STRATEGY DEVELOPMENT AND THE ROLE OF LANGUAGE

by

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Abstract

This study investigated the role of language in the frequency and nature of preschool children's memory strategies. Twenty children, aged 18-33 months, were observed during a memory-for-location task for their use of potentially strategic behaviors. Each child accompanied the researcher while she hid a stuffed toy in a natural location (e.g., under a pillow). The children were told to remember the toy's location, in order to retrieve the toy when a bell rang after a delay of 3 minutes. During the delay interval, six behaviors occurred: looking, pointing, approaching, attempting to retrieve, peeking, and verbalizations. These behaviors could be used by the child in order to aid their memory of the hiding place. A control trial was also included and was like the experimental trial in all respects except that the toy remained visible during the delay interval. Frequencies of the target behaviors were compared among themselves and also were correlated with scores on two standardized language measures. There were three main findings, (1) these young preschool children produced more of the target behaviors when memory was required than when it was not, (2) non-verbal strategies were used more often than verbal ones, and (3) verbal proficiency predicted the use of memory strategies. Post-hoc tests indicated that children who had more advanced language skills were less likely to use overt memory strategies but, as the task progressed, children who earned higher percentile scores on the language tests talked more during the experiment. These results are consistent with developmental theories that emphasize the initial cost of using memory strategies to solve a problem and the constraints inherent in low language knowledge. They also point to the importance of attending to non-verbal behaviors when evaluating cognitive skills in very young children.

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Chapter 1: Introduction

A wide body of literature shows that children's performance on memory tasks improves with age. Over the last forty years, developmental research has shown that most of the age related improvement is due, not to changes in memory processes per se, but to changes in content familiarity and the use of memory strategies (Bjorklund & Douglas, 1997; Flavell, 2002). A great deal of the research on memory strategies has focused on school-aged children, with a small body of literature investigating the possibility of earlier competencies with preschool children. Results from early studies concluded that young children were astrategic but, most researchers now agree that children demonstrate mnemonic competencies earlier than was initially thought.

While many advances have been made in understanding the types of strategies children use at different ages, the literature has been less revealing about how children are able to use memory strategies. For example, much less is known about how language proficiency affects memory strategy use and whether or not developmental priorities must be met before verbal memory strategies will occur. Further, it is not entirely clear whether preschool children use mostly non-verbal strategies, verbal ones, or some combination of both. Due to the complexity of the language system, verbal strategies may be later to emerge or to be effective. On the other hand, given the relative simplicity of the language forms needed for some memory tasks, verbal strategies may quickly become the dominant choice, if language is available.

1.1 Memory Strategies Defined

Currently, most researchers agree that memory strategies are (1) potentially conscious cognitive or behavioral activities (2) occurring in addition to the natural consequences of carrying out a task, are (3) under deliberate control and (4) employed in an effort to enhance memory performance (Naus & Ornstein, 1983, Pressley, Forrest-Pressley, Elliot-Faust, & Miller's, 1985). Memory strategies are developmental in nature and children use memory strategies during memory processes such as encoding, storing, and retrieving information. Two memory strategies that have received a great deal of attention in the literature are rehearsal and organization. Rehearsal refers to the repetition of information, whereas organization refers to the combination of target items into categories. School-aged children have demonstrated clear competencies with both of these memory strategies. For example, 7 and 10-year-olds readily engaged in verbal rehearsal when learning serial lists of words (Schneider & Pressley, 1997). In another study, second and fourth graders used organization during a categorical sorting task involving recall (Schneider, 1986). In general, developmental changes in memory strategies are exemplified by the refinement of existing strategies, the acquisition of new strategies, the application of existing strategies in different environments, and the use of strategies in conjunction with others (Siegler & Alibali, 2005).

1.2 A Brief History and Introduction to the Study of Memory Strategies

In the late 1960's theoretical frameworks and research methodology surrounding the study of memory development underwent a significant change that subsequently altered the way memory strategies were studied in young children. The shift in thinking was largely due to the explanatory limitations of the neo-behaviorist's stimulus-response approach to studying memory as well as conflicting results from studies investigating memory strategies in young

children. Early work in the area of strategy development had raised doubts about the existence of memory strategies in preschool children. In these initial studies, preschool children showed little evidence of independent and deliberate strategic behavior. In fact, the apparent lack of memory strategy use by preschool children was used as evidence to demonstrate that school-aged children were able to engage in memory strategies (Schneider & Pressley, 1997). As explanatory limitations prevailed, cognitively based memory models soon dominated the field and the modern era of memory development research was born (Schneider & Pressley, 1997).

As new studies emerged from the new cognitive paradigm evidence in favor of preschool children's strategic competencies in certain environments and with specific tasks became apparent. For example, Somerville, Wellman, & Cultice (1983) investigated children's prospective memory strategies through their ability to plan for a particular event at a specific time in the future. The events were either interesting (e.g., getting candy) or less interesting (e.g., getting the clothes out of the washing machine). Results showed that both the two and four year-old children remembered the more interesting event, suggesting that preschool children are capable of intentional memory when the event to be remembered is an interesting one. In another study, preschool children were asked either to play with a group of toys, or to remember a subset of the group for later recall. The children asked to remember the toys engaged in behaviors that were different from the children in the other group, in that they seemed to serve the goal of remembering. For example, children in the 'memory condition' did not 'play' with the toys, but engaged in purposeful activities, such as verbally naming the objects, visually scanning the objects, and leaving time unfilled, possibly to rehearse the stimuli (Baker-Ward, Ornstein, & Holden, 1984). These authors suggested that "significant advances in the development of memory strategies" occur "prior to the time at which children can be

identified as producers of such generally recognized and studied strategies as rehearsal and organization" (Baker-Ward et. al., 1983, p.574, for excellent reviews, see Pressley, Borkwski, & Schneider, 1987; Schneider & Pressley, 1997). The growing body of evidence in favor of preschool children's strategic abilities suggested that the developmental picture needed to be questioned. Thus, further research in the area of memory strategies was legitimized.

1.3 Tasks used to study memory strategies in preschool children

Task parameters were one clear area of difficulty and apparently had contributed to conflicting results in the early literature. For example, tasks from verbal memory studies in adults such as paired association and list memorization were also used to study memory strategies in preschool children. Although these tasks had been effective at eliciting rehearsal and organization in adults, they did not yield the same results with preschool children. In fact, the results from studies using adult-oriented tasks to study memory strategies in preschool children clearly showed what preschool children were not capable of doing, but provided little information about the strategic competencies present in this population (Schneider & Pressley, 1997). It was reasoned that preschool children should not be considered astrategic based solely on findings from studies that had used inappropriate tasks and a research paradigm that equated memory strategy use with adult-like manifestations of the behavior (Baker-Ward, Ornstein, Holden, 1984).

Modern research paradigms investigating memory strategies in preschool children have been closely tied to the strategy in question and have included: retrieval of hidden objects, memory-for-events, and memory-for-objects, with the specific tasks often being adaptations of methods used to study memory in infants (Schneider & Pressley, 1997). The tasks were designed to be simple, motivating, and naturalistic. For example, in a laboratory setting, a

'delayed reaction' or 'hide-and-seek' task was used to study memory strategies (DeLoache, 1984). In this paradigm, the child is asked to remember the location of a hidden object and then find it at the end of a delay interval. Studies using tasks such as these showed that preschool children are capable of using memory strategies and the age at which these behaviors emerge is developmentally earlier than was first thought (Ritter, Kaprove, Fitch & Flavell, 1973; Geis & Lange, 1976; Schneider & Sodian, 1988; Schneider & Pressley, 1997).

