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Effects of category knowledge, strategies, and social interaction on children's memory performance

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EFFECTS OF CATEGORY KNOWLEDGE, STRATEGIES, AND SOCIAL INTERACTION ON CHILDREN'S MEMORY PERFORMANCE

by

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ABSTRACT

EFFECTS OF CATEGORY KNOWLEDGE, STRATEGIES, AND

SOCIAL INTERACTION ON CHILDREN'S MEMORY PERFORMANCE

by

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This study of 120 4-year-old, 120 7-year-old Korean children, investigated children's memory performance in relation to developmental changes in category knowledge structure, emergent strategy use, and social context. In 2 experiments, pictures of items from two types of categories - slot-filler and taxonomic - were used. Experiment 1 contrasted three instruction conditions: simple remembering, sorting pictures, and directions for strategy use. Experiment 2 provided three social interaction conditions: alone, with a peer, and with an adult "expert."

In Experiment 1 the 7-year-olds performed better on both list types than 4-year-olds. The younger children, however, demonstrated better recall, clustering, and shorter latencies for the slot-filler than the taxonomic list, while the 7-year-olds showed no such differences. These findings support the view that script-based slot-filler categories have a strong influence on young children's memory performance (Nelson, 1988).

There was an interaction between age, category knowledge and

instructions. All Children performed better under strategy instruction on both list types. Younger children performed better with sorting instruction than with simple remembering instruction on the slot-filler but not the taxonomic list, again demonstrating the importance of slot-filler relations in item recovery. Twenty-tree 7-year-olds, but only 4-year-olds used strategies under all instructions.

The results of Experiment 2 showed that all children benefitted from expert guidance on both types of lists. 4-year-olds recalled more in the child-child condition than alone, suggesting that shared knowledge is a central feature of social interaction. Cultural attitudes toward learning may also influence performance. Compared to American, Korean children have more experience with expert (teacher) directions than with peer interactions.

These research results led to the general conclusion that children's memory performance at both ages was influenced by their slot-filler category knowledge. Younger children appear to be able to use the slot-filler category structure to search memory more effectively. Older children also have built up more scripts, as well as taxonomic category knowledge structures. These effects were observed under all conditions of instruction, social interaction, and strategy use.

To my mother and father
who brought me into the world
and sent me out into the world

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CHAPTER I

INTRODUCTION

> Memory is a prerequisite for the development of thinking, and is in turn affected by advances in intelligent information processing. The development of memory is not only the result of universal changes in cognitive competencies but also depends on cultural, social, and personal experiences (Weinert & Perlmutter, 1988, p. xiii).

The main goal of this study is to enhance the understanding of children's memory development as it reflects the complementary dimensions of individual processes (strategies and category knowledge) and social context (social interaction). The literature on each dimension is first reviewed separately, and then, moving beyond the focus on isolated variables in previous studies, a study of integrated variables is done. Such a study is held to be necessary to the understanding of children's memory development.

There is general agreement that with increases in age, children become increasingly competent in tasks that involve remembering (e.g., Schneider & Pressley, 1989). In contrast, however, there is no clear consensus as to how these developmental changes should be understood. Attempts to account for developmental differences in memory performance have emphasized the importance of two components: the operation of memory strategies and the role of the knowledge base. The task of trying to understand the independent and/or interactive contributions of these two factors on memory performance has been primary (Bjorklund, 1985; Chi, 1981; 1985; Ornstein & Naus, 1985). However, even with this emphasis, there is still little agreement in regard to the manner in which these two factors affect memory performance.

In memory strategy research, memory development during middle childhood has been characterized as the achievement of the effective use of memory strategies (Brown, 1975; Ornstein & Naus, 1985). Less consideration has traditionally been given to the emergence and development of memory strategies during early childhood and the role that the child's interaction with his/her social and material world may play in the child's memory development. However recent studies have revealed that young children have also often been shown to rely primarily on immediate perceptual access (e.g., Wellman, 1988), and make considerable efforts at close visual inspection of and specific attention to the materials to-be-remembered when given memory instructions (e.g., Baker-Ward, Ornstein, & Holden, 1984). However, they rarely spontaneously employ more sophisticated strategies such as semantic organization. Fewer studies directly examining deliberate memorization in younger children have been done, so relatively little is known about the emergence and development of memory strategies during childhood. The first issue addresses in then, this research is conducted to augment the understanding of the development of memory strategies (semantic organization), by (a) identifying the child's early attempts at memorization, and (b) exploring changes in spontaneous mnemonic activity in the social context during early childhood.

In regard to the dynamic interaction of knowledge and strategies, Bjorklund (1985) basically assumes that age-related changes in children's free recall and organization are primarily due to age-related differences in content knowledge. Bjorklund and his colleagues provide ample empirical evidence showing that the knowledge base not only affects strategy use but also has nonstrategic effects on memory performance. Ornstein and Naus (1985) propose that young children may initially demonstrate goal-directed memory strategies in the context of highly supportive task environments and then show gradual generalization to other less supportive contexts. Young children may initially demonstrated memory strategies when asked to remember strongly related materials, or materials in which an underlying structure is made very explicit. Ornstein and Naus's (1985) claim that even preschoolers can be deliberately strategic stands in contrast to Bjorklund's (1985) claim that children do not appear to be strategic until adolescence. It seems likely that this disagreement reflects attention to different features of intention. Bjorklund seemes to require a plan for strategic activities that is fully-developed in advance, whereas Ornstein is willing to accept mere awareness of a mnemonic goal. Neither of them, however, has tried to provide a detailed description of the nature of children's knowledge.

Interestingly, studies of children's knowledge representations as a function of development (e.g., Mandler, 1983) are clearly relevant to this issue, but these are not considered in analyses of memory development. Yet, it is important to learn about what children know and how that knowledge changes with age and experience, before we can have an adequate understanding of the impact of that knowledge on performance, either directly or via the mediation strategies. Knowledge structures are assumed to guide memory performance by anchoring word meanings within the structure. The focus has mainly been on two issues: the study of taxonomic knowledge structures (e.g., Rosch, 1978) and the study of event-based knowledge structures (e.g., Nelson, 1986). Recently, on this point, Nelson (1983, 1985) proposed a slot-filler model of category knowledge development. In this model categorical relationships among items emerge from script representations, that is, from schematically organized knowledge acquired through a child's real world experience. It is proposed that the slot-fillers form the child's initial category structure and are combined into fully developed hierarchically organized context-independent taxonomic categories as the child develops and learns. Thus slot-filler organization is assumed to correspond more closely to the categorical structures in young children's semantic memory. Second, in this study, I consider developmental changes in children's category knowledge and then attempt to relate characteristics of category knowledge to strategic attempts to use that information in a social context.

In general, social influences on children's memory performance have not often been emphasized in research done under the information-processing paradigm. Although Vygotsky (1978) did not detail how social interaction influences memory, his theory suggests that memory develops in the context of social interaction and in response to the demands of that context. The development of memory is explored as an adaptation to the demands of the social world.

The literature of social interaction indicates that socio-cognitive conflict (Piaget) and internalization of regulation (Vygotsky) are two dominant mechanisms proposed to account for social facilitation of cognition. Most contemporary researchers have claimed that the adult's guidance, support, and structuring of children's activity can facilitate development of various cognitive processes such as language, and memory-related processes during childhood (e.g., Bruner, 1975; Rogoff, 1990; Verdonik, 1988). The implication of these is that individuals develop shared knowledge and shared meaning in social contexts on the basis of social processes. Although child-child interaction is not studied as often as adult-child interaction, several researchers have argued that child-child contexts are central to the child's social construction of reality (Azmitia & Perlmutter, 1989; Damon & Phelps, 1989). The emphasis on child-child interaction is derived from Piaget's (1932) notion that child-child interaction is relatively symmetrical in nature. These two kinds of social interaction have consistently been shown to serve different functions in children's memory development. Third, a systematic analysis of the interdependence of memory processes (knowledge and strategies) and social interaction is needed in this study.

Other studies move away from the consideration of the isolated variables affecting children's memory performance. Instructions to the subjects, variations in stimulus materials, and other aspects of the experimental situation can affect children's memory performance, but their impact is clearly mediated by children's previous experiences, both cognitive and social. Children's predispositions thus influence their approaches to tasks, their interpretation of supports that may be provided, and their ability to use strategic activities.

The present study is intended to reconsider some basic assumptions about the adequacy of individual memory processes (strategies and knowledge) to describe memory functions under social interaction. The levels of individual and social description will be recognized as complementary dimensions of memory functions during early childhood.

Developmental changes in category knowledge structure

Mandler (1983) has described two types of knowledge organization: taxonomic organization and schematic organization. Taxonomic organization is the most familiar type of organization. It consists of a hierarchical system of categories based on asymmetrical inclusion relations, wherein a superordinate term organizes and includes subordinate classes, for example, "animal" includes "dog," "tiger," and "lion," and so on (Collins & Quillian, 1969; Tulving, 1972). The other type of organization is the schema, a part-whole organization of elements. Schemas are organized in terms of variables that fill slots, which are instituted in specific contexts. Scripts (Nelson, 1978; Schank & Abelson, 1977) are a type of schema representing event structures and are "organized in terms of temporal and causal relations between component acts" (Nelson, 1983, p. 55).

The traditional view of children's knowledge organization assumes that hierarchical taxonomic categories develop late because young children lack the logical inclusion relations inherent in these structures. According to Inhelder and Piaget (1964), the necessary understanding of part-whole class relations is not achieved until the stage of concrete operations at age 7 or later. Prior to this stage children are held to rely on infra-logical structures, in particular on thematic or complementary relations, or on complexive or collective groupings.

A related view proposed by Mandler (1979) is that children first rely on schematic organizations such as scripts (event schema), stories, and scene schema. Young children, who do not utilize taxonomic relations, rely on primarily complementary relations which include both functional relations and situational or thematic relations, for example, "cup" and "milk", "chair," "table," and "stove." The children's knowledge base undergoes a shift from schematic to taxonomic organization. In this view, as in the traditional view, categorical organization is a developmental achievement of the early school years. The effect of taxonomic knowledge structures on performance on verbal memory tasks by school children is well known. When word lists contain a number of items from a single category, these items tend to be remembered better than unrelated items (e.g., Ornstein & Corsale, 1979).

The traditional view of classification and category development reflects the assumption of logical organization based on necessary and sufficient features (Smith & Medin, 1981). This assumption was challenged by Rosch and her colleagues (Rosch, 1978; Rosch et al., 1976), who proposed that natural language categories are organized around prototypes and reflect family resemblance principles rather than logical structures. Prototypes are the clearest cases of category membership, as determined by people's judgements, and the best exemplars of a category. Rosch and Mervis (1975) argued that categories are organized in terms of different levels of inclusion and abstraction. Rosch and her colleagues hypothesized that taxonomies of concrete objects include a basic level, a superordinate level, and a subordinate level of categorization. At the basic level, instances of the concept are relatively similar to each other. While basic-level exemplars are similar to each other, they are different from contrasting categories at the same level. For example, apples are readily distinguishable from bananas and melons. At the superordinate level, the similarity among exemplars is less striking than among basic-level objects. Fruit, for example, includes objects as diverse as an apple, banana, and peach. At the subordinate level there is somewhat greater perceptual similarity among exemplars than at the basic level. That is, while superordinate categories share few attributes and subordinate categories have overlapping attributes, category resemblance is well represented at the basic level since that is the level where instances of the same category share many attributes in common but are differentiated from instances of other categories at that level. However, not all levels are equally useful; the most useful level is the most inclusive level at which the structure of attributes that are perceived in the real world is mirrored.

Basic level categories generally bear single word labels, share similar perceptual features and are acted on in similar ways. Although adults may represent sub-classes of basic level categories, young children seem to represent them holistically rather than as sets. In contrast, the superordinate term of taxonomic categories combines object concepts into inclusion hierarchies. Instances of such categories do not necessarily share similar perceptual features and although they usually have a functional basis, the function may be very abstract, not based on simple action relations. The inclusion relation is conventional, not empirical; the semantics of the language determine what is included in conventional categories.

Based on the analysis of hierarchical levels, Rosch et al., (1976) hypothesized that basic level terms should generally be the first category terms acquired. Experiments showed that the first categorizations of children are at the basic level (e.g., CAR, DOG), with subordinate (e.g., TAXI, COLLIE) and superordinate (e.g., VEHICLE, ANIMAL) developing later. Rosch and her colleagues (1976) found that 3-year-olds could sort objects at the basic but not the superordinate level. Horton and Markman (1980) examined the relative utility of exemplar and linguistic information for acquiring basic and superordinate categories by using artificial animal categories. Developmental differences were predicated in the ability to benefit from the linguistically specified criteria information. Young children learned categories at the basic level more easily than those at the superordinate level. They also found that linguistic information facilitated acquisition of only superordinate, not basic level, and only for the older children. These studies defined levels in terms of more and less specific differentiating perceptual features. However, perceptual features are not sufficient for identifying natural language superordinate categories, functional information being crucial at this level.

Smith and Medin (1981) state that typicality is an inverse measure of complexity; since atypical items contain more features than typical ones, atypical items will require longer comparison stages. The fact that typical concepts are learned before atypical ones becomes just another example of simple concepts being mastered before complex ones. The typicality effect has been supported in studies of priming effects from the category term (Duncan & Kellas, 1978), free recall (Bjorklund, 1988; Rabinowitz, 1984) and cued recall using categorical relations for recall when child-defined typical items are used

(Bjorklund & Thompson, 1983). The later study provided evidence that children's performance is higher for lists of highly typical than for less typical category items. The reason proposed is that typical items are more similar to the category prototype than less typical category items. This literature suggests in effect that children's first categories are made at the basic level and that typical concepts are learned before atypical, more complex ones, but hierarchical structures emerge later.

