues greater than 1 and were retained from a factor analysis for interpretation. Together these factors accounted for 78.42% of the variance in the original data. Variables loading on a factor higher than .30 were retained and used to interpret the factor (Tabachnick & Fidell, 2001). The results of these analyses can be seen in Table 4. The strongest factor, Factor 1: Explicit Organizational Strategies, includes variables that focused on categorical organization of the material, such as sort/layout, sequential touching, category naming, and repeated categorically. Stack loaded with a negative value on this factor. Other factors were: Factor 3 included association multiple and task goal; Factor 4 included strategies that focus on labeling of the cards (label and repeated single label); Factor 6 included association single, description, and test with a negative value. Only one variable loaded for Factors 2, 5, and 7: what, sort/stack, and layout, respectively. Some caution should be exercised in consideration these results, in light of the fact that the size of our sample was less than what is recommended by some researchers (suggested minimum sample size is 100 to 200 observations), a situation that could potentially lead to unstable solutions (Guadagnoli & Velicer, 1988).

Prediction of children's recall from study strategies factors—In hierarchical regressions, we examined the prediction of children's memory performance from maternal strategies during the study period using the factors derived from the factor analyses. Gender was entered on the first step because in preliminary analyses we found a gender difference in recall performance (see *Children's Memory Performance*). When gender was the only predictor in the model, it accounted for 9.60% of the variance of children's recall, $F(1, 47) = 4.87, p < .05$ (see Table 5). In the second step, in addition to gender, we entered the seven factors derived from the exploratory factor analysis. The overall model was significant, accounting for 44.50% of variance. Only Factor 1, Explicit Organizational Strategies, made a significant independent contribution in predicting children's recall. Moreover, after adding the factors, gender failed to account for significant amount of variance in the model.

Maternal Behaviors during the Recall Period

Description of behavior—Four maternal behaviors were coded during the recall period. The descriptive statistics on maternal recall strategies are provided in Table 1. There was substantial variability in use of the specific maternal strategies. For example, only 10% of all mothers used spatial reminders to elicit children's recall. General prompts were used by all mothers, likely because they were part of the instruction mothers were asked to provide. However, some mothers tended to use general prompts repeatedly in contrast to those who used them only a few times. The maternal recall behaviors of spatial reminder, category-level probe, and item-level probe were intercorrelated (r s range .35 to .67). Frequent use of general prompts was negatively related to other recall categories with the exception of the category-level probe strategy (r s range -.34 to -.45).

Relations between maternal behaviors during the recall period and children's recall—The results of Pearson correlations between maternal recall strategies and the number of items children recalled are provided in Table 6. General prompt was negatively related to children's recall. In contrast, other maternal recall behaviors were positively related to children's memory performance. The length of the recall period varied across dyads ($M = 2.20$ min, range = .92 min - 4.37 min). The length was significantly related to the number of items children recalled, $r(46) = .59, p < .001$. After controlling for recall time, all maternal retrieval behaviors remained related to children's recall (Table 6, right column).

Prediction of children's recall from recall strategies—We tested a second regression model to predict children's memory from the maternal recall strategies. As in the regression model for children's recall using study period strategies, gender was entered first, and all recall strategies were entered second. The overall model was significant, explaining 50.50% of the variance. Importantly, we found that despite the finding that all recall strategies were significantly associated with children's recall, only one strategy, providing category-level probes, was a significant predictor (see Table 7). Gender again failed to account for a significant amount of variance in the model after adding the recall strategy variables.

Relative Contribution of Maternal Study and Recall Strategies to Children's Recall

To examine the prediction of children's memory performance using significant predictors from the study and recall periods, we ran a third hierarchical regression model (see Table 8). Gender was entered on the first step, then we used the Explicit Organizational Strategies Factor and category-level probe as other predictors in the model. The maternal study strategies that constituted the Explicit Organizational Strategies Factor and the recall strategy of providing category-level probes made significant independent contributions to children's recall, despite a collinearity among these predictors (Factor 1 was significantly related to the category-level probe at $r = .53, p < .001$). Similar to previous models, gender failed to independently contribute to the model, after adding other predictors. Overall, gender, maternal study behaviors, and

recall strategies accounted for 46.90% of the variance in children's recall, $F(3, 44) = 12.95$, $p < .0001$.