1.4 Are Preschool Children Truly Strategic?

Several studies have shown that preschool children do in fact use methods to aid memory; however, it has been questioned as to whether it is appropriate to label these behaviors as strategic. Given that preschool children tend to engage in memory strategies that are often different in nature from those observed in school-aged children, it is not surprising that this is the case. For example, preschool children point to, look at, and verbally label objects to aid later recall, whereas school-aged children engage in more sophisticated memory strategies such as rehearsal and organization. However, it would be shortsighted to conclude that preschool children are astrategic for three reasons. Firstly, research has shown that preschool children do engage in intentional behaviors aimed at remembering, although they tend to be simple and sometimes ineffective. For example, when engaged in a memory task, preschool children tried to avoid being distracted in order to remember as much as possible during the delay interval (Yussen, 1974). In another study, children touched one object in order to distinguish it as the one to be remembered and they engaged in this behavior while the other objects were present (Wellman, Ritter, & Flavell, 1975). One example of preschool children using an ineffective strategy comes from Heisel and Ritter's (1981) study in which children were asked to hide an object in a container so that they could find it at the end of a delay

period. The youngest children in the study hid the object in the same location from one trial to the next whereas older children hid the object based on spatial location. While the younger children in the study did use a simple memory strategy, it proved to be ineffective, because it did not aid their recall. When a child does not benefit from spontaneous and intentional use of memory strategies they are said to have a utilization deficiency (Wellman, 1988; Miller, 1990). Therefore, although simple and perhaps ineffective, these studies indicate that preschool children do engage in behaviors during memory tasks that seem to be oriented to the goal of remembering.

Secondly, research has shown that preschool children benefit from being prompted or taught to use a memory strategy. When a child does not spontaneously engage in a memory strategy but does experience benefit from being taught or prompted to use a memory strategy, they are said to be production deficient (Flavell, 1970). For example, kindergarten children were given a list of words to remember and during the task some children engaged in verbal rehearsal of the word list, thereby orally repeating the list of words, whereas others did not. The children who did not spontaneously use a memory strategy were taught the verbal rehearsal strategy and later re-tested. The results showed that children do benefit from being taught a memory strategy since memory performance improved for those children who did not at first spontaneously use the verbal rehearsal memory strategy (see Keeney, Cannizzo, & Flavell, 1967; Moely, Olsen, Halwes, & Flavell, 1969).

Thirdly, several studies have provided evidence to support the notion that successful strategy use by preschoolers appears to occur most often in highly obvious and relevant situations and depends, at least partially, on the type of task used to elicit memory strategies. For example, when the memory task is simple, it appears that preschool children do show

deliberate behavior aimed at remembering, whereas when the task is complex, preschool children tend to use fewer memory strategies. Using a simple hide-and-seek task, DeLoache, Cassidy & Brown (1985) conducted what is now regarded as a landmark study in the memory strategy literature. Preschool children, between the ages of 18-23 months, watched as the experimenter hid a stuffed toy (e.g., "Big Bird") in a natural location (e.g., under a cushion). The children participated in a total of four memory conditions and were told to remember the toy's location for later retrieval. After the toy was hidden, and while playing an unrelated game with the researcher, the children engaged in various behaviors, which seemed to aid their memory of where the toy was hidden. For instance, they looked at, pointed to, and approached the toy's hiding place. Such behaviors occurring during the delay interval were interpreted as deliberate and intentional acts that served as memory strategies for the child. Some children also made verbalizations about the hidden toy during the delay interval, which seemed to be attempts at keeping the information about location alive in short-term memory, rather than just incidental comments about the toy (Flavell, 2002). Interestingly, the children in this study verbalized about the hidden toy more often than using other non-verbal behaviors, such as pointing. A second group of children engaged in ten trials of the memory-for-location task, divided evenly across two days of testing, with one day taking place in the lab and one day taking place in the child's home. The results showed that the use of memory strategies declined over time suggesting that as children gain experience with the task fewer memory strategies are needed. Finally, a third group of children engaged in the same task with two important exceptions - the toy either remained visible for the duration of the delay interval, or the experimenter retrieved the toy at the end of the delay interval. In two of these conditions the children were not instructed to 'remember'. These groups of children served as control

conditions since the demand of remembering the toy's hiding place was removed by either having the toy remain visible or having the experimenter retrieve the toy. Children used significantly fewer memory strategies in these conditions than in conditions in which they truly needed to remember the location of the toy. Thus, although the memory behavior of preschool children tends to be fragile and employed in a limited number of environments it is strategic nonetheless (Bjorklund & Douglas, 1997).

1.5 Factors that influence memory strategies

Several factors appear to influence the use of memory strategies. Two of those factors are efficiency of processing and the knowledge base (Bjorklund & Douglas, 1997). Memory strategies are effortful mental processes that draw upon the limited information processing capacity of working memory. Research has shown that these mental resources are affected by age. For example, Bjorklund (1987) found that older children used more memory strategies than younger children. Bjorklund (1987) concluded that the younger children had less capacity available for processing memory strategies than the older children, thereby leading to lower frequencies of memory strategies. Thus, older children are more efficient at using their working memory in the service of completing the demands of the task as well as engaging in the use of memory strategies.

The knowledge base is another factor that influences the use of memory strategies and is related to efficiency of processing. The knowledge base refers to the background knowledge that a child has about a particular event or activity (Bjorklund & Douglas, 1997). As the knowledge base expands, changes in the efficiency of processing are also realized. However, functional gains in the capacity of working memory are not due to actual increases in capacity rather, an elaborate knowledge base allows for more efficient processing of information within

the knowledge base (Bjorklund & Douglas, 1997). Typically, knowledge base has been examined within the context of the memory task. The now classic example is the study investigating memory span conducted with novice and expert chess players (Chi, 1978). Both the novice and the expert chess players were instructed to remember the spatial locations of chess pieces on a chessboard for later recall. The results showed that expert chess players had better recall compared to the novice chess players. Chi (1978) concluded that the expert chess players did not in fact have a greater memory span compared to novices, rather it was their level of experience with the task that positively affected their ability to process and recall information related to chess (Chi, 1978). Siegler and Alibali (2005) expanded on these findings, suggesting that memory strategies are observed when a child has experience with the task, due to the limited capacity of information processing in working memory. According to these authors, experience with a particular task will free up the resources necessary for using a memory strategy.

Although, preschool children have proven to be capable of using memory strategies in certain environments and with certain tasks it is important to remember that a number of factors, such as efficiency of processing and the knowledge base influence their behavior. As mentioned above, the effect of language proficiency on memory strategies has not been studied and could potentially be another knowledge base that affects the use of memory strategies.

1.6 Current Thinking about Memory Strategies

Research over the past 20 years has significantly changed the field of memory strategy development and many advances have been made. Theories that portray memory strategy development as non-linear, continuous, and highly variable have replaced ones that depicted memory strategies as static and stage-like. Research has shown that strategy development is

non-linear, in that specific strategies do not follow an invariant developmental sequence. For example, a child may suddenly stall in their development of strategies for no apparent reason and then begin again, or a child may regress, meaning a strategy that was once non-effortful now requires more mental resources. Strategy development is also continuous and does not end with emergence of a strategy (Flavell, 2002). The strategies that children use are continually changing and although they may become proficient at using a specific strategy, the development of additional strategies will not halt as a result. For example, young children use a variety of memory strategies during a given task and even change strategies from trial to trial. Finally, research has shown that memory strategies are affected by factors such as efficiency of processing aw well as the knowledge base, and are highly variable both within and between individuals. This variability is reflected in the number of strategies a child uses per trial (Flavell, 2002), the number of times a child changes strategies from trial to trial (Coyle & Bjorklund, 1997), and the types of strategies a child uses on any given trial.

1.7 The Current Project

Although there have been investigations into the development and use of memory strategies in preschool children the majority of studies have focused on school-aged children and adults. Yet, preschool children have been shown to engage in deliberate behavior during memory tasks and some researchers have suggested that this behavior is indeed strategic (DeLoache et al. 1985, Bjorklund & Douglas, 1997). For example, during a memory-for-location task DeLoache et al. (1985) found that preschool children engaged in target behaviors more often when the task required memory than when it did not, with verbal behaviors being used more frequently than non-verbal ones. However, despite the acknowledgement that preschool children do engage in specific behaviors based on whether the task is one that

requires memory, some researchers do not feel comfortable labeling these behaviors as strategic. In addition, research has shown that several factors affect the use of memory strategies, such as efficiency of processing and the knowledge base but, research has not investigated language in this regard. Thus, although there have been investigations into how children go about using memory strategies several questions have been left unasnwered. The current study aims to investigate preschool children's strategic competancies and to determine whether or not language could be considered another factor affecting the use of memory strategies.