In an attempt to integrate the findings from both traditional and recent category research with evidence of children's event schema knowledge, Nelson (1983, 1985) proposed a slot-filler model of category development. In this model categorical relationships among items emerge from script representations, that is from schematically organized knowledge. Slot-filler categories are motivated by the child's integration of knowledge based on real world experience. Slots are generally given names by people who take part in the events. For example, adults may say "Let's put on your clothes" or "Don't play with your food." Then "clothes" and "food" come to stand for those items that can occur in the relevant slots. Slot-filler categories are formed on the basis of 'shared function'. It should be noted that shared function represents the principle of 'substitutability' within a frame. Members of such categories represent alternative possibilities within familiar events. This model further proposes that more general conventional superordinate categories are formed from the merger of more specific slot-filler categories, which are nonetheless of a higher level than basic level object categories. Schema and higher-order categories are developmentally related, with higher-order categories emerging as slot-fillers in event schema. The fully developed hierarchical taxonomic category draws on members from different script contexts as subcategories, objects that share the same function but occur in different scripts (e.g., "eat toast for breakfast," "eat peanut butter sandwich for lunch") come to be joined into a single category with the category term (i.e., food). Script-based subcategories are combined into larger taxonomic categories as the child develops and learns. Thus the development projected in this model is from basic level to slot-filler to taxonomic category. Slot-filler categories are hypothesized to predominate in the pre-school years with superordinate categories, which reflect conventional semantic organization, emerging with school experience.

This view is similar to Vygotsky's (1962) ideas about the relation between natural "spontaneous" concepts and "scientific" concepts. Vygotsky believed that spontaneous concepts lacked systematicity, while the primary characteristic of scientific concepts was their inclusion in a hierarchically organized system. Rather, in the script model concepts are organized within an experiential-based representational system, not conceived as non-systematic.

This proposal has received empirical support from several studies. Nelson and Nelson (1990) used a category production task with 5- and 8-year-olds to test the hypothesis that children's categories are organized in terms of slot-fillers. In one condition children were given general category instructions for the categories food, clothes, and animals. In the second condition they were asked to generate instances for two context-constrained categories (e.g., "food you eat at breakfast/lunch"). There was a significant condition by age interaction in the number of instances produced: 5-year-olds gave more items in the context-constrained condition, while 8-year-olds produced more in the general category condition. This finding suggests that the younger children confined their free responses to one context, and thus cues for two contexts enabled them to increase, and in some cases double, their responses. In contrast, older children apparently called on many contexts, reflecting general taxonomic categories in the free condition, and were thus confined to fewer instances in the context-constrained condition. Thus this experiment supported the view that younger children organize their category knowledge in terms of script-based slot-fillers, while these context-constrained categories become merged at school age into broader superordinate categories.

Using a memory task, Lucariello and Nelson (1985) presented pre-school children with lists of words composed of groups of category members for recall. One list consisted of slot-filler items (lunch food, clothes put on in the morning, and zoo animals), where each item fit into a familiar script. A second taxonomic list was composed of familiar instances of broader superordinate categories (food, clothes, and animals). Conditions included free recall, recall cued with taxonomic cues, and for the slot-filler list, recall cued with slot-filler cues. The slot-filler list was superior to the taxonomic list in terms of both amount recalled and organization of recall, and script cues produced higher recall than category cues. A second study replicated these results and compared a complementary list, composed of items from different categories occurring within a single script (e.g., sandwich, cup, plate), to the taxonomic and slot-filler lists. The complementary list was comparable to the taxonomic list in amount recalled, while the slot-filler list was superior in recall to both of the others. These results supported the interpretation that script-based slot-filler organization guided children's memory for and organization of the lists. Additionally, Siegel et al., (1989) argued that the slot-filler effect is simply due to item-to-item high association because the taxonomic list was composed of items low in item-to-item associations, whereas the slot-filler list contained items high in item-to-item associations in the Lucariello and Nelson (1985) study.

To test the generality of the slot-filler category model in a cross-cultural perspective, and to explain the high association among slot-filler items, Yu and Nelson (1993) used a category production task and a memory task with young Korean-speaking children. In the category production task, 5-year-olds and 8-year-olds produced category instances given either slot-filler or taxonomic instructions. Five-year-olds produced more instances in the slot-filler condition while 8-year-olds produced more in the taxonomic condition. In the memory task, first, the slot-filler list was contrasted with the taxonomic list that included the most typical members of the categories that had been previously rated by 5-year-old Korean children (Sung, 1986). Both high typicality and slot-filler status contribute to high associativity of items, and it has been argued that slot-filler effects are due simply to associativity. Thus if children perform at a higher level with the slot-filler than the most typical item list, it provides further support for the model. Second, inter-item latencies within a category were obtained for both list types to test the assumption that slot-filler organization is more accessible to recall and thus produce shorter latencies than general taxonomic organization. As predicated, for the 5-year-olds slot-filler categories led to superior recall, higher levels of organization and shorter latencies than taxonomic categories in free and cued recall conditions, and also led to increased recall when script cues were provided.

In the 8-year-olds, there were no differences in total items recalled, in organization, and in latencies between the slot-filler and the taxonomic categories. These findings are consistent with the results of the Lucariello, Kyratzis, and Nelson study (1992) that found that slot-filler type knowledge remained significant for 7-year-olds who also showed conventional forms of taxonomic knowledge. In this study (Yu & Nelson, 1993) the items on both the slot-filler and the taxonomic list were generated by 5-year-olds. These lists include the most typical items in the taxonomic categories, and the most frequent response in the slot-filler categories. Probably both the slot-filler and the taxonomic knowledge are well established for the 8-year-old children. The categories generated by 5-year-olds may have become better established and activated relatively automatically in older children's semantic memory (e.g., Bjorklund, 1985; Ornstein & Corsale, 1979). These results support the position that hierarchical taxonomic categorical structures emerge and develop from a conceptual knowledge base initially organized schematically.

Recently, Lucariello, Kyratzis, and Nelson (1992) used various tasks with 4-, 7-year-olds, and adults to explore the emergence and the kinds of taxonomic knowledge. They distinguished several forms of taxonomic knowledge: 'horizontal' (e.g., dog-cow) and 'vertical' (e.g., dog-animal). Horizontal relations included 3 category types: 'slot-filler,' 'conventional subcategory' based on constrained and/or an arbitrary cultural groups, and 'conventional superordinate' based on unconstrained function. Results showed preschooler taxonomic knowledge to be restricted to slot-filler categories. Conventional horizontal relations and vertical taxonomic knowledge emerged with age. Although 7-year-olds displayed greater knowledge of taxonomic relation in the category production task and word association task, they incorporated slot-filler categories into larger category structures. In the forced-choice-picture task, both group of children showed thematic over taxonomic and slot-filler relations. Thus slot-filler categories continued to play an organizational role in the structure of taxonomic categories.

Additional evidence in support of the slot-filler model has been reported in Nelson (1988), Krakow and Blewitt (1989), Rosner and Smick (1989), and

Sell (1992), using different paradigms including recall, category production, word association, and forced picture choice.

In summary, these studies offer support for Nelson's developmental hypothesis. Young children's performance supports the notion that slot-filler representations: (a) are derived from event -based experience; and (2) serve as the basis of abstract, hierarchical taxonomic structure.

The above findings may be interpreted in terms of a theory of the differentiation between semantic and conceptual structure in long-term memory (Nelson, 1982, 1986). Semantic memory draws on conceptual organization and the script-based slot-filler categories are likely to enter into semantic organization as the first and most salient category structures. Hierarchical, taxonomically based categories are more abstract and advanced semantic structures that draw on and organize the first context-derived categories, and thus they are less developed in the younger child. Accordingly, then, with an increase in age, children's memory performance for lists of categorically related items increase (e.g., Ornstein & Corsale, 1979).

Until now, the developmental research has clarified a number of issues that relate to the acquisition and development of category organization based on event representational structure, it is needed more concerns about the importance of slot-filler categories in older children's fully developed hierarchical taxonomic categories. The slot-filler category hypothesis predicts that when lists are composed of script-based categories in contrast to broader categorical structures, recall and organization of material to be remembered by preschool children is improved, and taxonomic relations will be evident for older children. Yet it is important to keep in mind that this does not imply that event-based relations will be nonexistent in older children's knowledge structure. In the Lucariello, Kyratzis, and Nelson study (1992) slot-filler structure remaines in the 7-year-olds, and in the Yu and Nelson study (1993) 8-year-olds show no differences in memory performance between the slot-filler and the taxonomic categories. If event-based relations exist in older children's knowledge structure, what kind of features of the slot-filler category will affect older children's memory performance? More study is needed to explore the role of slot-filler categories in older children's memory structure. The generality of the slot-filler effect needs to be tested further in various children of different culture backgrounds and using different languages in their social context.

The components of memory development: strategies and knowledge

1. Spontaneous use of memory strategies

The earlier studies of memory strategies concentrated mostly on school-age children. Recent research has given more attention to strategic behaviors in preschoolers with the results that the traditional view of young children's memory processing, once described as "involuntary," "nonstrategic," "pre-operational," and "production-deficient" had to be revised.

Recent studies have shown surprising mnemonic competence by young children. Although the benefits of mnemonic strategies on recall have typically not been observed until about age 6, the activation of mnemonic strategies in response to the instruction "to remember" have been demonstrated at age 4 (Sodian, Schneider, & Perlmutter, 1986). Even toddlers as young as 18-months-old have been observed to employ strategy-like behavior when instructed in a naturalistic setting to remember a toy's location (Deloache, Cassidy, & Brown, 1985). Along the same lines, Wellman (1988) argued that even 4-year-olds are truly strategic in memory tasks in the following senses: they employ strategies deliberately with the intention of helping themselves remember, their use of strategies is frequent, and that the strategies are significant in explaining young children's cognitive performance. This suggests that preschoolers can be credited with having mnemonic strategies, yet are such novices to the task of remembering that their strategies are more faulty than effective. These findings challenge previous claims that young children cannot behave strategically on memory tasks. However the relation between young children's strategic capabilities, and the strategic repertoire that is observed in the elementary school years is poorly understood (Ornstein, Baker-Ward, & Naus, 1988).

In order to facilitate the consideration of behavioral strategies within the young child's repertoire that might represent deliberate mnemonic activities, experiments used simplified task settings (e.g., Heisel & Ritter, 1981; Wellman, Ritter, & Flavell, 1975). In general, the child was asked to remember an object's location, and could meet the task demands with such simple nonverbal mnemonic mediators as touching a hiding place or marking a location with a cue provided by the experimenter. The use of such simple recognition paradigms demonstrated that even 3-year-olds can show evidence of deliberate, planful behavior in the performance of memory tasks (Flavell & Wellman, 1977).

Although the use of simple task settings has contributed significantly to the understanding of young children's capacities to prepare intentionally for a memory demand, they have not focused attention directly on the development of memory strategies. The highly specific nature of many of these tasks does not facilitate the examination of the behaviors that children often use in attempting to remember. The simple verbal and nonverbal behaviors that young children may themselves generate as mnemonic mediators are not readily encompassed in many memory-for-location paradigms. These simple behaviors could reflect rudimentary forms of the memory strategies used by older subjects. Hence, their expression by young children may constitute a point of origin for investigations of the development of memory strategies.

Many researchers have shown that children become more proficient in spontaneously generating strategies for sorting and retrieving information as they grow older (Chi, 1983; Kail & Hagen, 1977; Ornstein, 1978). However, less information directly examining deliberate memorization in younger children has been collected. Consequently, relatively little is known about the emergence and development of memory strategies during early childhood (Naus & Ornstein, 1983). In simplified task situations, children as young as 3 years of age have been shown to exhibit intentional memory behavior (e.g., Acredolo, Pick, & Olson, 1975). The assessments of children's metamemory have indicated that young children (4-year-olds) have acquired the concept of memorization as an active process requiring deliberate activity (Wellman & Johnson, 1979).

Research by Baker-Ward, Ornstein, & Holden (1984) was conducted on the development of memory strategies by identifying the child's early attempts at memorization, examining the behavioral expression and mnemonic effectiveness of these early efforts in deliberate remembering, and exploring changes in spontaneous mnemonic activity during early childhood. Four-, 5-, and 6-year-olds were shown a set of toys and instructed in three different conditions: (a) Target-Remember (told to do anything to remember a specified subset of the object names), (b) Target-Play (told to be certain to play with a specified subset of the objects), and (c) Free-Play (simply told to play with the objects). The results of this study are that naming the stimuli and visual inspection were more frequent in the Target-Remember condition at all ages, and manipulating and playing with the stimuli were more frequent in both of the play conditions. For the younger children, various strategies were once again ineffective, or faulty; recall differed across the instruction conditions only for the 6-year-olds, not for the 4- and 5-year-olds. This result seems to indicate that children's activity period behaviors reflected a serious and even studious approach to the memory task and suggest that young children themselves employ intention in memory tasks. However, young children rarely employ sophisticated strategies such as semantic organization spontaneously. If young children are unaware of the function of inference in knowledge acquisition, they will not understand that deliberate encoding of information about the relationships between items to-be-remembered will facilitate a memory task. They will rely on the information given rather than go beyond the information in their strategy efforts. This claim is found in the research on preschoolers' understanding and use of cuing strategies.

Deliberate use of cuing strategy requires an understanding that in the absence of direct perceptual evidence a piece of semantically related evidence can function as source of knowledge. Although even 4-year-olds sometimes use this strategy in the preparation for future retrieval when cues and targets are semantically closely associated (e.g., Geis & Lange, 1976), this seems to be dependent on the strength of the association between cue and target. Thus preschoolers' cuing behaviors may reflect an automatic reaction to high associativity between cue and target rather than a deliberate strategy (Bjorklund, 1985). However, Beal (1985) found that even 4- to 5-year-olds are aware of some of the basic requirements for retrieval cues, that is, a cue should be associated with the target item.

Of course, the preschooler's use of strategies is quite unsophisticated compared to that of the school-age child. Through the preschool and school years, children use strategies more effectively (Baker-Ward, Ornstein, & Holden, 1984), and they abandon weak strategies, such as looking and single-word rehearsal, in favor of more powerful ones, such as categorization based on meaning and multi-word rehearsal (Justice, 1986; Guttentag, Ornstein, & Siemens, 1987).

Young children's strategic remembering is particularly apparent in tasks where remembering itself is obviously instrumental, that is, in order to a get a toy and play with it. If this is true, it suggests that general strategic failures when they occur (i.e., the absence of any deliberate approach to the task) may often be motivational failures. The memory test used simply did not engage the child's strategic problem-solving.