Discussion

The major goals of the present study were to examine systematically how mothers structured a deliberate memory task with their young children and to determine the relations between specific maternal memory strategies and children's remembering. Although children as young as 2 years of age have demonstrated impressive memory skills in a variety of contexts, especially in familiar environments (Bauer, 2006), their memory performance greatly depends on external support. For example, in the context of autobiographical memory, at 20 to 24 months of age, when children are just beginning to participate in conversations about their past experiences, their verbal reports are rudimentary and fragmentary (Eisenberg, 1985). Even, when children are older and they are able to provide more details about past occurrences, their memories are still most often in response to specific prompts from an adult (Fivush, Gray, & Fromhoff, 1987). Thus, it is an adult partner who is doing most of the work during such memory conversations, providing the structure and content of the talk. In the present research, 3-year-old children and their mothers were engaged in the process of remembering semantically related picture stimuli in a laboratory context. The results of the study indicate that this task continues to be challenging for the children even with help from their mothers. The average level of recall was low (3 items out of 12), which is comparable with findings from previous research with children of approximately the same age (e.g., Haden, et al., 2001, Perlmutter & Myers, 1979; Sodian, Schneider, & Perlmutter, 1986).

Despite the average low level of recall, we found substantial variability in children's performance: some children were able to remember almost all items (up to 10) and other children did not remember any of them. Based on our results, we argue that variability in children's memory can be at least partially explained by the different levels of support the children received from their mothers during this task. Importantly, the pattern of associations between maternal behavior and children's level of performance suggests that some mothers approach this particular memory task strategically, selecting the most beneficial teaching technique in helping their children to encode the to-be-remembered material and then to retrieve it later.

The nature of the sort-recall task in which mothers were asked to engage their children provided the opportunity to use mnemonic techniques that focused on the organization of stimuli. Organization of to-be-remembered material is considered to be a powerful memory strategy that generally benefits memory performance. To perform organization, which involves the combination of different items into categories, an individual needs either to recognize existent conceptual relations among the items or to create meaningful connections among them. It has been found that spontaneous and effective use of organizational strategies is not evident until 10 or 11 years of age (Hasselhorn, 1992). During independent performance, preschoolers usually do not use typical organizational strategies (e.g., sorting), although they might demonstrate strategy-like behavior, such as naming of the items or visually examining them (Baker-Ward, et al., 1984).

Previous experimental studies with preschoolers have demonstrated that young children's level of remembering can be enhanced by helping them execute organizational strategies (see Bjorklund et al., in press, for review). For example, those 4-year-old children who received explicit instruction "to put those toys together that go together" before a study period recalled significantly more to-be-remembered objects than children who were in a play-in-remember condition (Sodian, et al., 1986). Moreover, it has been also found that providing category cues at the time of retrieval improves children's recall performance substantially (Kobasigawa,

1974; Sodian, et al., 1986). Therefore, it was not surprising that maternal emphasis on categorical relations among items both at the time of encoding and later at retrieval was positively related to children's recall. Specifically, children whose mothers were more likely to physically or verbally separate items into groups or sequentially touch items according to their categorical relations remembered more items than children whose mothers failed to highlight meaningful connections among the task material. In contrast, mothers' tendency to keep the cards in one pile, effectively preventing their children from examining the relations among the items, was related to poorer performance by their children. At the time of recall, cueing children's memory at the level of a separate item and at the level of the category was related to recall. However, only providing category-level cues (i.e., asking children to recall to-be-remembered items in relation to their categorical membership) was a significant predictor of children's performance during the recall phase of the task.