The two sets of questions to be addressed in this study concern (1) the frequency and nature of memory strategies and (2) the role of language proficiency in the use of memory strategies and in particular, verbal memory strategies. The study will first attempt to replicate the DeLoache et al. (1985) findings that preschool children do intentionally engage in memory strategies when instructed to remember the location of a hidden toy and that these behaviors tend to be verbal in nature. The study will then look for associations between performance on the memory task and scores on the language measures. Although this study will use the DeLoache et al. (1985) basic paradigm it will differ in one important respect. Instead of using a between subjects design whereby each child participated in either the memory condition or the non–memory condition, children in the current study will participate in both conditions and comparisons will be made within child to provide a more rigorous test of the effect.

The first set of questions concern the frequency and nature of potentially strategic behavior seen in preschool children. Are preschool children capable of independent and deliberate use of memory strategies? And, what types of potentially strategic behaviors occur and at what frequency? If preschool children are capable of distinguishing between the memory

and non-memory conditions, then instances of potentially strategic behavior should be higher in conditions that require remembering than in those that do not.

The second set of questions to be addressed in this study concern the relationship between language and potentially strategic behavior. Is the frequency and nature of potentially strategic behavior seen in preschool children related in some way to their language proficiency? It was hypothesized that children with high language proficiency should preferentially use verbal memory strategies, whereas children with low language proficiency should use fewer verbal memory strategies.

Chapter 2: Methodology

The current project was designed to investigate the role of language in the use of memory strategies with young preschool children. To investigate these possibilities preschool children between the ages of 18-33 months were asked to participate in two memory-for-location conditions separated by one non-memory condition as well as participate in standardized measures of non-verbal cognition and language: the Mullen Developmental Scales (1995) and the MacArthur Communicative Development Inventory: Words and Sentences (CDI) (1992). The tasks took place in either the child's daycare or a lab at the University of British Columbia (UBC) and included a delay period during which the child played interesting, but unrelated, games with the researcher in the middle of the room. Scores from the non-verbal cognition and language scales were compared to the total number and type of potentially strategic behavior(s) observed during the delay intervals to explore possible constraining or facilitating effects. There were three reasons for this methodological decision. First, a group of studies by DeLoache and her colleagues have shown that a preschool child's ability to find a hidden toy is stable and robust in different environments and throughout a variety of delay intervals. For example, children tested in their own home and in the lab were able to find a hidden toy during both conditions, independent of the delay interval that lasted between seconds and days (see DeLoache et al., 1985). Secondly, DeLoache and her colleagues have established that children engage in memory strategies more frequently when the demand to remember falls upon the child rather than the researcher. Thus, to investigate intentional memory in this study children were asked to remember the location of the hidden toy in conditions one and three, but in condition two, the toy remained visible throughout the delay and the researcher retrieved it at the end of the interval. Thirdly, verbal language typically

begins to emerge at about 12 months of age therefore typical children between 18-33 months should have some use of verbal language. Furthermore, preschool children have been shown to engage in both oral verbal and non-verbal memory strategies during highly interesting and comprehensible tasks (DeLoache et al. 1985). Thus, the memory-for-location task seemed to be an appropriate one, with which to investigate memory strategies in preschool children, and in particular verbal memory strategies, in conjunction with the child's language profile and general developmental profile.

2.1 Participants

Twenty children (N=20), aged 18-33 months, took part in this study. Participants were recruited from daycares located at the University of British Columbia (UBC) (12 children) and through word of mouth (8 children). For the children at UBC daycares, a letter was sent to the parents, describing the study and asking parents to consent to have their child participate. Eighty-four letters were distributed to six different daycares. Staff members were asked to give the letter to parents of children 18-36 months of age. For the children recruited through word of mouth, an email or telephone call was initiated by the parents indicating an interest or willingness to participate in the study. These parents were then provided with the same documents as described above. Twenty-two consent forms were returned indicating a willingness to participate, and of these one withdrew before beginning the study and one moved out of the area.

All children underwent assessment of non-verbal cognition and language skills to determine whether or not they met the criteria for inclusion. In order to participate in the study each child was required to demonstrate that they were functioning between 18-36 months of age in both non-verbal cognitive tasks and language tasks presented in English. They were also

required to have normal or normal-when-corrected, vision and hearing. All of the children who were tested met these criteria and went on to complete the experimental task. Although none of the children had a history of speech-language or other learning difficulties, language testing done during this study indicated that three children fell into the group of "Late Talkers" (Paul, 1993), with an approximate 50% likelihood of continuing language-learning difficulties. In addition, none of the children wore hearing aids and four were from multilingual families.

2.2 Procedures

Each child was seen for two, 40 minute sessions. During the first session, language and non-verbal cognitive assessments were completed using the Mullen Scales of Early Learning (1995) and the MacArthur-Bates Communicative Development Inventory: Words and Sentences (1992) (the McArthur). During the second session, participants joined the researcher in a game of hide-and-seek with a stuffed toy. All children participated in the same tasks in order listed.

2.3 Language and Developmental Assessment Tools

The Mullen Scales of Early Learning (1995) (the Mullen) is a comprehensive measure of cognition and is used to assess infants and children from birth to 68 months. It focuses on a child's abilities in a variety of domains. These domains are broken into five scales: visual reception, fine motor, gross motor, receptive language, and expressive language. Additionally, it is important to note that the language subtests on the Mullen are predominately lexical in nature. In general, this measure was chosen because it provides both global and domain-specific views of a child's non-verbal cognitive skills and language skills in the desired age range for this study (18-36 months).

The MacArthur CDI: Words and Sentences (1992) (the MacArthur) is a widely used, parental report of a child's current production of words and sentences. The toddler scale may be used with children between 16 and 37 months of age. Part I of the scale includes a 680-word vocabulary production checklist, whereas Part II deals solely with production of sentences and grammar. This measure was chosen because it provides an efficient and reliable measure of a child's language production. For example, test re-test reliability measures for the toddler scale "exceeded 0.9 at each monthly level for vocabulary production" (Fenson et. al, 1992 p. 68). In addition, the MacArthur (1992) was chosen because it may demonstrate a child's language ability more readily when the child is unfamiliar with the researcher.

2.4 Experimental Task

The experimental task took place in a quiet room at the child's daycare or in a laboratory at UBC, both of which were furnished with the same type of furniture and accessories (e.g., chair, table, and rug). The experimental task used in this study closely resembles the memory-for-location task used in DeLoache et al. (1985). In DeLoache et al. (1985) five consecutive memory trials were separated by a 3-minute delay interval whereas, in the current study there were two memory trials, which involved asking each child to remember the hiding place of a stuffed toy, after a 3-minute time delay. Between these two trials there was one non-memory trial in which the stuffed toy remained visible during the delay interval. In addition, the current study used a within subject design to investigate the effects of the experimental task whereas DeLoache et al. (1985) used a between subject design.

2.5 Training Phase

At the beginning of session two, each child participated in either one or two trials of a game involving gross motor movements, designed to familiarize him/her with the sound of the

timer that was used to track the delay interval and the idea of doing something after hearing the bell ring. For example, the participants were told to clap their hands when they heard the bell ring. Children who had difficulty following the directions during the game were given another opportunity. Two children required extra training and played the game for a second time.

2.6 Materials Selection

Each child was shown three stuffed toys and was asked to choose one. The children were monitored for engagement and interest with the toy that they chose and were allowed a one-time switch to a different toy that was more interesting to them. Two children in the study switched toys between the experimental trials. Otherwise, each child chose one toy that served as the stimulus for all three trials of the experimental task. The remaining stuffed toys were put into a bag and out of the child's direct view. Following these preliminary steps, the experimenter and child proceeded to the experimental task itself.