However, strategies and knowledge are not so easily dichotomized. One thing that increases is knowledge of effective information handling procedures, at least within that domain. That is, strategies for representing, retrieving, and utilizing information of a particular sort are part of the knowledge acquired in knowledge acquisition. The same complex interaction between strategies and knowledge holds in the preschool years as well.

2. Nonstrategic effects of the knowledge base

Ackerman's (1987) descriptions model focuses solely on nonstrategic aspects of memory, stressing the interaction of knowledge base and functional capacity in a form of context-interactive processing. The nature and organization of the knowledge base is central to context-interactive processing because it affects how specific a cue can be and how specific a cue must be effective.

Ackerman focused primarily on developmental issues showing how features associated with a concept become more strongly integrated with age. He suggests that as more and more connections are made between units of information in memory, and the structure formed by the inter-connections of that information increases in complexity, there will be greater opportunity for the automatic activation of rich and elaborate associations.

Lange (1973) noted that clustering in children of preschool and elementary school age involved the recall of stimulus materials that were both categorically and associatively related. When he presented 6- and 11-year olds with categorical items that were not strongly interconnected, the results were that above-chance clustering was not obtained in the children; only the 15-year-olds in Lange's sample demonstrated a significant degree of clustering. These findings led Lange (1973, 1978) to argue that category clustering in preadolescent may be automatically determined by the associative structure of the materials, not by categorical organization. One possible reason for the powerful impact that associativity has on organization is that associatively related items represent preestablished units in a child's semantic memory. That is, associative relations are readily activated (compared to categorical relations) by young children, with clustering in recall based on such relationships representing nonstrategic (i.e., relatively automatic processing).

Bjorklund and his colleagues (Bjorklund, 1988; Bjorklund & Buchanan, 1989) assessed children's acquisition and generalization of an organizational strategy for sets of typical and atypical items over repeated trials. Levels of recall and clustering were greater for the sets of typical than atypical items, with age differences being most apparent for the atypical items. Children were also classified according to organizational strategy on each trial, separately for the typical and atypical items using the dual criterion of being classified as strategic if they had at least one long intra-category cluster (three words or more) and fast within-category inter-item latencies. The 3, 5, 7 grade children were trained to use an organizational strategy on sets of either typical or atypical items. The results of training were that there were no grade differences in the percentage of children classified as strategic for the typical items by the final training trial. However grade differences were apparent for the atypical items. They concluded that using highly typical items makes the training of a strategy easier and the generalization of that strategy more likely.

Bjorklund's (1985) arguments place the knowledge base in a central position in the explanation of age-related changes in strategy use. Bjorklund and his colleagues (Bjorklund & Jacobs, 1985; Bjorklund & Zeman, 1982, 1983) have argued that prior to adolescence, children's organizational activities cannot be viewed as strategies. They suggest that the effects of the knowledge base upon young children's memory performance are involuntary or automatic (Hasher & Zacks, 1979; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977), requiring little of the child's attention or planful behaviors.

In studying the nonstrategic effects of knowledge base, Bjorklund (1987) looks at two basic types as between-item and within-item effects. Between-item effects refer to the encoding of relational information which bring varying amounts of structure and organization to the knowledge base. For example, even as early as first grade, children exhibit high levels of recall and clustering for classmates' names without showing any awareness of using strategies (Bjorklund & Zeman, 1983). This tendency reflects the relatively automatic activation of associative relations. Within-item effects refer to elaborative encoding of individual items in memory independent of organizational effects. The wider the variety of features that are encoded and the richer the representation, the greater the range of cues and inter-item relations that can serve to elicit that item. The finding that some children's names are more apt to be remembered than others in a class recall experiment can be interpreted as a refection of these item-specific effects (Bjorklund & Bjorklund, 1985).

So far, age-related changes in memory performance are seen as directly reflecting corresponding differences in the facility with which relations in semantic memory are activated by children of different ages. With increasing language experience, it is proposed that semantic categories become better established, thus increasing the ease with which relations among items within a category are automatically activated. This increased efficiency in the processing of category information results in elevated levels of organization in memory that are viewed as automatic activations of relations within a well-established conceptual system. This automatization is viewed as freeing up additional processing capacity for other cognitive activities.

Through story and list recall studies of script knowledge, Nelson and her colleagues (Nelson & Gruendel, 1981; Hudson & Fivush, 1983; Lucariello & Nelson, 1985) using real-world knowledge showed that the structure of preschool children's scripts influences the organization of their recall of script-based categories. The results suggest that preschool children seem to be unable to use either categorical or schematic structures deliberately to organize recall. Kindergarten children are able to use both structures strategically while categorical knowledge improves over the age studied. They argued that schematic structures seem to be familiar to young children and automatically organize recall in directed memory tasks because the schema acts as an automatic, retrieval guide; once the appropriate schema is activated, the particular units can be sequentially accessed.

In the study of reconstructing a scene with 30 objects arranged in a panorama resembling a town, Gauvain and Rogoff (1986) showed that children perform better in more meaningful memory tasks that take advantage of real-world knowledge structure (i.e., knowledge of spatial layouts), and that children's memory performance actually declines when formal strategies such as rehearsal are misapplied to tasks in which meaningful relationships serve as better memory organizers. An emphasis on the contextual relations in the material to be remembered is similarly suggested by research on children's memory for organized events, stories, and scripts (Mandler, 1983; Nelson, 1986)

3. Interaction between strategies and knowledge

These two components of memory-strategies and knowledge-are not independent. On the contrary, they interact with one another. It is argued that the age-related increase in memory performance is largely due to the development of deliberate mnemonic strategies for encoding and retrieval (Hagen, Jongeward, & Kail, 1975). Young children show poor memory ability because they do not spontaneously use these strategies. Ornstein and Naus (1985) have suggested that one of the ways by which knowledge influences memory performance is via the mediation of particular memory strategies, and they have called for the joint investigation of strategies and knowledge.

If age differences in the associative structure of the knowledge base can be related to developmental changes in recall, what factors account for this relationship? One possibility is that as the knowledge base becomes more articulated, children are able to utilize the enriched associative structure in their deliberate attempts at remembering. This possibility was explored in the experiment by Tarkin, Myers, and Ornstein (1985). Children who were 8-yearsold rehearsed as they were presented either a high meaningfulness list or a low meaningfulness list. They found that 8-year-olds rehearsed and recalled nearly twice as much if the words were highly meaningful. In fact, with highly meaningful words, their performance resembled that of 11- and 12-year-olds. That is although all of the words were known to the children, some participants rehearsed items that elicited many associations. The data indicated clear differences in rehearsal as a function of condition. The low meaningfulness group rehearsed fewer than two different items at each opportunity for rehearsal, whereas the high meaningfulness group included more than three items in each rehearsal set, a value characteristic of that of 11- and 12-year olds.

Corsale (1978 in Ornstein & Corsale, 1979) asked 5- and 8-year-olds to group items that "go together" or to group in preparation for recall. The list items were drawn from taxonomic categories, but the salience of the category exemplars was varied (typical/atypical items). While the 8-year-olds showed the tendency to use a task-appropriate strategy, 5-year-olds sorted in a taxonomic fashion only with the highly salient list under instructions to group on the basis of meaning.

In the above instances children used strategies more skillfully when they had greater knowledge of the information to be remembered. Ornstein (1985) has argued that even preschoolers can be deliberately strategic in the context of highly appropriate materials, based on the notion that knowledge system facilitate the execution of more efficient strategies.

To summarize so far, there are three major arguments in respect to development. First, younger children can behave strategically on memory tasks. Second, children's memory involves nonstrategic processes that are automatically stimulated by the knowledge base in terms of an automatic spread of activation in an associative network. Third, age and ability-related changes in strategy use are closely linked to the development of knowledge structures. There is little agreement about the memory processes in respect to the salience of knowledge, and explicit experimental instruction. More systematic studies are needed to explore: (1) How does children's knowledge change with age? It is one thing to characterize children's knowledge at any particular age, and another to describe changes in that knowledge with age and experience; (2) How does knowledge affect memory performance? What are the conditions under which memory may be driven automatically by the activation of the knowledge system? Under what condition is the impact of knowledge mediated by deliberate strategies? In this context, it is essential to describe how social interaction function to support, organize, direct memory function.

Social interaction

Social interaction as an important source of memory performance, and individual cognitive growth, has become a prominent issue in developmental research, suggesting that memory development and individual cognitive development can be aided by social support (e.g., Ellis & Rogoff, 1982; Ratner, 1984).

Social interaction captures well the emphasis on the bidirectional nature of social and cognitive processes in development. In the social process, a partner can increase one's task motivation by energizing expressive and communicative behavior, making the task appear manageable, providing emotional support in a difficult situation, or making a task more enjoyable. These benefits depend on two or more people interacting within the context of the social exchange. At the same time, as a cognitive process, two or more people require goal recognition or definition, planning of behavior around the goal, adopting effective goal-related strategies, monitoring and changing goal-directed behavior, and so on. Social interaction also includes bidirectional influences between social and cognitive processes. The planning, monitoring, motivating, and regulating of behavior have to happen on the interpersonal plane as well as through intrapersonal processes (e.g., Damon, 1984).

There are two distinguishable types of social interaction. Many researchers have studied vertical interaction (represented by adult-child interaction), partly because of the influence of Vygotsky (1978) (e.g., Bruner, 1975, 1983; Rogoff, 1990, 1991). These researchers assume that one member (i.e., the developed person) continues to be more capable than the other (i.e., the developing individual) at every moment of interaction. The other type of interaction is the horizontal interaction (as in child-child interaction). The notion of child-child implies interactions of equal status. Research inspired by Piaget (1932) has emphasized the role of contradiction, especially by child-child, in promoting individual cognitive restructuring. These two kinds of social interaction have consistently been shown to serve different functions in children's development.

1. The role of adult-child interaction.

Most contemporary researchers, working from Vygotskian assumptions (e.g., Bruner, 1975, 1983; Ellis & Rogoff, 1982; Wertsch et al., 1980) have examined the impact of adult-child interaction on children's development. From Bruner's (1975, 1990) notions of 'scaffolding' to Newman, Griffin, and Cole's (1989) concept of 'appropriation' and Rogoff's (1986, 1990) concept of 'guided participation,' all the studies cited entail elaborations of the concept of zone of proximal development.

Vygotsky's (1978) ideas have served as a source of inspiration for this perspective, through his suggestion that individual cognitive development is embedded in a socio-cultural environment that provides tools for thinking and partners who are skilled in the use of such tools, by introducing the concept of 'zone of proximal development.' Vygotsky (1987) defined the zone of proximal development as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p.86). Vygotsky argued that children's interaction with others in the zone of proximal development provides children with the opportunity to carry out cognitive processes jointly that are more advanced than they could manage independently, and that this joint process served as the basis for children's subsequent independent efforts. This transition from other- to self-regulation is the hallmark of Vygotsky's approach. Adaptive "give and take" in a zone of proximal development between adult and child provides structure for new tasks when it is needed, but it also involves subtle demands that stretch the child's competence and influence the eventual incorporation of the external help into the child's own thinking processes. Many researchers (e.g., Brown & Ferrara, 1985; Bruner, 1985; Ellis & Rogoff, 1982) have tried to infer the zone of proximal development and to assess empirically how interaction occurring within this zone promotes self-regulation.

A landmark study conducted by Ninio and Bruner (1978) demonstrated a sequence of interaction through the preschool years that prepare middle-class children for literacy. In this inquiry, they catalogued the shifts in parental attempts to "scaffold" their children's participation in reading bedtime stories before the children had attained literacy. At first, parents were found to engage their children in the interaction by asking them to label objects depicted in pictures, often supplying the answer but asking for confirmation (e.g., "It's a ball, right?") in the case of children with limited vocabularies. Through the process of scaffolding, Ninio and Bruner report, objects and events in stories were related to children's own possessions and experiences. As a result of the carefully modulated interaction during story reading parents were found to enable children to enter the process of telling and reading stories long before they were able to do so on their own. Again, a form of intermental functioning is viewed as occurring before children are able to take over a task on the intramental plane, and the transition from inter- to intramental functioning is viewed as a basic mechanism for intellectual development. However, the majority of researches have not included assessments of children's abilities prior to interaction (e.g., Brown & Ferrara, 1985; Ellis & Rogoff, 1982; Ninio & Bruner, 1978). If one does not establish the lower boundary of the zone of proximal development, that is, children's independent competence prior to the interactive session, interactive effects are difficult to evaluate.

According to Vygotsky's theory, all higher mental functions develop in the context of social interaction. Remembering can be viewed as an activity that is at first jointly carried out by parent and child, then later performed by the child alone. Children may internalize the process of retrieving information from memory through participation in parent-guided conversations about past experience (Eisenberg, 1985; Lucariello, 1987). By providing probes and prompts for children in the form of questions, children can then use this structure to remember information in their conversations.

There have been a number of suggestions that social interaction can support memory development, and a few studies of the question (Rogoff, 1990). Rogoff's concept of "guided participation" (Rogoff, 1990) is an effort to extend Vygotsky's notion of the zone of proximal development. She stresses that children are active in participating in activities with guidance from more skilled people. Both participation and guidance are mutual efforts of children and their partners or companions. Guided participation necessarily involves subtle communication between people as to what new information is needed or appropriate and how it can be made compatible with current levels of skill and understanding. Children and their social partners build bridges from children's current understanding to reach new understanding through processes inherent in communication. The effect of guided participation is supported by several memory tasks in which children, assisted by adults, showed improvement in their memory performance. Four-year-old children remembered slightly more items in a free recall task when their parents were encouraged to assist them in learning the list of items, than when their parents were instructed to present the list without elaboration as in standard laboratory procedures (Mistry & Rogoff, 1987 in Rogoff, 1991). Five-year-olds benefitted from guidance by an experimenter who followed specific scripts varying in the extent of guidance and child participation in learning and remembering the category rationale for a set of common items (Goncu & Rogoff, 1987 in Rogoff, 1991).

The process of internalization is found in the progress of children in using active memory strategies (Ornstein, Baker-Ward, & Naus, 1988). At first a child requires considerable help in using the strategy. At this time information relevant to using a particular strategy in many different contexts becomes internalized. Then the child is able to do so under certain limited conditions; still later, the child can apply the technique in many contexts. Finally, like adults, the child uses many strategies flexibly and efficiently in a wide variety of situations.