It is interesting to note that most items used in the present task were highly familiar to the children. It has been suggested (e.g., Rossi & Wittrock, 1971) that salient categorical associations among items might automatically promote the organization of to-be-remembered material without explicit attention to the categorical relations among them at the time of encoding. However, in our case, maternal behavior that just ensured knowledge of the items, such as labeling the cards or requesting the labels from the children, was not associated with children's recall. Thus, children needed explicit instructions and demonstrations to recognize the inter-relationships among the items and as a result to benefit from this. In parallel with this finding, there were other maternal teaching strategies, such as providing associative information that potentially could promote children's memory, but were not found to aid recall. When mothers discuss the item's perceptual features, provide general knowledge about the object depicted on the card, or create associative links between the item and child's own experiences, this might activate children's long-term memory that in turn could aid the process of remembering. In addition, maternal use of associations might make this formal memory situation more interesting, increasing children's engagement in the task. Previous research has indicated that maternal use of associative information during mother-child autobiographical memory conversations seems to facilitate children's independent memory reports about laboratory experienced events (Bauer & Burch, 2004). However, in the context of a deliberate memory task, mothers' attention to information that was not directly relevant to the target items was not related to the children's recall.

The present investigation provided evidence of patterns among different maternal behaviors. Maternal teaching strategies that were related to organization of the items into categories, such as physical or verbal emphases of categorical connections among items, were intercorrelated with one another, creating a factor that strongly related to children's level of remembering. Most notably, mothers who explicitly separated the items depicted on the cards into categorical groups by laying cards into sorted groups also often sequentially touched cards that belonged to the same category. They also frequently provided the name of the semantic categories, and they repeated the labels within a category as a unit. The fact that mothers were able to focus children's attention on a critical characteristic of to-be-remembered material in a number of different ways suggests that mothers understood the specific demands of the memory task and directed their efforts in helping children to encode information in a beneficial, organizational fashion. Importantly, mothers who were effective in structuring the process of encoding information and thus potentially making this information more accessible for recall later, continued to provide organizational structure while helping their children to retrieve target information. Moreover, remembering was optimized when organizational support was provided during both task periods: at the time of getting information *into* memory and at the time getting information *out* of memory. Previous research on young children's memory development has reported that the most difficult task for young children is to access stored information from long-term memory rather than to encode it in the first place (Howe, Brainerd,

& Kingma, 1985). A number of studies demonstrated that under highly supportive retrieval conditions, when directive cues were provided, young children were able to recall as much information about the stimuli as older children (e.g., Kee & Bell, 1981; Kobasigawa, 1974).

In the present investigation, mothers' behavior was assessed during the study and recall phases of a memory task. What mothers did when helping their children to study the to-be-remembered items and later to recall them independently predicted children's memory performance. This finding fits well with memory development research that has shown that maternal differences in talking about aspects of an event as it is unfolding (encoding phase) and talking about an event experienced in the past (retrieval phase) both strongly influence what young children remember and report about the event (Bauer & Burch, 2004; Reese et al., 1993; Tessler & Nelson, 1994). In the context of joint reminiscing and children's personal memory narratives (Haden et al., 2001) as well as in the context of elicited-imitation paradigm and children's nonverbal recall performance (Burch & Bauer, 2004), it has been argued that joint elaborative discussions about salient aspects of an event while it is ongoing aid children in forming a richer and better organized and thus more readily accessible memory representation. As a result, mother-child interactions during an event provide children with an opportunity to learn skills related to effective planning for subsequent assessments of memory. Similarly, verbal interactions while talking about already experienced events provide children with opportunities to acquire memory skills necessary for effective search, retrieval, and reporting. In the context of strategic remembering in the present study, maternal behavior might facilitate children's ability to use organizational strategies while preparing for a future memory test. In addition, maternal support during the recall period may teach children strategic approaches for recovery of already stored information.

It is worth mentioning that in the present sample we found a gender difference in memory performance: girls, on average, recalled more items than boys. This finding is consistent with previous research. Although most often no systematic effects of gender have been found in young children's level of remembering (e.g., Perlmutter & Myers, 1979; Schneider & Sodian, 1991), when gender differences do emerge they are in favor of girls (Cox & Waters, 1986). Despite the gender difference in the children's level of recall, maternal teaching behavior did not differ as a function of child's gender with one exception: mothers more often stated the goal of the task while interacting with their daughters than sons. (Task goal was also the only maternal behavior to relate to children's language skill.) However, even though gender was related to the number of items recalled, gender was not a significant predictor of children's memory performance when maternal teaching behaviors were taken into account.