2.7 Memory Trials

The experimental task consisted of three trials, two "memory trials" separated by one "non-memory trial". During the memory trials, the child accompanied the researcher to the toy's hiding place and watched as it was hidden. All participants were directed as follows: "Elmo (or the toy that they chose) is going to hide; remember where he is and when the bell rings you can find him". The researcher always called attention to the act of hiding the toy, but did not name the hiding place (e.g., "Look, Elmo is hiding here"). The child then returned to the middle of the room and played a modestly engaging activity, such as completing a puzzle, with the researcher for the duration of the delay interval. A bell signaled the end of the delay interval, at which time the child was permitted to find the toy. If the child did not begin to search for the toy when the bell rang, she/he was prompted by the researcher to do so (e.g.,

"where's Elmo? go find him."). If at first the child failed to find the hidden toy then he/she was encouraged to continue looking or was given hints to find it (e.g., "I think he's over there"). During the memory trials the stuffed toy was hidden either under a pillow, inside a backpack, or behind a chair. The hiding locations were counterbalanced across participants and trials.

During the delay interval, participants were kept from hovering over the location where the toy was hidden or actually retrieving the toy before the bell rang. If a child was hovering around the location for an extended period of time or was attempting to retrieve the toy before the end of the delay period, he/she was invited back to the middle of the room to continue to play with other toys for the remainder of the delay interval. The child was, however, permitted to approach the vicinity of the hidden toy or take a peek at the toy, and then return to play with the researcher.

2.8 Non-Memory Trials

The "non-memory" or "nap" condition aimed to investigate whether potentially strategic behaviors observed in the search trials were memory specific, by seeing if children engaged in these behaviors significantly more when the toy was hidden than when it was not. During the "non-memory" condition the toy remained visible throughout the delay interval. The experimenter told the participants: "Elmo needs to take a nap now; I'll wake him up when the bell rings." The toy was then placed in one of the locations used during the "memory" trials, but was visible to the child (e.g., on the pillow instead of under the pillow). When the bell rang at the end of the delay interval the experimenter retrieved the toy.

2.9 Data Analysis

Each session was video-recorded for later analysis. In addition, a second observer was present and hand scored all strategic behavior as it occurred. The second observer was present in case the child went out of the camera's angle of focus and also provided data for inter-rater reliability.

2.10 Coding of Strategic Behavior

The chief focus of this study was on intentional behaviors that appear to support working memory. Following DeLoache et al. (1985), six types of behavior were coded from the videotapes: pointing, looking, approaching, peeking, attempting to retrieve, and verbalizing. These behaviors were operationalized as follows:

Pointing	child extends arm and/or finger in direction of hidden toy.
Looking	child turns head and looks in the direction of hidden toy for a period of at least 2-seconds.
Approaching	child moves towards hidden toy, but not close enough to actually retrieve.
Peeking	child has a shift in gaze or brief head movement in direction of toy while in the vicinity of the toy.
Attempting	child moves towards the hidden toy, close enough that retrieval would be possible if not interrupted by researcher.
Verbalization	child makes a comprehensible comment about the hidden toy or some verbalization in conjunction with another target behavior.

DeLoache et al. (1985) coded individual target behaviors that occurred in rapid succession or simultaneously as episodes as well as individually. For example, "if a child looked toward the hiding place and said "Big Bird" then went back to coloring, then looked toward it again and pointed to it, his/her individual target behavior score for that trial was four, but two episodes" (DeLoache et al. 1985, p.128). In the current study, if target behaviors occurred sequentially, even if in close proximity, the behaviors were coded separately. Some behaviors, such as approaching, attempting to retrieve, and peeking were not dually coded with looking although looking occurred naturally at the same time. Looking was not coded in this instance since it was not seen as an additional intentional act of remembering; rather it was seen as a natural by-product of the action. All of the behaviors that occurred during the delay interval, for both the "memory" and "non-memory" conditions, were coded and counted, yielding eighteen raw frequency scores for each child.

2.11 Inter-rater Reliability

The researcher and a second observer, both of them advanced graduate students in speech-language pathology with training in observational assessments, independently coded 15 of the videotapes. The level of agreement between the two observers was 97% for the target behaviors. Discrepancies in coding occurred for only one child and were due to coding error. Review of the tape resolved the disagreements.

Chapter 3: Results

The purpose of this study was to explore the early use of language in young preschool children's behavior during a memory-for-location task. First, the study aimed to investigate the frequency and nature of potentially strategic behaviors, attempting to replicate the DeLoache et al. (1985) findings that preschool children engage in memory strategies during a memory-for-location task and that they use verbal strategies more frequently than other types. Secondly, the study aimed to investigate the possible relationships between language proficiency and potentially strategic behaviors, in particular verbal behaviors.

In order to answer the first research question, Analysis of Variance (ANOVA) procedures were used to examine differences in the occurrence of the various types of potentially strategic behaviors, overall and in each of the three conditions. To answer the second question, each participant's performance on verbal and non-verbal standardized tests was correlated with his/her performance on the experimental tasks.

3.1 Frequency and Nature of Potentially Strategic Behavior

The first set of analyses was designed to investigate the frequency and nature of potentially strategic behaviors during a memory-for-location task. All of the participant's raw scores for each strategy type in each condition were used to calculate means and standard deviations and these values appear in Table 3.1.

Table 3.1 Means and standard deviations (SD) by condition for 6 individual target behaviors, oral non-verbal behaviors, and all target behaviors combined

	Conditions			
Behaviors	C1 (memory)	C2 (non-memory)	C3 (memory)	Combined
Pointing	0.55 (1.14)	0.50 (1.23)	0.45 (0.60)	1.65 (2.80)
Looking	1.55 (1.70)	1.15 (1.26)	1.35 (1.22)	4.05 (2.80)
Approaching	0.45 (0.88)	0.05 (0.22)	0.85 (1.13)	1.35 (1.50)
Peeking	0.25 (0.55)	0.10 (0.44)	0.50 (0.82)	0.85 (1.18)
Attempt to Retrieve	0.10 (0.44)	0.10 (0.30)	0.15 (0.36)	0.35 (0.81)
Verbalization	0.70 (1.17)	0.65 (1.66)	0.60 (0.75)	1.95 (2.54)
Non-Verbal Combined	2.9 (3.25)	1.9 (2.47)	3.3 (2.77)	8.25 (5.86)
Combined	3.65 (3.87)	2.55 (4.07)	3.90 (3.18)	

These results indicate that the highest frequency of potentially strategic behaviors occurred in the 'memory conditions' as opposed to the 'non-memory' condition, with both condition one (C1) and condition three (C3) showing high rates of potentially strategic (M = 3.6 and M = 3.9, respectively). Condition 2 (C2) had a lower rate of potentially strategic behaviors with a combined mean of 2.55. Across conditions, looking, verbalizing, and pointing were the most frequently occurring behaviors.

Post-hoc examination of the data indicated an interesting trend pertaining to the co-occurrence of potentially strategic behaviors. A potentially strategic behavior was said to co-occur with another if the second behavior was observed within three seconds of the first. For example, verbalizations occurring within 3 seconds of looking were judged to co-occur with looking. Verbalizations co-occurred most frequently with looking, accounting for 32.2% of

total looking behavior in C1, 47.9% in C2 and 14.8% in C3. Verbalizations infrequently accompanied other non-verbal behaviors but, when this was the case, more often than not looking was also included in the episode.

The means and standard deviations reported in table 3.1 include some children who did not in fact use any potentially strategic behaviors during one or more of the conditions. Five children in the study used fewer than three potentially strategic behaviors of any type during the three conditions combined. The children ranged in age from 18-33 months. For example, of these five children, one was 18-months-old, one was 24-months-old, one was 28-months-old, one was 30-months-old and the other was 33-months-old and of these children, two had low language scores and two had above average language scores. The means and standard deviations of the potentially strategic behaviors, excluding the responses of those five children, are indicated in table 3.2.