Relating of children's early communication and memory, the literature on parent-child conversational exchanges documents the parent's expertise as a conversational partner. This interaction is guided by the adult so as to guarantee successful and ever increasing participation by the child. The parent provides communicative support that is calibrated to the child's levels of competence. Adults lessen and eventually remove particular forms of support as the child becomes able to operate without support or to glean support from other sources, such as the physical setting or mental representations (e.g., French, Lucariello, Seidman, & Nelson, 1985; Lucariello, 1987; Hudson, 1990). Peters (1986) provides a careful longitudinal analysis of parental support and child participation in collaborative storytelling between a 2-year-old and his father. Deloache (1984) notes the supportive role of mother's memory questions in picture-book reading. Toddlers whose mothers managed conversations about past events by rephrasing and elaborating their questions recounted more information in more coherent narrative form several years later

(Fivush & Hudson, 1990). Ratner (1984) found that mother's memory-demand questions were correlated with children's performance on memory tasks at ages 3 and 4. Ratner argued that children internalize the use of questioning and retrieval cues first provided by parents in order to search their own memories.

2. The role of child-child interaction.

From the perspective of contextual influences on development, peer interaction is not studied as often as adult-child interaction. Several researchers have, nevertheless, recently argued that peer contexts are central to the child's social construction of reality (Azmitia & Perlmutter, 1989; Damon & Phelps, 1989).

Piaget (1932) distinguished between adult-child interaction, in which an adult authority figure controls the goals and course of an activity, and child-child interaction, in which negotiation and persuasion among equals lead to the elaboration of children's understanding of how to generate and coordinate the goals of activity. Due to the relatively symmetrical nature of child-child interaction (i.e., relatively little cognitive and social distance between peers), such interaction often would be more conducive to cognitive process than would more asymmetric interaction. This emphasis on symmetrical interaction is derived from Piaget's notion that children are assumed to be actively involved in seeking out and even generating data that nourish the development of their cognitive schemes. Symmetrical relations are also more likely to present new information in such a way that children can understand the nature of the discrepancy between their ideas and those of others and resolve the conflict productively.

Piaget (1932) also proposed that social input becomes instrumental for cognition during the transition from preoperational to concrete operational thinking. Very few researchers have explored the contribution of child-child interaction to preschool children's cognitive development. Some studies have shown that preschool children can solve problems interactively (e.g., Cooper, 1980) and that they are more engaged and enjoy joint problem solving more than solitary problem solving. In addition, some types of child-child interaction are more conducive to learning than solitary (Azmitia, 1988), and interactive gains can generalize to preschool children's subsequent individual performance (Azmitia, 1988). Nevertheless, many studies have failed to produce evidence that for preschool children interactive contexts promote more productive activity or greater learning than solitary situations (Bearison et al., 1986; Gauvain & Rogoff, 1985; Perret-Clermont, 1980). These findings may support Piaget's claim that there are developmental constraints on child-child interaction benefits.

Research on child-child collaboration has been conducted by a group of Genevan psychologists (e.g., Perret-Clermont, 1980). They have conducted a series of experiments to examine the effect of child-child collaboration on logical reasoning skills associated with the Piagetian stage of concrete operations: perspective taking, conservation, and so on. Most of the Genevan research employs a training study design in which subjects are randomly assigned to treatment or control groups in which they are exposed to different social contexts.

Perret-Clermont (1980) suggests that the child-child process of active cognitive reorganization is induced by cognitive conflict. She claims also that cognitive conflict is most likely to occur in situations where children with moderately discrepant perspectives are asked to reach a consensus. The results are increased ability to use concrete operational logic. It appears that Perret-Clermont's notion that cognitive conflict is the mediator between children's interaction and cognitive reorganization can be tested best in contexts where overt manifestations of conflict are likely. Perret-Clermont's hypothesis about the importance of cognitive conflict comes from Piaget's theory concerning the role of social factors in development.

Piaget (1970) identified four factors that he believed are necessary for a theory of cognitive development: maturation, experience with the physical environment, social experience, and equilibration or self-regulation. In addition, Piaget claimed that equilibration is the most fundamental of the four factors. Child-child interaction, and social experiences in general, derive their importance from the influence they can exert on equilibration through the introduction of cognitive conflict.

When Piaget looks at child-child interaction, therefore, he looks for evidence of disequilibrium, that is, cognitive conflict. He is not interested in describing or explaining social interactional processes as a whole. Piaget's theory is most helpful in explaining those situations where cognitive conflict is clearly and overtly expressed in external social behaviors. For Piaget, social interaction completes cognitive structures.

From a Vygotskian perspective, Forman (1981 in Forman & Cazden, 1985), and Forman and Cazden (1985) examined the collaborative aspects of child-child interaction. These studies do not derive from the Piagetian assumption that child-child interaction provokes disturbances in individual that he or she then reuses alone. Instead, they proceed from the assumption that child-child interaction facilitates development by enabling children to carry out aspects of tasks together that they could not perform alone, and which they rarely get the chance to perform with adults.

Forman (1981 in Forman & Cazden, 1985) had fourth- and seventh-grade students work in pairs to perform a "shadows" task, which consisted of matching three-dimensional shapes to projected shadows of two-dimensional shapes on a screen. She reported that some of the dyads worked collaboratively, shifting roles in the task from tester to evaluator. Forman argued that, especially when operating as a dyad, the children developed analytic skills they did not demonstrate individually.

Although little research on the influence of child-child interaction on memory development has been directly examined, it is plausible that the studies of children's peer conversations may be helpful understanding the role of child-child interaction in memory development. Nelson and her colleagues have discussed the role of generalized event representations (script) in supporting children's peer conversations (Nelson & Gruendel, 1979; Nelson & Seidman, 1984; French et al., 1991). They suggest that very young children have detailed and well-structured knowledge about events in which they participate regularly, such as eating lunch and going to McDonald's. Nelson and Gruendel (1979) reported that preschool children engage in true dialogue when a shared knowledge base (script) exists. For example, a lunch-time script was hypothesized to account for the demonstration of background knowledge of objects and people in a dialogue between two 4-year-old children. Shared script knowledge was suggested to help structure and maintain dyadic interaction, acknowledge mutual understandings, and resolve misunderstandings. Nelson and Gruendel characterized the dialogue as 'true communication,' because it was said to have included turn taking, joint conversation, elaboration, and coordination. Shared script knowledge may provide a bridge between solitary play and interactive play by providing a context within which each partner can make contributions that are understandable to the other (Nelson & Seidman, 1984). Similar findings have been reported by Furman and Walden (1990).

French et al., (1991) studied the question of how children become able to communicate with their peers. Their hypothesis is that a central factor in young preschooler's (ages two to three) ability to communicate with their child-child is the underlying knowledge base they can activate and draw upon. Original data show that children are able to practice talking with one another while bypassing their difficulties in taking the perspectives of the other and establishing shared presuppositions to support the interpretation of utterances. They suggested that physical settings that elicit shared knowledge and hence shared presuppositions facilitate young children's communications with one another. Successful communication always involves shared meaning: drawing some of this shared meaning from environmental sources makes communication easier and more likely.

Scripts provide a framework of shared knowledge between individuals about routine situations or interaction. Scripts can enable individuals to make inferences about unstated events and establish roles and goals to help maintain communicative exchanges. Individuals who are familiar with events are better able to generate component actions and may know more about individual's roles and common items used in such events than individuals who are less familiar with these scripts (Chi & Glaser, 1985; Nelson, 1986).

Recently, several studies have compared the effects of adult-child and child-child interaction on the development of skills and knowledge (e.g., Gauvain & Rogoff, 1989; Rogoff, 1990). Most of this research tends to treat child-child interaction as mimicking, perhaps poorly, the interaction between adults and children that facilitates development.

In Gauvain and Rogoff (1989)'s study, 5-year-olds worked in dyads with adults or with age-mates to plan routes through a model grocery store. They found that when a dyad (adult-child or child-child) shared the responsibility for generating the plan, the children showed greater use of advanced planning when performing a later task alone. Children who had worked alone on planning efficient routes through the store performed as well later as did children who had worked with peers or with their mothers. Simply having a partner did not increase the efficiency of routes planned by these children. However, the children who shared decision making in their interaction with partners performed better than did children who had worked alone and better than children who had a partner but had not worked jointly. They concluded that coordinated interactions rather than independent functioning appears to facilitate the development of planning strategies.

However, Damon (1984) points out adult-child and child-child interaction may make 'unique' and 'complementary' contributions to children's intellectual development. In his view, adult-child interaction is necessary for the child's development of new knowledge and existing social rules and institutions. In contrast, child-child interaction "can provide a forum for discovery learning [and] can introduce children to the process of generating ideas and solutions with equals" (p.335). Damon's arguments concerning the difference between adult-child and child-child interaction are grounded in the ideas of Piaget, the theorist most often juxtaposed to Vygotsky in discussions of the social origins of intellectual development.

The literature on social interaction indicates that socio-cognitive conflict (Piaget) and internalization of regulation (Vygotsky) are two dominant mechanisms proposed to account for social facilitation of cognition. The similarity between Piagetian and the Vygotskian perspectives is in noting that both of their mechanisms imply some level of conflict. However, the two perspectives differ in at least two important ways. First, Vygotsky allocated a more important role to social interaction than Piaget. Thus, for Vygotsky, the problem is to specify how the social is translated into the individual. For Piaget, the opposite is the case; that is, researchers in this tradition must incorporate a social mechanism into a theory of individual development and explain why social conflict is more conducive to change than nonsocial conflict. Second, although Piaget claimed that symmetric interaction is more conducive to learning, Vygotsky emphasized the contribution of asymmetric interaction.

Thus, not all social interaction has the same characteristics. The interesting question is whether there are systematic links between certain types of social interaction and certain types of memory components. Children participate in a variety of structurally different relationships that have different effects on development because of the different interactional processes characterizing them. At the same time, children bring their own developmental and individual characteristics to these relationships. Hence, the processes that are presumably universal within horizontal or vertical relationships, by virtue of the structural features of these relationships, also possess the uniqueness and variety of the children who participate.

Conclusion and hypotheses

Memory is viewed through the literature reviewed as a cognitive activity embedded in larger social and cognitive tasks. Thus, an important direction in memory development research has been to investigate the content, organization, and accessibility of children's emerging knowledge structures as well as the interaction between developing memory ability and social context. Studies are needed to determine what kind of knowledge structures children bring to that experience and whether children can make sense of the structure of the experience in what kind of type of social interaction.

The goal of this study was to integrate the isolated variables that affect children's memory performance attending to both the individual processes and social processes. On the individual process side, this study will consider the developmental changes in category knowledge structure and the emergence of the ability to use strategies. On the social process side, the social context depends on the experimenter's instruction and social interaction. This study is a starting point in integrating variables which affect children's memory development.

This study is designed as cultural comparison. Young Korean-speaking children residing in Korea participated in the two experiments. First, the slot-filler list was contrasted with a taxonomic list that has been previously rated and recognized by younger Korean children. Second, there were three social context conditions in the experiment 1: (1) a remember instruction condition where children were permitted to use any of their own strategies; (2) a sorting instruction condition where a memory task was used as a game and the children do not receive any information that they would have a memory test; (3) a strategy instruction condition where children received the organizational strategies and category knowledge information as input.

In experiment 2, there was more focus on adult and child social interaction. To establish children's independent competence an alone group and two kinds of interaction groups are compared. The alone group was used as a baseline measure of children's competence.

The present study was intended to: (1) specify developmental changes in category knowledge, (2) identify the child's early attempts at memorization and explore changes in spontaneous organizational strategy in the social context, and (3) describe the characteristics of relation between category knowledge and the strategic attempts to use that information under social influences. These main goals were set with the understanding that memory development reflects the complementary dimensions of individual processes and social context during childhood.

General hypotheses and specific predictions follow:

Hypothesis I. There is a relation of age to the styles of knowledge organization.

Prediction 1: Younger children's (i.e., 4-year-olds) memory performance will be better in the slot-filler list than taxonomic list.

Prediction 2: Older children's (i.e., 7-year-olds) memory performance will show no difference between taxonomic list and slot-filler list because older children have already formed two categories in the semantic memory system.

Hypothesis II. There is a relation of age to the use of strategies.

Prediction 1: Younger children's memory performance will be nonstrategic because it is the result of automatic processes based on their knowledge; younger children's performance will be better in the sorting instruction and strategy instruction than in the remember instruction.

Prediction 2: Younger children will be able to use strategies spontaneously; younger children will show better performance in the remember instruction than in the sorting instruction.

Prediction 3: Older children's memory performance will be nonstrategic; older children's memory performance will be better in the sorting instruction and in the strategy instruction than in the remember instruction.

Prediction 4: Older children will use strategies spontaneously. By using strategies, they will have better performance than without strategies; older children's memory performance will be better in the remember instruction than in the sorting instruction. Older children's memory performance will show no difference between in the remember instruction and in the strategy instruction.

Hypothesis III. There is a relation of age and list variable to instruction.

Prediction 1: Children will have better performance in the sorting instruction than in the remember instruction.

Prediction 2: Younger children will show better performance in the strategy instruction than in the sorting instruction and in the remember instruction in the slot-filler list.

Prediction 3: Younger children's memory performance will show no difference between the strategy instruction and the sorting instruction in the taxonomic list.

Prediction 4: Older children will show better performance in the strategy instruction than in the sorting instruction and in the remember instruction in either lists.

Hypothesis IV. There is a relation of age and list variable to social interaction.

Prediction 1: Younger children will show better performance in the child-child interaction than in the alone condition in the slot-filler list.

Prediction 2: Younger children's memory performance in the taxonomic list will show no difference between the child-child interaction and the alone group.

CHAPTER II

EXPERIMENT 1

Method

Subjects. One hundred twenty Korean children participated in experiment 1. The group consisted of sixty 4-year-olds (mean age 4 years, 3 months) and sixty 7-year-olds (mean age 7 years, 1 months). The four-year-old group consisted of 28 females and 32 males, and the 7-year-olds, 27 females and 33 males. Children were selected from a nursery school and a public school in a middle class urban neighborhood in Daegu, Korea. They were all monolingual native Korean speakers. There were 10 children in each of six conditions in each age group.