In the present study mothers were explicitly asked to engage their children in deliberate remembering of the material that supports the use of organizational strategies. We can only speculate then as to whether the individual differences in maternal behavior that we found in the laboratory environment might relate to how mothers spontaneously facilitate the development of children's memory strategic skills in everyday life situations. Yet, although all mothers were instructed to help their children to remember the same stimulus materials, there were mothers who systematically highlighted meaningful relations among items, and some mothers who failed to use the available categorical cues. Such differences among mothers might reflect not only differences in how they interpreted and achieved the task of remembering in the formal laboratory context but might also uncover more general differences that children experience on a daily basis. If mothers are sensitive to meaningful relations in information in the environment and are skillful in organizing the process of remembering for their children, they might be more likely to use naturally occurring memory situations to teach effective ways of encoding and retrieving information. For example, even a simple task of finding a favorite toy might provide the opportunity to perform an organizational search according to the toy's category (it would work best if the toys were sorted during the cleaning time). In everyday life,

children might encounter numerous situations when deliberate remembering can be facilitated by parental support.

Finally, we note that the present findings are from a very homogeneous sample of middle- and upper-middle class families, with highly educated parents. In addition, on average, the children demonstrated greater language skill than is typical for their age. These factors represent a limitation on the generalizability of our results.

In closing, the present research demonstrated that mothers' use of memory strategies related to their children's memory performance. We did not, however, assess children's independent strategic behavior. To argue that maternal differences in guiding their children's deliberate remembering might set the foundation for children's ability to plan, execute, and control mnemonic strategies, we need to examine the possible link between the characteristics of early mother-child interactions during deliberate memory tasks and the ways in which children approach a similar task independently. Thus, this study provides only an initial attempt in exploring the social roots of strategic remembering.

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Appendix

Word Lists for the Sort-recall Task

Set 1	Set 2
Clothing	Sports
Belt	Tennis
Coat	Golf
Pants	Soccer
Skirt	Football
Fruit	Appliances
Banana	Stove
Orange	Refrigerator
Cherry	Computer
Apple	Television
Places	Vegetables
Park	Mushroom
Home	Corn
Airport	Onion
Gas station	Carrots

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Table 1
Descriptive Statistics on Maternal Behavior during the Study and Recall Periods

Variable	Number of mothers used (%)	Mean	Standard deviation	Range
Study period				
Stack	35 (73%)	3.27	2.71	0 - 7.0
Layout	9 (19%)	0.46	1.35	0 - 7.0
Sort/stack	8 (17%)	0.39	1.04	0 - 5.0
Sort/layout	21 (44%)	1.23	1.61	0 - 5.0
Sequential touching	19 (40%)	0.95	1.50	0 - 5.5
What	48 (100%)	10.96	5.40	2.0 - 24
Label	48 (100%)	8.60	2.65	3.0 - 12.0
Repeated single label	48 (100%)	5.04	4.47	1.0 - 19.0
Repeated categorically	24 (50%)	1.14	2.03	0 - 12.0
Category naming	32 (67%)	1.84	2.40	0 - 10.0
Description	44 (92%)	2.16	1.41	0 - 6.0
Association single	46 (96%)	6.25	3.48	0 - 13.5
Association multiple	15 (31%)	0.51	1.03	0 - 4.5
Test	5 (10%)	0.15	0.47	0 - 2.0
Task goal	22 (46%)	0.47	0.61	0 - 2.0
Recall period				
Spatial reminder	5 (10%)	0.36	1.25	0 - 6.0
General prompt	48 (100%)	5.84	3.37	0.5 - 14.5
Category-level probe	25 (52%)	0.85	1.07	0 - 3.0
Item-level probe	17 (35%)	1.52	2.60	0 - 10.0

Table 2
Correlations between Mothers' Strategies at the Study Period and Children's Recall Both without and with Study Time Controlled

<i>Maternal behavior</i>	<i>Children's recall</i>	<i>Children's recall (Partialed with Study Time)</i>
Stack	-.39**	-.33*
Sort/layout	.33*	.25
Sequential touching	.48**	.43**
Repeated categorically	.32*	.27
Category naming	.56**	.52**
Task goal	.41**	.38*

*
 $p < .05$

**
 $p < .01$

Table 3
Inter-correlations among Maternal Behaviors during the Study Period

Maternal Behaviors	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Stack	-												
2. Layout		-											
3. Sort/stack		-.32*											
4. Sort/layout			-										
5. Sequential touching													
6. What													
7. Label													
8. Repeated single label													
9. Repeated categorically													
10. Category naming													
11. Description													
12. Association multiple													
13. Task goal													

Note. Only significant correlations are reported. Two strategies, association single and test, are not included in the table because they did not show significant correlations with any other strategies.