Table 3.2 Means and SD's (excluding five participants) by condition for 6 individual target behaviors, oral non-verbal behaviors, and all target behaviors combined

	Conditions			
Behaviors	C1 (memory)	C2 (non-memory)	C3 (memory)	Combined
Pointing	0.67 (1.29)	0.66 (1.40)	0.60 (0.63)	1.93 (2.43)
Looking	2.00 (1.73)	1.40 (1.35)	1.80 (1.08)	5.27 (2.28)
Approaching	0.60 (0.99)	0.66 (0.26)	1.13 (1.19)	1.73 (1.49)
Peeking	0.26 (0.59)	0.00 (0.00)	0.67 (0.90)	0.93 (1.16)
Attempting to Retrieve	0.13 (0.51)	0.13 (0.35)	0.20 (0.41)	0.47 (0.91)
Verbalization	0.87 (1.30)	0.87 (1.88)	0.80 (0.77)	2.54 (2.70)
Non-verbal combined	3.67 (3.41)	2.27 (2.74)	4.40 (2.29)	10.38 (4.58)
Combined	4.53 (4.01)	3.13 (4.56)	5.20 (2.54)	

These results also indicate that the highest frequency of potentially strategic behaviors occurred in C1 and C3 (M = 4.53 and M = 5.20, respectively). C2 again had a lower rate of potentially strategic behaviors compared to C1 and C3, with a combined mean of 3.13. Removing those five children who used less than five potentially strategic behaviors resulted in an increase in the overall frequency of each potentially strategic behavior, with the largest increases seen in C3.

Statistical tests were conducted to test the reliability of the above findings. In order to compare verbal and non-verbal behaviors, frequency scores for each of the non-verbal behaviors were combined into a single score for each child. Differences between verbal and non-verbal behaviors as well as differences among the three conditions were investigated using a two-way, repeated measures, ANOVA, Type (2) X Condition (3), with Type (verbal, non-verbal) and Condition (C1, C2, C3) treated within subject. The results of this analysis indicated that the main effect for Type, $F = 34.34$; $df = 1, 19$; $p. < .05$, was significant. Eta^2 for this effect was 0.86 indicating a large effect size. The main effect for Condition however, was not significant, $F = 0.70$; $df = 2, 38$; $p. > .05$. The Type by Condition interaction was also not statistically significant, $F = 2.13$; $df = 2, 38$; $p. > .05$. Although, as is evident in Table 3.1 and 3.2, the use of potentially strategic behaviors in conditions 1-3 trended in the expected direction. Thus, to further explore the interaction of Type and Condition, the ANOVA was repeated without the five children who had used virtually no potentially strategic behaviors. This analysis yielded a statistically significant interaction, $F = 3.06$, $df = 2, 28$; $p. < .05$. Eta^2 for this effect was 0.10, indicating a low effect size. Figure 3.1 shows the total use of verbal and non-verbal behavior in conditions 1-3.

Figure 3.1 The difference between the frequency of verbal (oral) and non-verbal target behavior in conditions 1-3

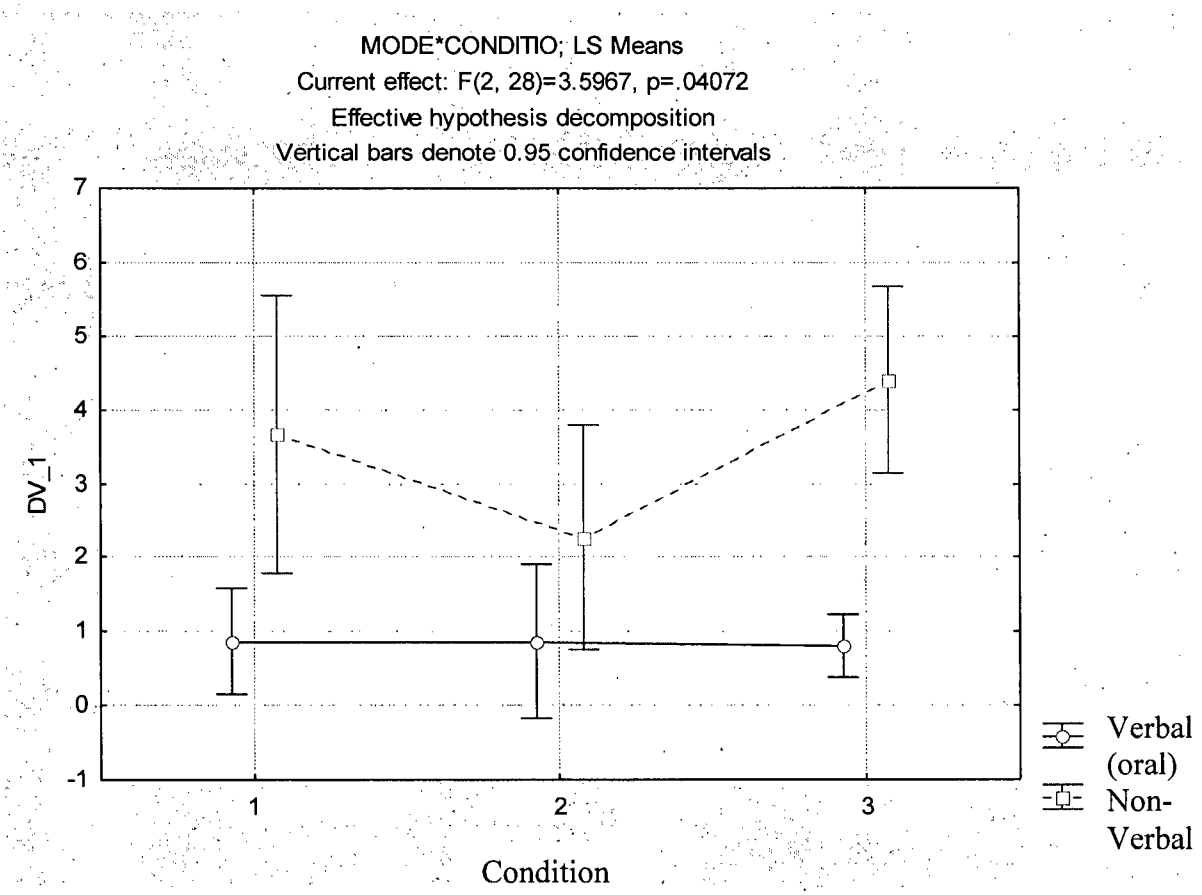

Figure 3.1 shows that the mean frequency of verbal behavior was essentially constant from one condition to the next, while the frequency of non-verbal behaviors varied according to whether circumstances required remembering the location of the toy or not. Post-hoc analysis of the interaction using a Tukey's test indicated the source of the significant interaction. Although there was no difference between the three conditions in the frequency of verbal behaviors, there was a significant difference between the three conditions in the frequency of non-verbal behaviors. A significant increase of non-verbal behaviors compared to verbal behaviors was

evident in C1 and C3 but not in C2. In addition, the difference between C3 and C2 was significant for non-verbal behaviors. The difference between C1 and C2 failed to reach significance but trended in the appropriate direction.

The next analysis was designed post-hoc to investigate possible subgroups within the total sample. Each of the 20 participants was categorized into one of seven different patterns of behavior. If at least three potentially strategic behaviors were used in a given condition, the child was classed as a 'high' strategy user in that condition. If two or fewer potentially strategic behaviors were observed, the child was classed as a 'low' strategy user in that condition. Table 3.3 shows the patterns of individual differences characterized by mean age.

Table 3.3 Seven different patterns of individual differences in the frequency of target behaviors in conditions 1-3

Seven Patterns of Individual Differences			
Group	Use of target behaviors in C1-C2-C3	N	Mean Age
A	high-low-high	4	20.5
B	low-low-high	5	26.8
C	low-low-low	4	28.75
D	high-high-low	2	25.5
E	low-high-high	2	28
F	high-low-low	2	23.5
G	high-high-high	1	18

In Group A, the behavior of four children followed the predicted trend, in that these children used more potentially strategic behaviors when the presence of memory demands was apparent (high-low-high). Group B, consisted of five children who displayed little to no potentially strategic behaviors in C1 and C2 but higher levels of potentially strategic behaviors

in C3 (low-low-high). Group C consisted of four children and was characterized by an overall low use of potentially strategic behaviors (low-low-low). The remaining four groups all had low group membership, with two children in group D, E, and F and one child in group G.

If instead of using absolute performance levels, we look merely at directions of difference, 11 out of the 20 participants fit the hypothesis that memory behaviors should increase in the presence of memory demands. These children used more potentially strategic behaviors during the memory condition (C1 and/or C3) than in the non-memory condition (C2). The remaining nine children in this study did not use more potentially strategic behaviors during the memory conditions. Table 3.4 shows the number of children who followed the predicted trend (Pattern Y) as well as those that did not (Pattern X) and compares the age range and the mean age of both groups.