Materials. Two recall lists of twelve photographic items were selected as test items. All of the items were familiar to nursery school children. Each photograph was developed on a 3 x 5 inch card. The photographs were then covered with transparent contact paper to prevent soiling. The taxonomic list, containing 4 items from each of 3 taxonomic categories, was constructed on the basis of typicality rated by 5-year-old Korean speakers (Sung, 1986) and a category production task (Yu & Nelson, 1993). The slot-filler list, containing 4 items each of 3 subcategories, was composed of frequent responses given to three subcategory questions based on the category production task (Yu &

Nelson, 1993). Twenty nursery school children recognized the lists of photographs through a procedure of naming of the photographs in the pilot study. The two lists are presented in Table 1.

TABLE 1

Two Recall Lists

Taxonomic List

Animals: bear dog elephant pigeon

Clothing: hanbok hat suit underwear

Food: apple mandu mixed noodle kimbob

Slot-filler list

Breakfast: boiled rice eggfry fish kimchi

Clothing going to school: jackets pants socks t-shirt

Zoo animals: elephant lion monkey sea lion

Procedure. Each child from each age group was assigned randomly to one of six experimental conditions. The six conditions in each age group were composed as follows: taxonomic list/remember; taxonomic list/sorting; taxonomic list/strategy; slot-filler list/remember; slot-filler list/sorting; slot-filler list/strategy.

Each child was tested individually in a quiet room and received a practice trial and performed a free recall task. Both were administrated by the same experimenter. Before the experimental task, a practice trial using other photographs was given to ensure that children understood the task demands.

Remember instruction: The experimenter gave the child the following instructions as translated into Korean: "We are going to play a game of naming the photograph. First, we are going to say the names of some photographs and when we are done, I'm going to ask you how many you can remember. So first, I'll say them and then you say them." The experimenter then said the name of each photograph at the rate of one every 3 seconds, allowing the child to repeat each name before going on the next one. The lists were presented in a blocked order. After all photographs were presented, the child was given about 3 minutes to memorize the names of items, and then the child received the free recall task.

Sorting instruction: The experimenter laid out the photographs in random order prearranged for each subject individually and gave the child the following instructions: " We are going to play a game of selecting the photograph. Do anything you would like with the photographs? We can select and name them. So first I'll say them and then you select them with saying the names of photographs, and I'll ask the names of photographs and then you answer the names of them." The experimenter then said the name of each photograph at the rate of one every 5 seconds, allowing the child to select and speak each name, and asked the name of each photograph and then the child answered before going on the next one. The lists were called in a blocked order. The experimenter put each photograph which the child selected and named on the next table in the blocked order. The child could look freely at the photographs on the next table. With the selecting and naming procedure completed, the experimenter removed all of photographs on the next table and the child was immediately asked what he or she remembered. In the sorting instruction, at the beginning the experimenter did not inform the child that he or she would perform the free recall task after the selecting and naming game. The children immediately received the free recall task at the end.

Strategy instruction: The experimenter laid out the photographs. Each row contained the items from a given category with the order of categories and of items within a category randomly prearranged for each subject. The experimenter informed the child that the child would receive the free recall task after the game was done and gave the child the general explanation about the relations of items within a category and the questions which emphasized the purpose of an organization strategy as follows: " We are going to put together things that are similar, such as all the food. It will be easier to remember." The experimenter showed the four photographs of the food and said the name of each and put them on the next table. The experimenter said "we're put thing together all the food, aren't we? I will ask you the name of each photograph and then you tell me the name of it." After checking the name, the experimenter asked, "Why did we put these photographs together?." The child gave answers such as food or the similarity of the photographs, and so on. Correct answers were provided if the child did not provide them. The experimenter showed the four items in each category, and explained the relation of the items within a category, asked the name of each item, and then asked the reasons for putting the four items together. After the explanation and question about the relation of items in one category, the experimenter continued the same procedures in the other categories. The lists were called in a blocked order. After all the photographs were presented, the experimenter removed all of them from the table by the blocked order, and the child was immediately asked what he or she remembered.

In the free recall task with all three sets of instructions, when a child stopped responding, additional memory prompts were given until the child indicated that he or she could not remember any more items. It took about 9-10 minutes per child in each of the three sets of instructions. Responses were written down and tape recorded in the order in which they were provided for later verification by the experimenter.

There were differences in the three instructions. Whereas the remember and strategy instruction told the child that he or she would receive a free recall task at the beginning with the following instructions: "I'm going to ask you how many you can remember," the sorting instruction did not give this information. Whereas in the remember instruction condition the children had 3 minutes to remember items, in the sorting instruction condition the children played with and sorted the photographs with the experimenter and received the free recall task immediately (i.e., they had no specific memorizing time), In the strategy instruction condition, the experimenter guided the children to the better memory performance by suggesting category knowledge and the organization strategy by questions about the relations of items within a category. They also received the free recall task instruction immediately after they were done. So, the remember instruction permitted the use of any of the children's own strategies, if they had them. In the sorting instruction memory procedure was used as a play and sort, and in the strategy instruction, guided category knowledge and strategies were used.

Results

A 2 (age group) x 2 (list type) x 3 (instruction) factorial design was employed with the between-subjects variables partitioned by age group (4-year-olds and 7-year-olds), list type (taxonomic list and slot-filler list), and instruction (remember, sorting, and strategy). Analyses were carried out separately on the total items recalled, clustering scores, and latencies between items as dependent variables. ARC and RR used as clustering scores and the results of ARC present in the Appendix A-1.

Recall. The mean number of items recalled is shown in Table 2. The

ANOVA, computed on the total items recalled, revealed significant main effects of age group, $F(1,108) = 213.14$, $p < .001$, list type, $F(1,108) = 26.50$, $p < .001$, instruction, $F(2,108) = 78.83$, $p < .001$, an age group by list type interaction, $F(1,108) = 12.14$, $p < .005$, and an age by instruction interaction, $F(2,108) = 9.50$, $p < .001$.

TABLE 2

Mean number of items recalled by Age group, List type and, Instruction condition (s.d.s in parenthesis)

Age & List type	Instruction: Remember	Sorting	Strategy	Mean
4-year-old				
Taxonomic	5.20	5.40	8.20	6.27
	(.92)	(.84)	(.79)	
Slot-filler	6.00	7.20	10.80	8.00
	(.82)	(1.23)	(1.03)	
7-year-old				
Taxonomic	9.20	9.40	11.10	9.90
	(1.32)	(1.65)	(.74)	
Slot-filler	9.30	10.10	11.30	10.23
	(1.89)	(.74)	(.48)	
Mean Taxonomic	7.20	7.40	9.65	8.08
Mean Slot-filler	7.65	8.65	11.05	9.12

As can be seen in Table 2, the main effect of age group rests on the fact that the 7-year-olds ($\underline{M}$ = 10.07) produced more than 4-year-olds ($\underline{M}$ = 7.13).

The main effect of list type reveals that more slot-filler items ($\underline{M}$ = 9.12) were produced than taxonomic items ($\underline{M}$ = 8.08). The main effect of the instruction condition shows that the children who received the list in the strategy instruction ($\underline{M}$ = 10.35) produced more than in the sorting instruction ($\underline{M}$ = 8.03) and in the remember instruction ($\underline{M}$ = 7.43). Student Newman-Keuls post hoc test ($\underline{p}$ < .05) showed no significant difference between the sorting instruction and the remember instruction.

Figure 1 presents the age group by list type interaction. The 4-year-olds produced more in the slot-filler list than in the taxonomic list [$\underline{F}(1,54)$ = 52.00, $\underline{p}$ < .001], whereas for the 7-year-olds there was no significant difference in the number of items recalled in these two lists.

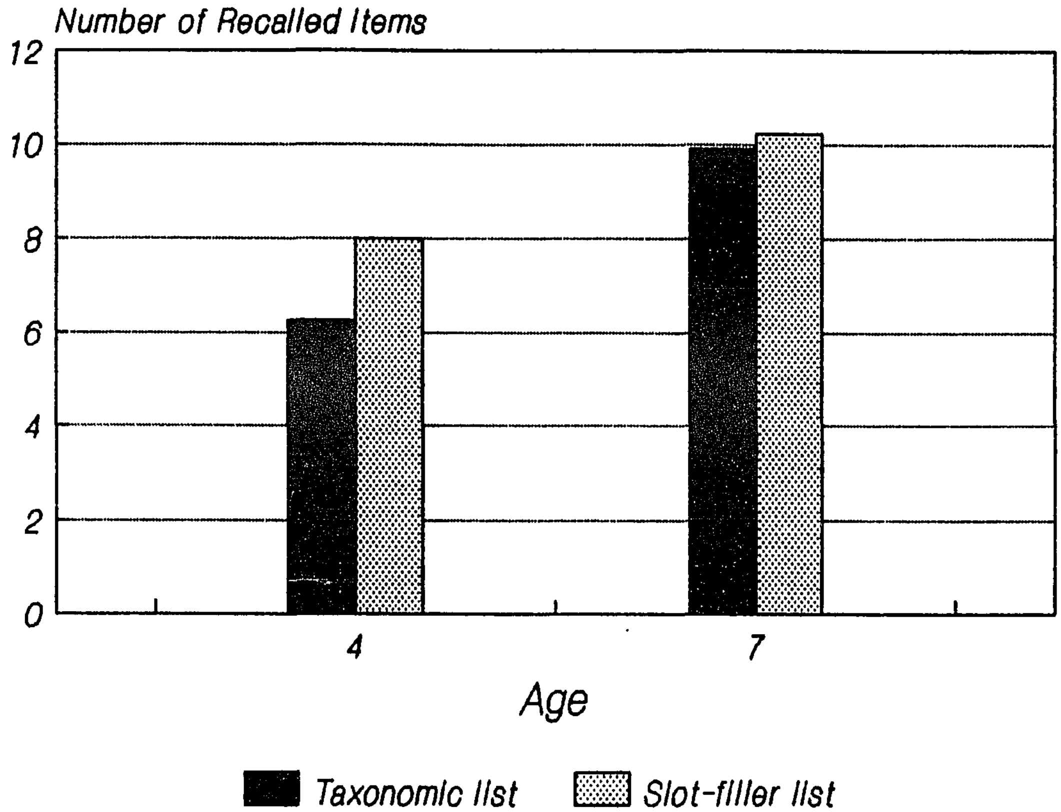


Figure 1. Number of recalled items as a function of age in taxonomic and slot-filler list interaction.

Figure 2 presents the age group by instruction interaction. The 4-year-olds [$\underline{F}(2,54) = 99.77$, $\underline{p} < .001$], and the 7-year-olds [$\underline{F}(2,54) = 20.57$, $\underline{p} < .001$] respectively produced more in the strategy instruction than in the sorting instruction and in the remember instruction. Student Newman-Keuls post hoc tests ($\underline{p} < .05$) showed that there were significant differences between the strategy instruction and the remember instruction, and between the strategy instruction and the sorting instruction whereas there was no significant difference between the remember instruction and the sorting instruction in the 4-year-olds and 7-year-olds.

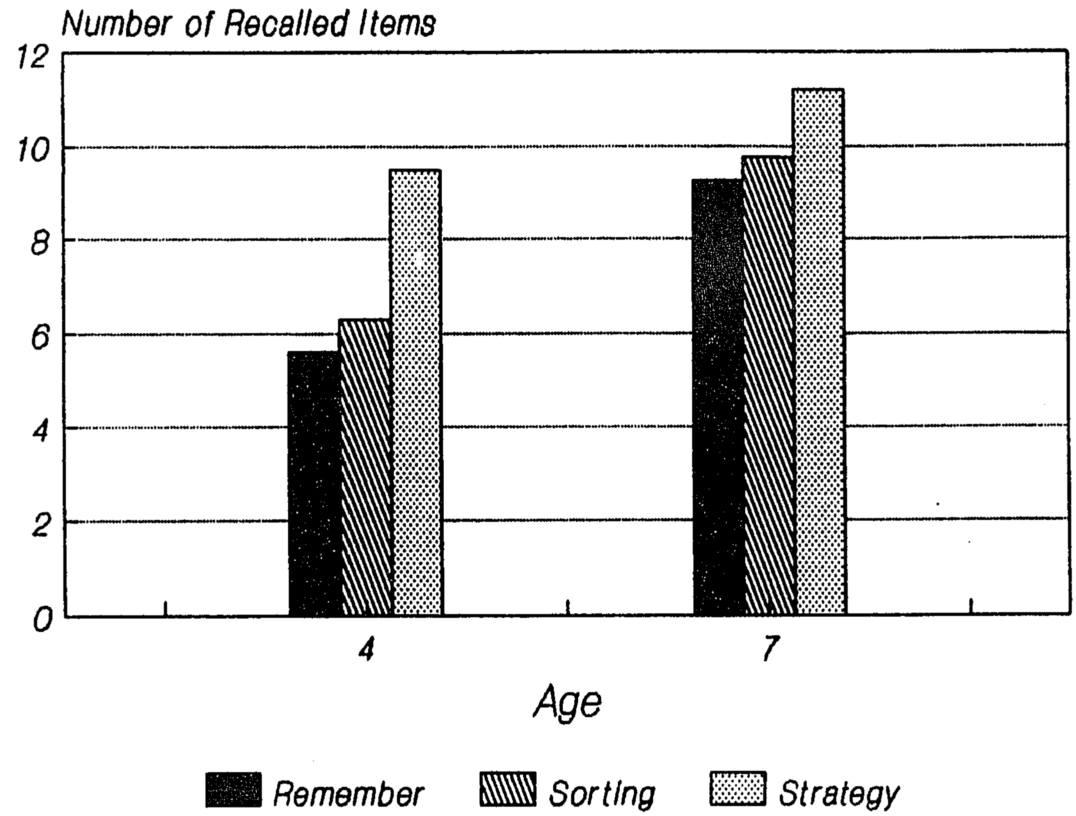


Figure 2. Number of recalled items as a function of age in remember, sorting, and strategy instruction interaction.