*
 $p < .05$

**
 $p < .01$

Table 4
Factors Derived from an Exploratory Factor Analyses of Maternal Behavior during the Study Period

<i>Factor label</i>	<i>Eigenvalue</i>	<i>% Variance</i>	<i>Variables Loading and Loading Value</i>
Factor 1: Explicit Organizational Strategies	3.52	23.47	Stack (-.88) Sort/layout (.84) Sequential touching (.87) Category naming (.64) Repeated categorically (.54)
Factor 2	1.85	12.35	What (.87)
Factor 3	1.58	10.55	Association multiple (.85) Task goal (.79)
Factor 4	1.49	9.92	Repeated single label (.85) Label (.71)
Factor 5	1.15	7.66	Sort/stack (.92)
Factor 6	1.13	7.51	Association single (.90) Description (.40) Test (-.43)
Factor 7	1.04	6.96	Layout (.96)

Table 5
Regression Models Predicting Children's Recall from the Factors of Maternal Strategies during the Study Period

<i>Predictor</i>	<i>B</i>	<i>SE B</i>	<i>β</i>	<i>F</i>
Step 1				
Gender	1.61	0.73	.31 *	4.87 *
Step 2				
Gender	1.23	0.68	.24	
Factor 1	1.34	0.31	.51 **	
Factor 2	-0.43	0.32	-.16	
Factor 3	0.43	0.33	.16	
Factor 4	-0.26	0.32	-.10	
Factor 5	-0.34	0.31	-.13	
Factor 6	-0.34	0.32	-.13	
Factor 7	-0.07	0.32	-.03	3.91 **

Note. $R^2 = .10$ for Step 1; $\Delta R^2 = .35$ for Step 2 ($ps < .05$).

*
 $p < .05$

**
 $p < .01$

Table 6
Correlations between Mothers' Strategies at Recall Period and Children's Recall Both Without and With Recall Time Controlled

<i>Maternal Behavior</i>	<i>Children's recall</i>	<i>Children's recall (Partialed with Recall Time)</i>
General prompt	-.33 [*]	-.36 [*]
Spatial reminder	.48 ^{**}	.44 [*]
Category-level probe	.62 ^{**}	.32 [*]
Item-level probe	.55 ^{**}	.30 [*]

^{*}
 $p < .05$

^{**}
 $p < .01$

Table 7
Regression Models Predicting Children's Recall from Maternal Recall Strategies

<i>Predictor</i>	<i>B</i>	<i>SE B</i>	<i>β</i>	<i>F</i>
Step 1				
Gender	1.60	0.73	.31 [*]	4.87 [*]
Step 2				
Gender	0.71	0.59	.14	
Spatial reminder	0.46	0.26	.22	
General prompt	-0.10	0.10	-.13	
Category-level probe	1.05	0.38	.43 ^{**}	
Item-level probe	0.10	0.17	.09	8.57 ^{**}

Note. $R^2 = .10$ for Step 1; $\Delta R^2 = .41$ for Step 2 ($ps < .05$).

*
 $p < .05$

**
 $p < .01$

Table 8
Regression Models Predicting Children's Recall from Maternal Study and Recall Strategies

<i>Predictor</i>	<i>B</i>	<i>SE B</i>	<i>β</i>	<i>F</i>
Step 1				
Gender	1.61	0.73	.31 [*]	4.87 [*]
Step 2				
Gender	1.56	0.63	.30 [*]	
Factor 1	1.33	0.32	.51 ^{**}	12.25 ^{**}
Step 3				
Gender	1.08	0.60	.21	
Factor 1	0.75	0.34	.27 [*]	
Category-level probe	1.03	0.33	.42 ^{**}	12.95 ^{**}

Note. $R^2 = .10$ for Step 1; $\Delta R^2 = .26$ for Step 2; $\Delta R^2 = .12$ for Step 3 ($ps < .05$).

*
 $p < .05$

**
 $p < .01$