Table 3.4 Comparisons of two patterns of target behavior in conditions 1-3 characterized by age

Group	Pattern X	Pattern Y (predicted)
N	9	11
Age Range	18-33	18-29
Age Mean	26.6	23.9

The next analysis was designed post-hoc to determine the degree to which the behavior of individual children conformed to the group trend and to identify other possible subgroups within the sample. Each of the 11 children that followed the predicted trend could be further categorized as either increasing or decreasing the amount of potentially strategic behaviors across memory conditions (e.g., increase: C1 = 2, C2 = 1, C3 = 6 or, decrease: C1 = 9, C2 = 1,

C3 = 4). Five of the participants used more potentially strategic behaviors in C1 compared to C3 and another five used more potentially strategic behaviors in C3 compared to C1 (One participant used the same number of potentially strategic behaviors in both C1 and C3).

3.2 The Effects of Language Ability on the use of Potentially Strategic Behaviors

In order to examine the use of potentially strategic behaviors as they relate to language ability, the range, mean, and standard deviations were calculated for both raw scores and percentiles on the Mullen as well as the MacArthur and these figures appear in Table 3.5 and 3.6.

Table 3.5 Summary of the range, mean, and standard deviations for raw scores and percentiles on the Mullen

	Mullen Scales of Early Learning	
	Receptive	Expressive
Percentile Mean	67.65	57
Percentile Range	14 – 98	1 - 96
Percentile Standard Deviation	26.19	31.52
Raw Score Mean	27.05	24.35
Raw Score Range	19 – 35	14 - 37
Raw Score Standard Deviation	4.11	6.44

Table 3.6 Summary of the range, mean, and standard deviations for raw scores and percentiles on the MacArthur

	MacArthur CDI: Words and Sentences	
	Words Produced	Sentence Complexity
Percentile Mean	52.5	50.9
Percentile Range	3 – 97	10 - 95
Percentile Standard Deviation	28.71	28.92
Raw Score Mean	354.75	12.25
Raw Score Range	20 - 673	0 - 37
Raw Score Standard Deviation	242.07	13.23

Raw scores and percentile scores provide two ways to think about language proficiency. The percentile score can be interpreted as a verbal IQ, in that it indicates whether this is a relative strength for the child compared to other children, whereas the raw score is an indication of absolute level of language knowledge. Spearman product moment correlations were then calculated to determine whether verbal proficiency was associated with the use of memory strategies and these values appear in Table 3.7.

Table 3.7 Correlations between subtests of the Mullen, the MacArthur, non-verbal behaviors, (oral) verbal behaviors, and total use of potentially strategic behaviors in conditions 1 and 3.

Variables	C1 total behaviors	C3 total behaviors	C1 verbal behavior	C3 verbal behavior	C1 non-verbal behavior	C3 non-verbal behavior
Mullen Receptive Raw Score	*-0.49	-0.14	-0.17	0.28	*-0.53	-0.26
Mullen Expressive Raw Score	*-0.45	-0.14	-0.14	0.14	*-0.48	-0.18
MacArthur Raw Score	*-0.49	-0.06	-0.18	0.27	*-0.52	-0.12
MacArthur Sentence Complexity Raw Score	-0.35	0.17	-0.11	0.37	-0.38	0.10
Mullen Receptive Percentile	0.01	-0.06	0.06	0.29	-0.01	0.19
Mullen Expressive Percentile	-0.20	0.00	-0.02	0.27	-0.23	0.05
MacArthur Percentile	-0.16	0.13	-0.09	0.43	-0.16	0.05
MacArthur Sentence Complexity Percentile	0.02	0.44	-0.03	*0.59	0.04	0.35

* . Correlation is significant at the 0.05 level (2-tailed).

From these results, it appears that raw scores on the receptive and expressive subtests of the Mullen are moderately correlated with performance on the memory-for-location task in C1. The correlation coefficient is negative, however, indicating that as absolute language level increases there are fewer visible potentially strategic behaviors. A similar relationship was found for MacArthur raw scores and use of potentially strategic behaviors in C1. For the one

part of the MacArthur that covers grammatical knowledge rather than vocabulary, it was the percentile score rather than the raw score that was associated with the use of potentially strategic behaviors. These moderate coefficients indicate that the data are not only reliable but have a moderate degree of relationship and account for between 20-35% of the variance.

Finally, since the preliminary analyses investigating the frequency and nature of potentially strategic behaviors identified different patterns of use, further post-hoc analyses were conducted to determine the possibility of characterizing these groups by language proficiency. Table 3.8 depicts two different patterns of potentially strategic behaviors characterized by language proficiency.

Table 3.8 Comparisons of two patterns of target behaviors in conditions 1-3 characterized by age and language proficiency

Group	Pattern X	Pattern Y (predicted)
N	9	11
Age Range	18-33	18-29
Mean Age	26.6	23.9
Mullen Verbal Composite Score	26.9	22
Mullen Non-verbal Composite Score	28.3	27.9
MacArthur Verbal Composite Score	209	141.1

Further inspection of language proficiency in patterns 'X' and 'Y', suggested that there might be a particular age and period of development where potentially strategic behaviors are most evident. For example, on average children 23 months of age with an average verbal score of 22

showed trends in the expected direction for C1 and C3 whereas the developmentally older children did not.

3.3 Summary of Main Findings

1) The young preschoolers in this study used potentially strategic nonverbal behaviors more frequently when the conditions demanded memory than when they did not. However, this was not true of verbal behaviors.

2) Non-verbal behaviors were used more frequently than verbal ones during the memory-for-location task.

3) Raw language scores were significantly and negatively correlated with the total use of potentially strategic behaviors, whereas percentile scores on one measure of grammatical knowledge were positively correlated.

Chapter 4: Discussion

The purpose of this study was to investigate the nature and frequency of young children's memory strategies and to explore possible facilitating or constraining effects of language proficiency. Previous studies in the memory literature indicate that children as young as 18-months show evidence of memory strategy use during simple tasks. One area that has not been addressed in the literature is the role of language proficiency and how it relates to the use of memory strategies. Participant's scores on verbal and non-verbal standardized tests were compared to the nature and frequency of memory strategies observed during a memory-for-location task. Prior studies had used the memory-for-location task and observed memory strategies, especially verbal ones, in preschool children (DeLoache et al., 1985). This study aimed to reduce the gap in the memory strategy literature by investigating the role of language proficiency and the use of memory strategies in preschool children.

Before we can discuss the primary questions about the nature and frequency of the strategic behaviours, it is important to determine if in fact the targeted behaviours are strategic and whether they have been properly segmented. In order for a behaviour to be considered strategic it must be used independently and deliberately in the presence of memory demands. In the developmental literature, the criteria are typically operationalized by having multiple trials with varying memory demands. For example, Baker-Ward, Ornstein, & Holden (1984) asked children to either play with or memorize a set of stimuli and observed that they used memory strategies only during the memory condition. By 4 years of age children deliberately engaged in memory strategies such as verbally naming and looking at the stimuli in an apparent effort to aid their recall. These results suggested that young children are sensitive to memory demands and that they engage in specific behaviours when memory demands are present.

The current study yielded similar results to those obtained by DeLoache et al. (1985) with regard to young preschool children's use of memory strategies. The data indicate that children, aged 18-33 months, engaged in memory strategies more frequently when memory demands were present. Potentially strategic behaviours were more frequent in C1 and C3 than in C2. And if we look at just those children who exhibited the target behaviours, and only at behaviours that are non-verbal, this difference between conditions is statistically reliable. Note that the present study's finding was tested using a within subject, repeated measures design instead of the between subject design used by previous studies, including DeLoache et al. (1985). Repeated measures designs avoid the difficulties of matching participants and also reduce the size of the error term making effects more likely to be detected. Even though the effect size for the interaction was small, in the context of the larger literature the fact that the target behaviours did reliably decline when the memory demands were removed (C2) would seem to imply intentional strategic behaviour.