It is noticeable that 4-year-olds produced more items from the slot-filler list than from the taxonomic list in each instruction condition [remember: $t(18) = 2.06$, $p < .05$; sorting: $t(18) = 4.02$, $p < .001$; strategy: $t(18) = 6.33$, $p < .001$] whereas for 7-year-olds, there were no significant differences between these two lists in each instruction. For the 4-year-olds, the list type by instruction interaction [$F(2,54) = 4.69$, $p < .05$] reveals that for the slot-filler type, 4-year-olds produced more in the sorting instruction than in the remember instruction (Student Newman-Keuls test, $p < .05$), whereas for the taxonomic list there was no significant difference in these two instructions. The 4-year-olds produced more in the strategy instruction than in the sorting instruction and in the remember instruction in the taxonomic list and the slot-filler list (Student Newman-Keuls test, $p < .05$). The 7-year-olds produced more in the strategy instruction than in the sorting instruction and in the remember instruction (Student Newman-Keuls test, $p < .05$), whereas there was no significant difference between the remember instruction and the sorting instruction in either lists. The results of post hoc test are presented in Table 3.

TABLE 3

Student Newman-Keuls Post hoc Test (*: $p < .05$)

Age &	Taxonomic list			Slot-filler list		
Instruction	G1	G2	G3	G1	G2	G3
4-year-olds						
Remember (G1)						
Sorting (G2)				*		
Strategy (G3)	*	*		*	*	
7-year-olds						
Remember (G1)						
Sorting (G2)						
Strategy (G3)	*	*		*	*	

Organization. The ratio of repetition (RR) score (Bousfield, 1953 in Murphy, 1979) was used as an index of clustering in recall. Frender and Doubilet (1974) suggest that the ratio of repetition index may be better than the other clustering measures for detecting developmental change. This measure assesses category repetitions relative to the number of items recalled. This score is defined as r/(n-1), where 'r' is the number of intracategory repetitions observed in recall and 'n' is the total number of items recalled. The chance value of the RR for the selected lists is .217, and the maximum value is .870.

The ANOVA computed on Ratio of Repetition (RR) scores revealed significant main effects of age group [$F(1,108) = 109.09$, $p < .001$], list type [$F(1,108) = 32.46$, $p < .001$], instruction [$F(2,108) = 52.97$, $p < .001$], an age group by list type interaction [$F(1,108) = 24.68$, $p < .001$], and an age group by instruction interaction [$F(2,108) = 5.25$, $p < .01$]. Mean RR scores are shown in Table 4.

TABLE 4

Mean score of RR by Age group, List type and, Instruction condition (s.d.s in parenthesis)

Age & List type	Instruction: Remember	Sorting	Strategy	Mean
4-year-old				
Taxonomic	.255	.345	.578	.393
	(.215)	(.159)	(.141)	
Slot-filler	.460	.572	.718	.583
	(.052)	(.092)	(.071)	
7-year-old				
Taxonomic	.615	.631	.759	.668
	(.058)	(.075)	(.066)	
Slot-filler	.611	.667	.765	.681
	(.083)	(.063)	(.088)	
Mean Taxonomic	.435	.488	.669	.531
Mean Slot-filler	.536	.620	.742	.632

Seven-year-olds showed higher clustering (M = .675) than 4-year-olds (M = .488). Children who received the slot-filler list (M = .632) showed higher clustering than children who received the taxonomic list (M = .531). Children who received the list in the strategy instruction (M = .705) showed higher clustering than children who received the list in the sorting instruction (M = .554) and in the remember instruction (M = .485).

Figure 3 presents the age group by list type interaction. The 4-year-olds showed significantly higher clustering in the slot-filler list than in the taxonomic list [$F(1,54) = 39.09$, $p < .001$], whereas for the 7-year-olds there was no significant difference in the score of clustering produced in these two lists.

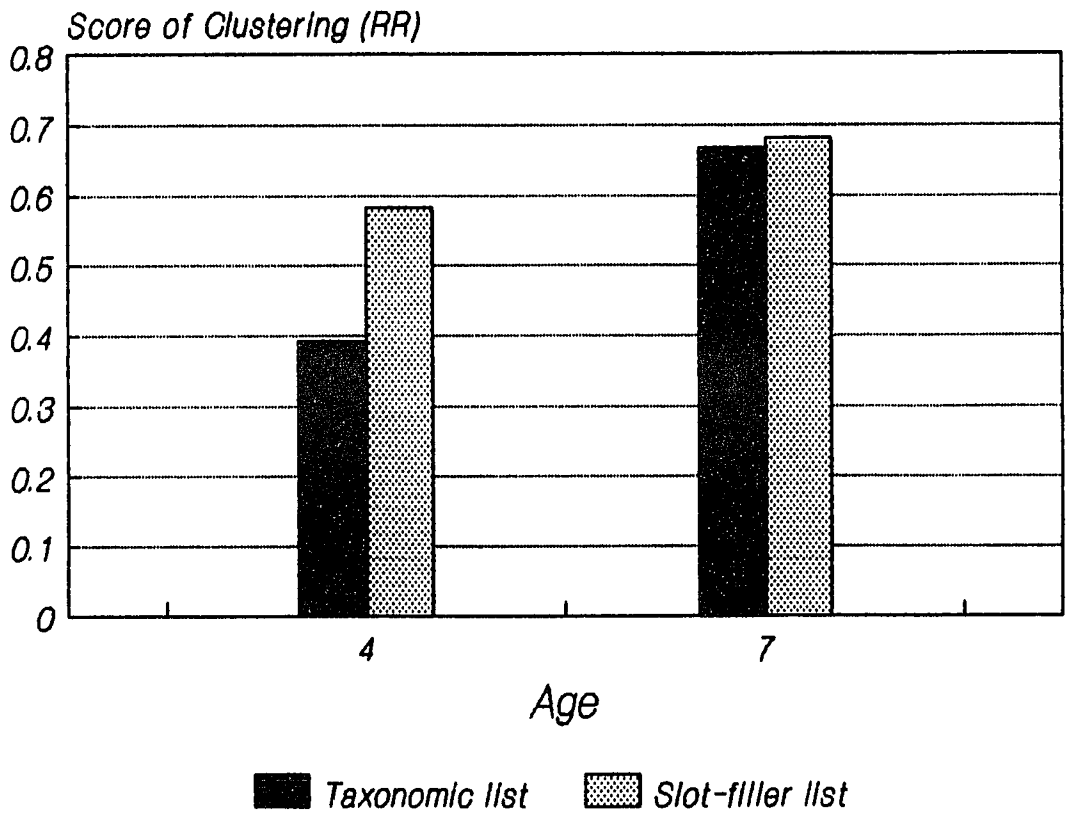


Figure 3. Score of clustering (RR) as a function of age in taxonomic and slot-filler list interaction.

Figure 4 presents the age group by instruction interaction. The 4-year-olds [$F(2,54) = 31.32$, $p < .001$], and the 7-year-olds [$F(2,54) = 23.22$, $p < .001$] respectively produced more in the strategy instruction than in the sorting instruction and in the remember instruction. Student Newman-Keuls post hoc tests ($p < .05$) showed that for the 4-year-olds there was no significant difference between the remember instruction and the sorting instruction, whereas for the 7-year-olds there was a significant difference between the remember instruction and the sorting instruction. For both 4-year-olds and 7-year-olds there were significant differences between the strategy instruction and the remember instruction, and between the strategy instruction and the sorting instruction.

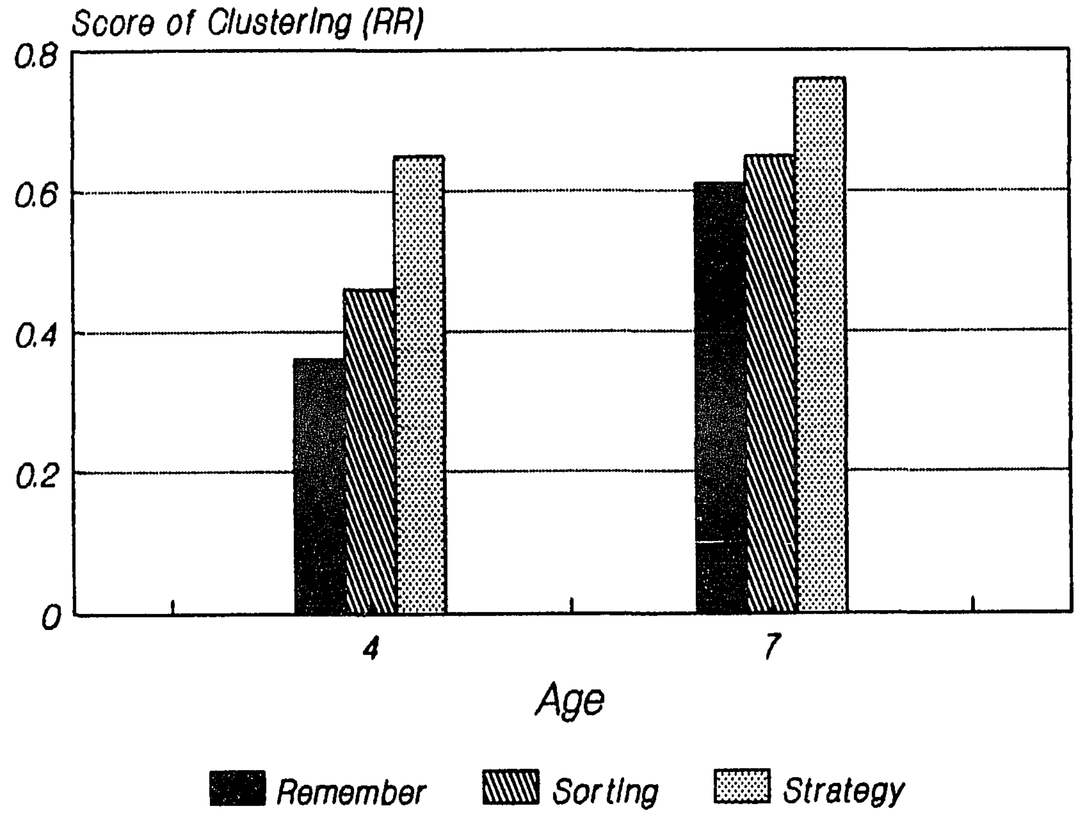


Figure 4. Score of clustering (RR) as a function of age in remember, sorting, and strategy instruction interaction.

It is noticeable that 4-year-olds showed higher clustering of the slot-filler list than of the taxonomic list in each instruction [remember: $t(18) = 3.15$, $p < .005$; sorting: $t(18) = 3.90$, $p < .001$; strategy: $t(18) = 5.13$, $p < .001$] whereas for 7-year-olds, there were no significant differences between these two lists in each instruction. For the 4-year-olds, although a list type by instruction interaction was not evident [$F(2,54) = .732$, n.s], for the slot-filler list 4-year-olds showed higher clustering in the sorting instruction than in the remember instruction (Student Newman-Keuls test, $p < .05$). For the taxonomic list, however, there was no significant difference in these two instruction conditions. The 4-year-olds showed higher clustering in the strategy instruction than in the sorting instruction in the taxonomic list and slot-filler list (Student Newman-Keuls test, $p < .05$). The 7-year-olds showed higher clustering in the strategy instruction than in the sorting instruction and the remember instruction (Student Newman-Keuls test, $p < .05$), whereas there were no significant differences between the remember instruction and the sorting instruction in these two lists. The results of post-hoc test are presented in Table 5.

TABLE 5

Student Newman-Keuls Post hoc Test (*: $p < .05$)

Age &	Taxonomic list			Slot-filler list		
Instruction	G1	G2	G3	G1	G2	G3
4-year-olds						
Remember (G1)						
Sorting (G2)				*		
Strategy (G3)	*	*		*	*	
7-year-olds						
Remember (G1)						
Sorting (G2)						
Strategy (G3)	*	*		*	*	

Latencies. Since it has been argued that relatively rapid consecutive recall of several items from the same category is more likely to indicate strategic category organization than the measure of clustering considered alone (e.g., Bjorklund, 1988), within-category latencies in comparison to between-category latencies were analyzed to further examine the quality of children's clustering. Latencies between consecutively recalled items in the categories were obtained for all subjects. An observer, unaware of the purpose of experiment, listening to a tape of the testing session, signaled latencies between items by pressing the spacing bar on a microcomputer terminal. Latencies were recorded to three decimals (i.e., milliseconds), and were classified as within-category (i.e., two items from the same category were recalled consecutively) or between-category (i.e., two items from different categories were recalled consecutively). Latencies involving repetitions and intrusions were omitted, as were latencies in excess of 25 seconds. Since all children had at least one between-category latency and nearly all subjects (117 of 120) were found to have at least one within-category latency, mean latencies for both lists were computed per subject.

An age group (2) x list type (2) x instruction condition (3) x latency type (2) ANOVA with the last factor repeated within subjects was performed. This analysis indicated significant main effects of age group, $F(1,105) = 5.35$, $p < .05$, list type, $F(1,105) = 5.17$, $p < .05$, latency type, $F(1,105) = 139.73$, $p < .001$ and an age group by list type interaction, $F(1,105) = 4.23$, $p < .05$. Mean latencies are presented in Table 6.

TABLE 6

Mean Latencies by Age group, List type, Instruction condition, and Latency type (s.d.s in parenthesis)

	Taxonomic List		Slot-filler List	
Instruction	WIT	BTW	WIT	BTW
4-year-olds				
Remember	3.432	6.647	2.528	4.206
	(1.991)	(3.891)	(1.345)	(2.457)
Sorting	3.906	5.675	2.559	4.273
	(1.585)	(1.395)	(1.125)	(1.657)
Strategy	3.949	6.993	2.611	6.208
	(1.641)	(1.434)	(1.122)	(1.819)
7-year-olds				
Remember	2.850	4.727	2.449	4.036
	(1.630)	(2.364)	(1.068)	(2.281)
Sorting	2.470	4.673	2.602	3.556
	(1.352)	(2.918)	(1.138)	(1.556)
Strategy	2.973	4.617	2.843	2.447
	(1.289)	(1.215)	(.843)	(1.325)
Mean Remember	3.141	5.687	2.489	4.121
Mean Sorting	3.188	5.174	2.581	3.915
Mean Strategy	3.461	5.805	2.727	4.328

Note. WIT: Mean latencies between consecutive two items from a same category.

BTW: Mean latencies between consecutive two items from different categories.

As can be seen in Table 6, the 7-year-olds ($\underline{M}$ = 3.354) had shorter latencies than the 4-year-olds ($\underline{M}$ = 4.416) between consecutively recalled items within categories. Children who received the slot-filler list ($\underline{M}$ = 3.360) had shorter latencies than children who received the taxonomic list ($\underline{M}$ = 4.409). Children had shorter latencies of within-category ($\underline{M}$ = 2.931) than between-categories ($\underline{M}$ = 4.838).

Subsequent examination reveals the age by list type interaction. The 4-year-olds had shorter latencies in the slot-filler list than in the taxonomic list [$\underline{F}(1,51) = 10.17$, $\underline{p} < .005$], whereas for the 7-year-olds there was no significant difference in the latencies in these two lists.

Distribution of Subjects classified as Strategic. The evaluation of children's strategic organization is based on individual differences within groups and thus provides information that is restricted to groups of children. To classify individuals as being strategic or not strategic, Bjorklund (1988; Bjorklund & Buchanan, 1989) has recently proposed that the joint incidence of (a) at least one intracategory cluster of three or more items and (b) faster mean within-category interitem latencies than mean between-category interitem latencies.

However, a child who discovers the categorical structure of a list and deliberately begins to search for the items of one category in his or her own semantic memory may produce very long within-category latencies when looking for additional items of a retrieved category. These long within-category latencies will be the result of a very well-controlled strategic behavior, but may lead to slower within-category latencies than between-category latencies. Thus, to identify the tendency of very long within-category latencies in the within-category latencies, the difference among the means of the within-category latencies (i.e., faster within-category latencies vs. slower within-category latencies) was tested across 59 subjects (fifteen 4-year-olds and forty-four 7-year-olds). The results reveal that only two 4-year-olds (1 slot-filler/sorting: $t = 2.23$, $p < .10$; 1 taxonomic/strategy: $t = 2.26$, $p < .10$) showed significant differences among the means of the within category latencies, but these children showed faster means for within-category latencies than for between-categories. The other children (thirteen 4-year-olds and forty- four 7-year-olds) showed no significant difference ($p < .10$) among the means of the within-category latencies. So, these results suggest that the faster within-category interitem latencies would be the controlled strategic behavior and can be used as a strategic criterion. The results of the test of mean comparisons present in Appendix B.

Thus, in this study, for children's strategic use of category organization, subjects were classified as behaving strategically if (a) their clustering score is reliably above chance (i.e., at least 1 SD above the chance level), and (b) they show faster mean within-category interitem latencies than mean between-category interitem latencies. Figure 5 presents the percentage of children classified as strategic on the basis of this criteria.

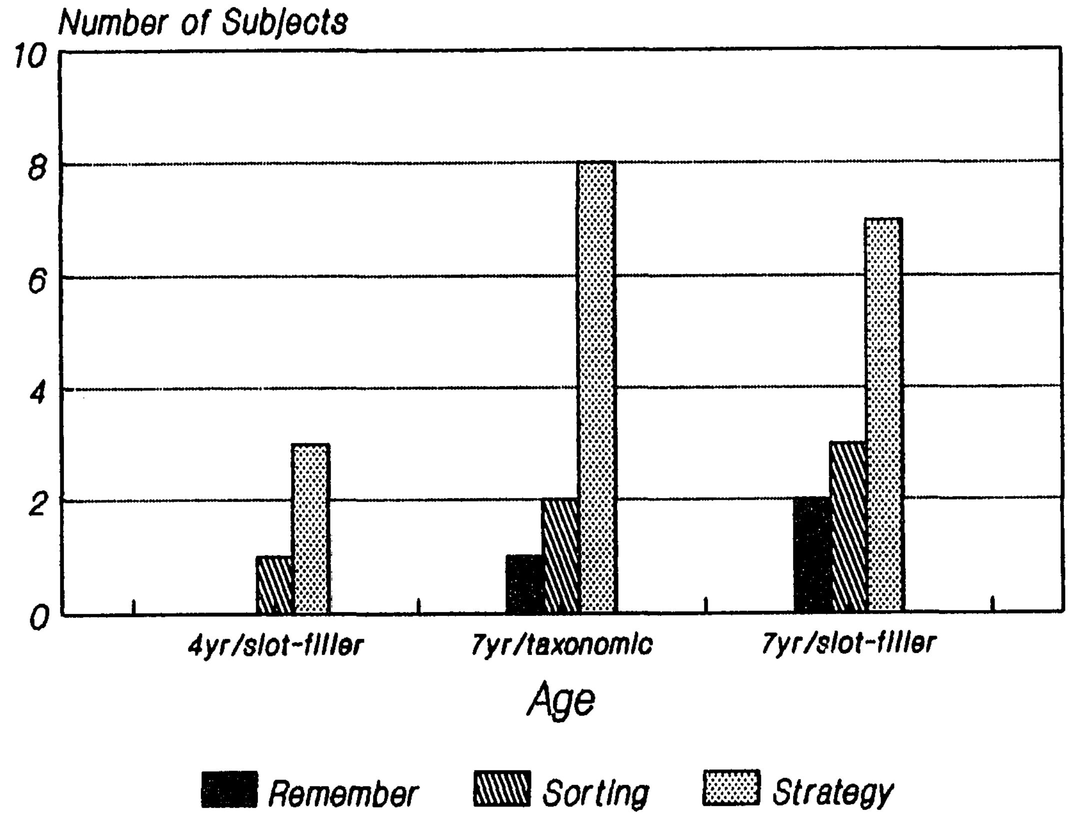


Figure 5. Number of subjects classified as strategic in remember, sorting, and strategy instruction.

The proportion of subjects classified as strategic was significantly higher in the strategy instruction than in the sorting instruction and in the remember instruction (overall: 18 out of 40 or 45% vs. 6 out of 40 or 15% vs. 3 out of 40 or 7.5%; X^2 [2] = 18.07, $p < .001$). The 7-year-olds were more apt to be classified as strategic than the 4-year-olds (overall: 23 out of 60 or 38% vs. 4 out of 60 or 7%; X^2 [1] = 17.25 $p < .001$).

Noticeably, the proportion of 4-year-olds classified as strategic was significantly higher in the slot-filler list than in the taxonomic list (overall: 4 out of 30 or 13.33% vs. 0 out of 30 or 0%; X^2 [1] = 4.29, p < .05) whereas the proportion of 7-year-olds classified as strategic was not significantly different in these two lists. The proportion of 7-year-olds classified as strategic was higher in the strategy instruction than in the sorting instruction and in the remember instruction (overall: 3 out of 20 or 15% vs. 5 out of 20 or 25% vs. 15 out of 20 or 75%; X^2 [2] = 17.48, p < .001) whereas the proportion of 4-year-olds classified as strategic was not significantly different in these instruction conditions.

As Bjorklund (1988) has argued, children classified as strategic on average should show higher levels of recall than nonstrategic subjects if the classification criteria are meaningful. Thus, comparisons were made between strategic and nonstrategic subjects. Since only 3 of 7-year-olds in the remember instruction were classified as strategic, these analyses were restricted to the sorting instruction and the strategy instruction of the experiment. A 2 (age) X 2 (list type) X 2 (strategic status) analysis of variance on the recall data in the sorting instruction presents in Table 7.

TABLE 7

Mean levels of Recall in the Sorting instruction as

Function of Children's Strategic status, Age, and List type

	Strategic status	
	Strategic children	Non strategic children
Taxonomic List		
4-year-olds	. (N = 0)	5.40 (N= 10)
7-year-olds	12.00 (N = 2)	8.75 (N = 8)
Slot-Filler List		
4-year-olds	9.00 (N = 1)	7.00 (N = 9)
7-year-olds	11.00 (N = 3)	9.71 (N = 7)

Note. The maximum possible score in each cell is 12.

The ANOVA computed on the total items recalled revealed significant main effects of age group, $F(1,33) = 109.92$, $p < .001$, list type, $F(1,33) = 13.77$, $p < .005$, strategic status, $F(1,33) = 26.65$, $p < .001$, a list type by strategic status interaction, $F(1,33) = 4.57$, $p < .05$.

Subsequent examination of the list type by strategic status interaction reveals that in the taxonomic list there was a significant difference between strategic and nonstrategic status whereas in the slot-filler list there was no significant difference in these two lists. It is noteworthy that whereas 7-year-olds produced more in the strategic status than in the nonstrategic status in the taxonomic list [$F(1,9) = 19.44$, $p < .005$], and slot-filler list [$F(1,9) = 18.03$, $p < .005$] only one 4-year-old showed as strategic status in the slot-filler list.

A 2 (age) X 2 (list type) X 2 (strategic status) analysis of variance on the recall data in the strategy condition presented in Table 8.

TABLE 8

Mean levels of Recall in the Strategy instruction as Function of Children's Strategic status, Age, and List type

	Strategic status	
	Strategic children	Non strategic children
Taxonomic List		
4-year-olds	. (N = 0)	8.20 (N= 10)
7-year-olds	11.25 (N = 8)	10.25 (N = 2)
Slot-Filler List		
4-year-olds	12.00 (N = 3)	10.29 (N = 7)
7-year-olds	11.43 (N = 7)	11.00 (N = 3)

Note. The maximum possible score in each cell is 12.

The ANOVA computed on the total items recalled revealed significant main effects of age group, $F(1,33) = 11.89$, $p < .005$, list type, $F(1,33) = 35.49$, $p < .001$, strategic status, $F(1,33) = 23.69$, $p < .001$, an age by list type interaction, $F(1,33) = 5.23$, $p < .05$.

Subsequent examination of the age by list type interaction reveals that the 4-year-olds produced more in the slot-filler list than in the taxonomic list whereas for the 7-year-olds there was no significant difference between these two lists. It is noteworthy that in the slot-filler list the 4-year-olds produced more in the strategic status than in the nonstrategic status [$F(1,9) = 14.40$, $p < .01$] whereas for 7-year-olds there were no significant differences between the strategic status than the nonstrategic status in the taxonomic list and slot-filler list.

Discussion

The results of Experiment 1 show that under all instructions the younger children showed better performance in memory and organization and shorter latencies for the slot-filler list than for the taxonomic list. These findings support the view that script-based slot-filler categories appear to have a strong influence on young children's memory performance (Nelson, 1983, 1985).

More interestingly, for the 7-year-olds, there were no differences in total items recalled, organization, and mean latencies between the slot-filler and the taxonomic lists. These findings are not inconsistent with the other studies of the slot-filler category.

The slot-filler category hypothesis predicts that taxonomic relations will be evident to the older children, but this prediction does not imply that slot-filler knowledge structures will be nonexistent in the older children. Some research showed that school-aged children were able to use their schemas more flexibly whereas preschooler appeared to be schema-bound (Greenfield & Scott, 1986; Lucariello, Kyratzis, & Nelson, 1992). In the current study, it may be the case that both the slot-filler and the taxonomic knowledge are well established for the 7-year-olds because the category items, recognized by 4-year-olds, have become better established and activated relatively automatically in older children's semantic memory (e.g., Bjorklund, 1985; Ornstein & Corsale, 1979), and two recall lists were given as photographic stimuli which are more salient than letter stimuli.

This tendency can be explained by two basic types of effect: between-item effects and within-item effects (Bjorklund, 1987). Younger children have between-item effects in the slot-filler knowledge structure, that is, they can encode relational information among items in the slot-filler knowledge structure. Older children have between-item effects in the taxonomic knowledge structure and within-item effects in the slot-filler knowledge structure, that is, they can encode relational information among items in the taxonomic knowledge structure and have elaborative encoding of individual items of slot-filler knowledge structure in dependent of organizational effects; for example, salient names are more apt to be remembered than others. The 7-year-olds who received strategy instruction showed a ceiling effect in the number of recalled items (taxonomic list: $\underline{M}$ = 11.10; slot-filler list: $\underline{M}$ = 11.30). Thus, the salience of and familiarity with the individual items of slot-filler knowledge structure might affect older children's memory performance. The results also support the hypothesis that older children had begun to form taxonomic structures with items for which they already had slot-filler knowledge structure.

There was an interaction between age and category knowledge, and instructions. For younger and older children the strategy instruction provided better memory performance for both taxonomic knowledge and slot-filler knowledge than did the other instructions. This result supports the Vygotskian view that adult guidance can facilitate the development of memory-related processes. Specifically, even given the strategy instruction, the 4-year-olds showed better performance in the slot-filler list than in the taxonomic list. This result implies that the slot-filler knowledge structure already developed in the younger children may be necessary for better memory performance on the basis of social processes.

More interestingly, whereas younger children showed no difference between the remember and the sorting instruction in the taxonomic list, they showed better performance in the sorting instruction than in the remember instruction in the slot-filler list. The results suggest that the sorting procedure did not facilitate recall and organization on the taxonomic list, but did on the slot-filler list. This finding is important because it has been shown that the sorting procedure is effective in recovering stored items to the extent that it helps to connect the relations among items. In this study, when the child is given a slot-filler frame as a sorting procedure, it has a facilitative effect on the memory performance. This finding is consistent with the results of previous studies that indicate that cuing by slot-filler names enhances recall for young children while the cuing by taxonomic names does not (e.g., Lucariello & Nelson, 1985).

Only four of 60 younger children were classified as strategic, specially one 4-year-old in the sorting/slot-filler list condition and three 4-year-olds in the strategy/slot-filler list condition. However, subsequent examination of the meaningfulness of the strategic classification criteria (recalled items in strategic status vs. recalled items in nonstrategic status) showed that 4-year-olds produced more of the slot-filler items in the strategic status than in the nonstrategic status in the strategy instruction condition. Although it seems three 4-year-olds were classified as having strategic status; they received the strategy instruction which gave them the general explanation about the relation of items within a category and the question which emphasized the organization strategy in this study. So this tendency might be a result of the general explanation about the slot-filler list, not the children's free use of organization strategy. Also, this suggestion can be supported by the finding that the younger children have better performance in the sorting instruction where they play and sort items and immediately receive the free recall test, than they have in the remember instruction where the children were permitted to use any of the children's own available strategies, or even in the condition which they received memory time to remember items. Thus, this conclusion is consistent with the position that younger children's memory performance is based on category knowledge structure and nonstrategic processing (Bjorklund, 1988; Nelson, 1988).