A second preliminary issue concerns the problem of segmentation, i.e. the discreteness of the observed behaviours. Frequency measures obviously reflect decisions as to whether we treat each of the observed behaviours as a separate instance or as integrated clusters of behaviours. In the present study, the only behavior for which this decision would have any real consequences was 'looking' since it occurred simultaneously or in close proximity to other targeted behaviors, as well as alone. Thus, the criteria used to decide whether to code 'looking' as a discrete behavior was necessity. In those instances where 'looking' seemed to be necessarily entailed as a natural by-product of another behavior, i.e., approaching, peeking, and attempting to retrieve, it was not coded. For example, one 'looks' in the process of 'approaching'. When 'looking' occurred alone, or in close proximity to other behaviors that did

not require it, i.e., 'talking', it was coded as a separate behavior. This decision rule is somewhat arbitrary, but is logically coherent and in line with methods used by other researchers. We turn now to a discussion of the primary research questions.

4.1 Frequency and Nature of Strategic Behaviour

The first set of questions to be addressed in this study concern the nature and frequency of memory strategies observed in preschool children, during a memory-for-location task. The study aimed to replicate the DeLoache et al. (1985) findings that preschool children use verbal strategies more frequently than other types. Each child participated in two memory conditions separated by one non-memory condition. Analyses of the results showed that non-verbal strategies were the most frequently occurring memory strategies regardless of condition. For example, one child looked toward the hiding location and then pointed at it before approaching the hiding location. Verbal memory strategies did occur. For example, another child looked at the hiding location and said "he hiding". However, verbal strategies such as this occurred at quite low frequencies and did not vary from condition to condition. These results are not consistent with the conclusion made by DeLoache et al. (1985) that children engage in verbal strategies more frequently than other types, with more verbal strategies occurring in the memory conditions.

Low frequencies make it difficult to interpret the data concerning possible verbal strategies. It may be that the verbal behaviours observed in this study were not strategic at all. Perhaps children talked because some aspect of the task or toy was novel, rather than to aid their recall. The key piece of data, i.e. the decrease of target behaviors in C2 is not present, but there is an obvious 'floor effect'. Due to the low frequency of verbal behaviours strategies, it is difficult to draw firm conclusions in this regard.

For the sake of argument, let us assume that the verbal behaviours are in fact strategic. How could we explain their low frequency? In addition, why are the present results different from those of DeLoache, et al. (1985)? Possible answers to these questions can be drawn from cognitive theory, from language acquisition facts, and from methodological considerations.

One set of explanations draws on models of cognitive information processing (Bjorklund, Muir-Broaddus, & Schneider, 1990; Siegler, 1995). Perhaps there was a low frequency of verbal behaviours due to the costs of the strategic behaviour itself. Memory strategies are effortful processes, drawing on the limited capacity of working memory and it is possible that the use of verbal strategies placed significant demands on these very young children's limited information processing capacity. This interpretation is consistent with research investigating mental effort and memory strategies in school-aged children. The results of these studies suggest that as age increases the efficiency of cognitive processing increases as well (Siegler, 1995; Case, 1985; Bjorklund, 1987; Kee, 1994; Guttentag, 1984). Thus, older children are more efficient with the limited capacity of working memory and are able to devote resources to both performing a memory task as well as using a memory strategy. On the other hand, young children must devote a greater number of resources to using a memory strategy and the memory task. Thus, young children are less efficient at using memory strategies and tend to use them less frequently as a result. In general, increases in age are related to increases in the frequency and efficiency of memory strategies to solve a problem.

Perhaps not surprising is the fact that the efficiency of the limited capacity of working memory is influenced by the knowledge base. The developmental literature shows that a larger, more differentiated body of knowledge about the material to be remembered improves the likelihood of remembering and may facilitate the use of memory strategies (Bjorklund, Muir-

Broaddus, & Schneider, 1990; Bjorklund & Jacobs, 1985). An elaborated knowledge base allows for increased speed and efficiency of the limited information processing capacity of working memory, thereby freeing up mental resources for accessing information and the use of memory strategies (Bjorklund et al. 1990). As discussed in chapter 1, knowledge arises from experience. It is possible that the current sample included children who did not have a great deal of experience using verbal strategies, thereby leading to the low frequency of verbal memory strategies.

A second set of possible explanations for the low frequency of verbal memory strategies concerns language proficiency. DeLoache et al. (1985) did not take account of language proficiency and did not posit any developmental or language priorities before verbal memory strategies occur. Therefore, one could wonder if the DeLoache et al. (1985) sample included children that were more verbally proficient than were the children in the present study. Perhaps verbal memory strategies were not easily available to those children using mostly non-verbal memory strategies, due to lower levels of language proficiency. Considering the age of the children in this study and the range of their language skills, it is not surprising that they tended to use non-verbal memory strategies more frequently than verbal ones. Firstly, verbal proficiency is just beginning to emerge when a child is 2-years-old and it is not yet a well developed skill. Research has shown that well developed skills are most likely to be used in conjunction with memory strategies (Brown, Bransford, Ferrara, and Canpione, 1983). Secondly, children who do not have well developed verbal skills are likely to find using a verbal memory strategy too effortful, given the demands of the task and using a memory strategy (Naus & Ornstein, 1985). Thus, it seems that when verbal strategies are new or just emerging they are used infrequently and with continued experience as well as development

verbal strategise may become more frequent. Furthermore, when considering the behavior and language proficiency of 4 out of the 5 children who displayed less than 3 memory strategies throughout the entire task, it is also possible that when language proficiency is either above or below average there is a relatively low use of memory strategies. We will return to this possibility in the next section of the discussion.

What is surprising is that the children in the DeLoache et al. (1985) study were in a similar age range and used a high frequency of verbal strategies. If, as is often the case in developmental studies, the DeLoache et al. (1985) participants included only children from University 'laboratory' preschools or daycares their sample could be biased toward higher verbal achievements, both absolutely and relative to peers. This has been a problem in other studies of child language. For example, in the Berkeley cross-linguistic study, post-hoc analyses revealed that virtually all of the children scored over the 85th percentile on a standardized measure of language (Johnston, personal communication, 2007). As is evident in Chapter 3 in Tables 3.5 and 3.6, this present study drew participants from several different sites achieving a wider range of verbal abilities and avoiding a verbally biased sample. Differences in the language ability of the children participating in the two studies could have easily led to higher uses of verbal strategies in the DeLoache et al. (1985) than in the study reported here.

Differences between the findings in the current study and in the DeLoache et al. (1985) could also be due to sampling and/or to differences in experimental design. Sampling differences are implicit in current work on individual differences in memory strategy use. It is clear in the literature that within the general developmental picture, individual differences occur. Post-hoc analysis in the present study revealed seven different groups of memory strategy use. For example, group 'A' (high-low-high) frequently used memory strategies in

both C1 and C3 but, used fewer memory strategies in C2. Recall that for all conditions each participant was categorized as either a 'high' or 'low' strategy user. It is possible that these seven groups exemplify both general developmental trends and individual differences in memory strategies. This interpretation is in line with current thinking about memory strategies, in that several factors are thought to influence the use of memory strategies. In fact, "any factor may have a different effect on strategy performance as a function of the age, knowledge base, and ability, as well as the strategy in question" (Bjorklund & Douglas, 1997 p.215). In order to help conceptualize the developmental changes and individual differences seen in memory strategies Siegler (1995) has proposed the strategy choice model. Memory strategies are referred to as overlapping waves "with the frequency of use of each strategy ebbing and flowing with increasing age and expertise" (Siegler, 1995 p.410). The model describes the effects of memory strategies both between children of similar ages as well as within children and suggests that for any given task, a child may use a variety of strategies with different frequency (Siegler, 1995). This degree of individual differences will, of course, make it more difficult to find the common threads.

Finally, the conflicting findings could reflect design issues. The most likely differentiating design feature between the DeLoache et al. (1985) study and the present one is the number of memory trials. DeLoache et al. (1985) used 5 memory trials whereas the current study had only 2. It is possible that the additional trials provided some children with a better opportunity to use verbal memory strategies.

To summarize briefly, the fact that verbal memory strategies were used infrequently by the children in the present study can be explained by several different factors: cognitive cost, language proficiency, sampling biases, and/or design differences. Each of these explanations

seems plausible, but the low frequencies of verbal strategies in this study and the lack of verbal measures in the DeLoache et al. (1985) study make it impossible to choose among them.

4.2 Language Proficiency and Memory Strategies

The second set of questions to be addressed in this study concern the possible relationships between language proficiency and memory strategies. Since the observed relationships will be influenced by the measurement tools that were used, we need to begin with a review of the characteristics of the language measures used in this study. The Mullen is a behavioural tool for assessing cognitive development that includes two language subtests: comprehension and production. The language subtests are primarily lexically based at the preschool age range. The MacArthur, in contrast, is a parent report assessment tool that is divided into two separable parts: Part I is a checklist of vocabulary intended to measure lexical knowledge and Part II is a checklist of grammatical knowledge, but also asks the parent to choose among possible phrase types that their child may be saying, thereby further measuring grammatical knowledge. Despite these differences, two types of data arise from both of these language measures: raw scores and percentile scores. Raw scores indicate absolute language level or developmental level whereas percentile scores are more indicative of language performance relative to a group of peers, and may have implications for personal style. These two types of scores are independent and could have different relationships to other factors affecting memory strategies, such as the knowledge base.

We now return to the second set of questions to be addressed in this study concerning the possible relationships between language proficiency and memory strategies. Each child participated in two language measures and completed two trials of a memory-for-location task. The data indicate that absolute language proficiency is related to the use of memory strategies

in preschool children and that grammatical knowledge also plays a role. Raw language scores on the Mullen and the MacArthur were correlated with both the total use of memory strategies in C1 and non-verbal memory strategies in C1. In addition, the sentence complexity percentile score on the MacArthur was correlated with the use of verbal memory strategies in C3.

Raw scores on the receptive and expressive subtests of the Mullen were moderately correlated with total memory strategies in C1 and non-verbal memory strategies in C1. The correlation coefficient is negative, however, indicating that as absolute language level increases there are fewer visible memory strategies. A similar relationship was found for MacArthur raw scores and use of total as well as non-verbal memory strategies in C1. This finding may not be surprising since the receptive and expressive subtests of the Mullen and Part I of the MacArthur are both heavily weighted towards vocabulary, but the agreement between behavioural and parent report measures is noteworthy. These correlations suggest that as absolute language level increases the use of memory strategy decreases. How can we explain the use of memory strategies going down as language level goes up? Possible answers can be drawn from cognitive theory and language acquisition facts.

Models of cognitive information processing can be used to interpret these correlations (Bjorklund, Muir-Broaddus, & Schneider, 1990; Siegler, 1995). Perhaps total and non-verbal use of memory strategies in C1 were negatively related to raw language scores due to efficiency of processing. It is possible that some of the children were efficient processors of the information used in this task and did not need to use a great deal of memory strategies to complete it. Recall that strategic behaviour is used to solve a difficult problem and if the problem is either too complex or too easy, then the frequency of strategic behaviour declines (DeLoache, 1984). Since those children who were proficient at language also tended to be

older, they may not have needed to use as many memory strategies during the memory-for-location task because the task was relatively easy for them. Efficiency of processing can also be used to explain the absence of correlation between language level and memory strategies in C3. It is possible that in C3, prior experience with the task in C1 has further reduced the cognitive demands resulting in even more efficient processing and more children for whom the task is easy.

Both of these explanations drawn from cognitive theory assume that the absence of overt memory strategic behaviors means that memory strategies are not being used. An alternative and equally interesting possibility is that some children are using covert memory strategies to aid their recall. Perhaps the five children that used fewer than three memory strategies throughout conditions 1-3 were using covert strategies. It is possible that a negative relationship between raw language scores and strategic behaviour exists because as some children become more adept with language they can use it covertly to represent and remember the hiding place instead of using overt memory strategies. However, it is not likely that all of the 5 children in this study who used less than three memory strategies were using covert memory strategies, but in any case the data from those five children could not have contributed to the current findings as the total frequency of target behaviors was too low.

Thus far we have argued that ease of the task due to language level or to increasing experience over trials leads to low levels of verbal behavior in C3. Although raw language scores were negatively correlated with the use of memory strategies, a positive relationship existed between the MacArthur sentence complexity percentile score and the use of verbal memory strategies in C3. This would seem to contradict the earlier argument. If the trend is for children to use fewer strategies as they gain more experience with the task and as they have

more language at their disposal, then how can it also be true that children whose grammatical knowledge is more advanced for their age tend to use more potentially strategic behaviors in C3? This correlation may be reflective of individual differences in interpersonal style, rather than the use of memory strategies. It is possible that children who are especially good at language, relative to their peers just talk more. Given the age of the children in this study, talking was limited to one or two word phrases; nevertheless, children who were especially good at language relative to their peers did a fair amount of talking.

How can we account for the absence of this relationship in C1? Perhaps the reason why the relationship between verbal memory strategies and the percentile score for sentence complexity, is not apparent in C1 has to do with knowledge about the task. It is possible that in C1 many resources are being allocated to determining how to handle the new task as well as the use of non-verbal memory strategies. However, during the memory task in C3 the child has already had some experience with the task in C1 and knows, e.g., that the three minute interval is not too long, thereby freeing up some cognitive resources so that he/she is able to resume their chatty nature.

4.3 Summary of Conclusions

The purpose of the current research was to investigate the nature and frequency of memory strategies in preschool children during a memory-for-locations task and explore possible relationships with language proficiency. The findings indicate that (1) preschool children are capable of deliberate and independent use of memory strategies (2) non-verbal strategies were more frequent than verbal ones, and (3) language and memory strategies share a complex relationship that appears to be related to both the a child's absolute language level as well as his/her language proficiency relative to their peers. The remaining sections of this

discussion will focus on the methodological strengths and limitations of this study. In addition, possible future directions for research in this area will be presented.

4.4 Methodological Strengths and Limitations

One strength in the methodology of this study was that it investigated preschool children's use of memory strategies using a within subjects, repeated measures design, with a task previously shown to elicit memory strategies in preschool children. A repeated measures, within subjects design provides a rigorous test of the relationship between memory strategies and language proficiency as well as preschool children's sensitivity to memory demands.

As mentioned earlier in the discussion, one limitation of this study is the small sample size. It was difficult to recruit a group of participants large enough to achieve statistical power and it is possible that some analyses, such as the strength of the interaction between C1 and C2, may have reached statistical significance if the sample size had been larger. An additional limitation is that the task may have been too easy for some of the children in the study since 95% of the memory trials were errorless, meaning that the child searched immediately in the correct location without first searching another location. Perhaps some of the children in this study may have engaged in higher frequency of overt memory strategies if the task was more difficult. Future studies should attempt to control for this effect by having each child complete tasks of varying difficulty.

In order to get an overall picture of language proficiency and to avoid excessive testing, each child participated in two verbal and two non-verbal subsets of the Mullen, which took between 30 to 45 minutes to complete. The verbal subtests targeted receptive and expressive language. In addition, each participant's parent(s) completed a self-report questionnaire, reporting about current word use. Although these measures were carefully chosen for their

ability to adequately represent language proficiencies in preschool children, further studies should attempt to use a wider variety of language measures to provide a better picture of language proficiency.

4.5 Future Directions

This study was exploratory in nature, as the role of language in preschool children's use of memory strategies had not been addressed in previous research. It has contributed to our understanding of the frequency and nature of memory strategies that preschool children use and how they are related to language proficiency. While these conclusions are somewhat premature, the findings are nonetheless suggestive. Preschool children do in fact use memory strategies, both verbal and non-verbal, to solve memory problems and the use of memory strategies are related to absolute language level and grammatical knowledge. Further research is needed to address the limitations of the current study and expand upon the findings. First, future research should focus on using a variety of tasks with more trials per child to better understand the interaction of task and type of memory strategies. For example, the use of several tasks should be used in order to determine the effect that task parameters have on the interaction between language proficiency and memory strategies. Second, additional language proficiency measures as well as measures of relative reticence should be used in order to tap into the different language domains. Third, subsequent studies should investigate the interaction between language proficiency and memory strategies in older children as well as adults. Finally, investigating the relationship between language proficiency and memory strategies should extend to other populations, such as those of children with developmental disabilities. Through subsequent research in the area of memory strategies and language we can improve current

theories and develop methods of intervention aimed at developing and strengthening preschool children's language proficiency.

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