Among the 7-year-olds, twenty-three of the sixty children were classified as strategic: 3 of 20 in the remember instruction, 5 of 20 in the sorting instruction, and 15 of 20 in the strategy instruction. Further examination of the meaningfulness of the strategy classification criteria showed that in the sorting instruction the five strategic children produced more items in the taxonomic list and in the slot-filler list respectively than the fifteen nonstrategic children. These results might indicate that category knowledge plays a major role in the spontaneous use of organization strategy. However, in the strategy instruction, there are no significant differences between the nonstrategic status and the strategic status in the taxonomic list and slot-filler list respectively. These results might be indicative of a more mature strategic competence on the part of the fifteen strategic 7-year-olds, in the sense that they are less dependent than 4-year-olds on category knowledge as a supportive feature of the materials to be remembered. 13% of the 7-year-olds can use organization strategy spontaneously, 25% of the 7-year-olds have strategic competence and this competence will appear with the adult's guidance, and 62% of the 7-year-olds did not reveal their strategic competence in this study. These findings might suggest that some of the 7-year-olds will have strategic competence and start to use it spontaneously through this period, yet it will be the case that category knowledge plays a major role in their memory performance.

CHAPTER III

EXPERIMENT 2

As noted in the Introduction, Experiment 2 was designed to focus on the social interaction. It provides a contrast for the alone group, the child-child interaction, with the expert-child interaction. The alone group was used to provide a baseline measure of children's competence.

Method

Subjects. One hundred twenty Korean children participated in experiment 2. The group consisted of sixty 4-year-olds (mean age 4 years, 4 months) and sixty 7-year-olds (mean age 7 years, 2 months). The four-year-old group consisted of 34 females and 26 males, and the 7-year-old group, 28 females and 32 males. Children were selected from a nursery school and a public school in a middle class urban neighborhood in Daegu, Korea. They were all monolingual native Korean speakers. There were 10 children in each of six conditions in each age group.

Materials. The two recall lists of twelve photographic items were the same as in Experiment 1.

Procedure. Children from each age group were assigned randomly to one of six experimental conditions. Six conditions in each age group were composed as follows: taxonomic list/alone; taxonomic list/child-child; taxonomic list/expert-child; slot-filler list/alone; slot-filler list/child-child; slot-filler list/expert-child.

Each child was tested either alone or with one other child (child-child condition) in a quiet room and received a practice trial and one free recall test by the same experimenter. Before the experimental task, a practice trial using other photographs was given to ensure that children understood the task demands.

Alone condition: The child was seated before a large table and received individually the following instructions: "We are going to play a memory game. We are going to say the names of some photographs and when we are done, I'm going to ask you how many you can remember. So first, I'll say them and then you say them." The experimenter then said the name of each photograph at the rate of one every 3 seconds, allowing the child to repeat each name before going on to the next one. The lists were presented in a blocked order. After all the photographs were presented, the experimenter left the room and the child was given about 5 minutes to remember them by whatever method the child chose (mnemonic strategies). After 5 minutes of memory time, the photographs were removed and the child received the free recall task.

Child-child condition: The child-child pairs (same-sex) together were given the same instructions as in the alone condition, and were additionally told that they could help each other in the 5 minutes of memory time to have better memory performance. After all the photographs were presented, the child-child pairs were given about 5 minutes to remember them, using the pair's own method, and then the experimenter left the room. After 5 minutes, the child was tested individually and separately on a free recall task.

Expert-child condition: The child received individually the following instructions. "We are going to play a memory game. We are going to say the names of some photographs and then the teacher (expert) will help you to remember the names of items. When you are done, I'm going to ask you how many you can remember. So first, I'll say them and then you say them." The experimenter then said the name of each item at the rate of every 3 seconds, allowing the child to repeat each name before going on to the next one. Secondly, the experimenter introduced the expert (teacher) to the child and left the room.

The expert was a female college student and was trained by the researcher. She taught the child, generally as follows. First, she gave the child the general explanation about the relations of items within a category, and, in a general question such as "why do we put the animals together?" emphasized the purpose of an organizational strategy, as in Experiment 1. Second, depending on the child's process, she gave the child the specific explanation and specific question that she manipulated the cards and told the children how to put them into categories, saying something like "I will put the dog next to the elephant" and then asking specific questions such as "where is the dog?

What was next to the cat?" The expert repeated the general explanation, the general question, the specific explanation, and the specific question, depending on the child's process during 5 minutes. After 5 minutes, the experimenter came back and the child received a free recall test immediately.

In the free recall task under all 3 conditions (i.e., alone, child-child and expert-child), when a child stopped responding, additional prompts to remember were given until the child indicated that he or she could not remember any more items. Responses were written down in the order in which they were provided and tape recorded for later verification by the experimenter.

Results

ANOVA was employed with the between-subjects variables partitioned by age group (4-year-olds and 7-year-olds), list type (taxonomic list and slot-filler list), and social interaction condition (alone, child-child, and expert-child). Analyses were carried out separately on the total items recalled, and clustering scores as dependent variables. ARC and RR used as the index of clustering analysis. The results of ARC are presented in Appendix A-2.

Recall. Mean number of items recalled is shown in Table 9. The ANOVA computed on the total items recalled revealed significant main effects of age group, $F(1,108) = 186.58$, $p < .001$, list type, $F(1,108) = 12.59$, $p < .005$, social interaction, $F(2,108) = 110.46$, $p < .001$, an age group by list type interaction, F (1,108) = 9.09, $p < .005$, and interaction of an age group by social interaction, $F(2,108) = 17.62$, $p < .001$

TABLE 9

Mean number of items recalled by Age group, List type, and Social interaction (s.d.s in parenthesis)

Age & List type	Social Interaction: Alone	Child-child	Expert-child	Mean
4-year-old				
Taxonomic	5.60	6.30	10.10	7.33
	(.70)	(.95)	(1.45)	
Slot-filler	6.60	7.90	11.20	8.57
	(.73)	(.74)	(1.03)	
7-year-old				
Taxonomic	9.80	10.00	11.60	10.47
	(1.55)	(1.25)	(.52)	
Slot-filler	9.80	10.10	11.80	10.57
	(1.56)	(.57)	(.43)	
Mean Taxonomic	7.70	8.15	10.85	8.90
Mean Slot-filler	8.20	9.00	11.50	9.57

As can be seen in Table 9, the main effect of age group rests on the fact that the 7-year-olds ($\underline{M}$ = 10.52) produced more than the 4-year-olds ($\underline{M}$ = 7.95). The main effect of list type reveals that more slot-filler items ($\underline{M}$ = 9.57) were produced than taxonomic items ($\underline{M}$ = 8.90). The main effect of the social interaction condition shows that the children who received the list in the expert-child condition ($\underline{M}$ = 11.18) produced more than in the child-child condition ($\underline{M}$ = 8.57) and in the alone condition ($\underline{M}$ = 7.95). Student Newman-Keuls post hoc test ($\underline{p} < .05$) showed no significant difference between the child-child condition and the alone condition.

Figure 6 presents the age group by list type interaction. The 4-year-olds produced more in the slot-filler list than in the taxonomic list [$\underline{F}(1,54) = 24.50$, $\underline{p} < .001$], whereas for the 7-year-olds there were no significant differences in the number of items recalled in these two lists.

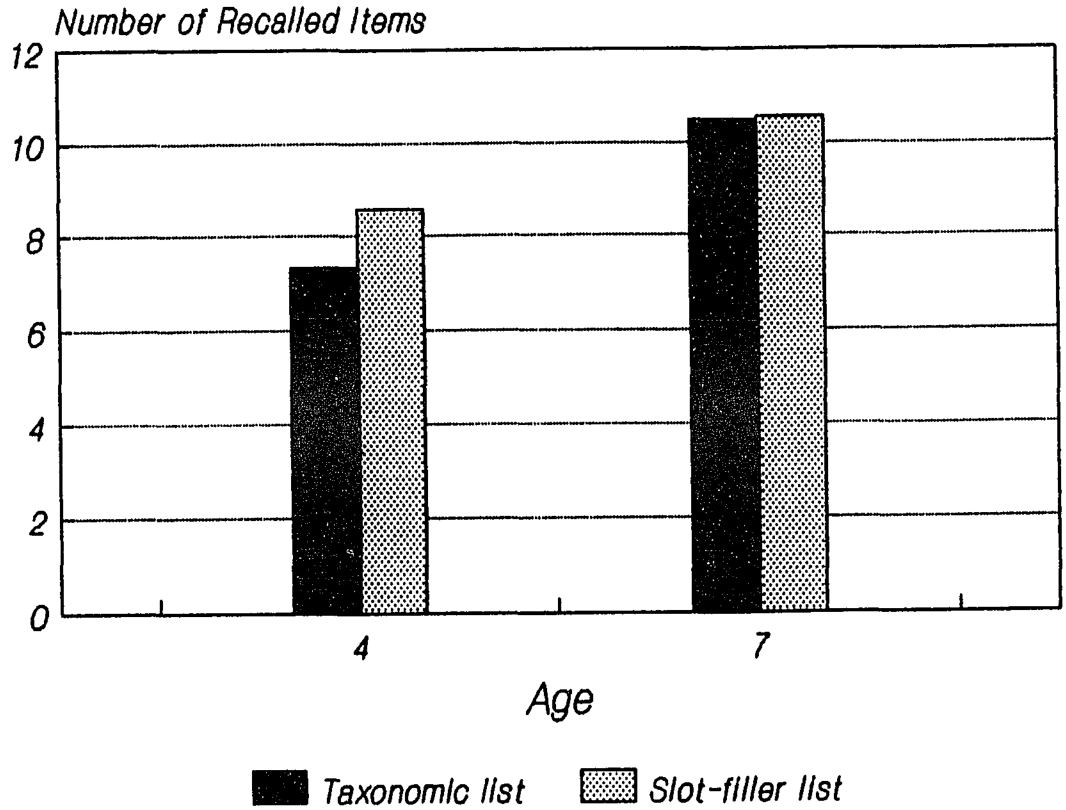


Figure 6. Number of recalled items as a function of age in taxonomic and slot-filler list interaction.

Figure 7 presents the interaction of the age group by social interaction. The 4-year-olds [$F(2,54) = 122.76$, $p < .001$], and the 7-year-olds [$F(2,54) = 17.96$, $p < .001$] respectively were produced more in the expert-child condition than in the child-child condition and in the alone condition. Student Newman-Keuls post hoc test ($p < .05$) showed that the 4-year-olds produced more in the child-child condition than in the alone condition. For the 7-year-olds there was no significant difference between the child-child condition and the alone condition.

Figure 7. Number of recalled items as a function of age in alone, child-child, and expert-child condition interaction.

It is noteworthy that 4-year-olds produced more items of the slot-filler list than of taxonomic list in each social interaction [alone: $t(18) = 3.20$, $\underline{p} < .005$; child-child: $t(18) = 4.21$, $\underline{p} < .001$; expert-child: $t(18) = 1.95$, $\underline{p} < .05$], whereas for 7-year-olds there were no significant differences between these two lists in each interaction. For the 4-year-olds, although the interaction of list type by social interaction was not evident [$\underline{F}(2,54) = .56$, n.s], for the slot-filler list 4-year-olds produced more in the child-child condition than in the alone condition (Student Newman-Keuls test, $p < .05$). For the taxonomic list there was no significant difference in these two social interaction conditions. The 4-year-olds produced more in the expert-child condition than in the child-child condition in the taxonomic list and slot-filler list (Student Newman-Keuls test, $p < .05$). The 7-year-olds produced more in the expert-child condition than in the child-child condition and in the alone condition (Student Newman-Keuls test, $p < .05$), whereas there were no significant differences between the alone condition and the child-child condition in either lists. The results of post hoc are presented in Table 10.

TABLE 10

Student Newman-Keuls Post hoc Test (*: $p < .05$)

Age & Instruction	Taxonomic list G1	G2	G3	Slot-filler list G1	G2	G3
4-year-olds						
Remember (G1)						
Sorting (G2)				*		
Strategy (G3)	*	*		*	*	
7-year-olds						
Remember (G1)						
Sorting (G2)						
Strategy (G3)	*	*		*	*	

Organization. The ANOVA computed on the Ratio of Repetition (RR) scores revealed significant main effects of age group [$F(1,108) = 93.49$, $p < .001$], list type [$F(1,108) = 14.46$, $p < .001$], social interaction [$F(2,108) = 73.63$, $p < .001$], an age group by list type interaction [$F(1,108) = 15.89$, $p < .001$], and interaction of an age group by social interaction [$F(2,108) = 12.99$, $p < .001$]. Mean RR scores are shown in Table 11.

TABLE 11

Mean Score of RR by Age group, List type, and Social interaction (s.d.s in parenthesis)

Age & List type	Social Interaction: Alone	Child-child	Expert-child	Mean
4-year-old				
Taxonomic	.335	.417	.647	.466
	(.094)	(.106)	(.106)	
Slot-filler	.450	.548	.758	.585
	(.073)	(.044)	(.078)	
7-year-old				
Taxonomic	.635	.638	.752	.675
	(.095)	(.065)	(.077)	
Slot-filler	.636	.624	.757	.672
	(.093)	(.073)	(.074)	
Mean Taxonomic	.485	.528	.700	.571
Mean Slot-filler	.543	.586	.758	.629

Seven-year-olds showed higher clustering (M = .674) than 4-year-olds (M = .526) Children who received the slot-filler list (M = .629) showed higher clustering than children who received the taxonomic list (M = .571). Children who received the lists in the expert-child condition (M = .729) showed higher clustering than children who received the list in the child-child condition (M = .529) and in the alone condition (M = .510).

Figure 8 presents the age group by list type interaction. The 4-year-olds showed significantly higher clustering in the slot-filler list than in the taxonomic list [$F(1,54) = 28.40$, $p < .001$], whereas for the 7-year-olds there was no significant difference in the score of clustering produced in these two lists.

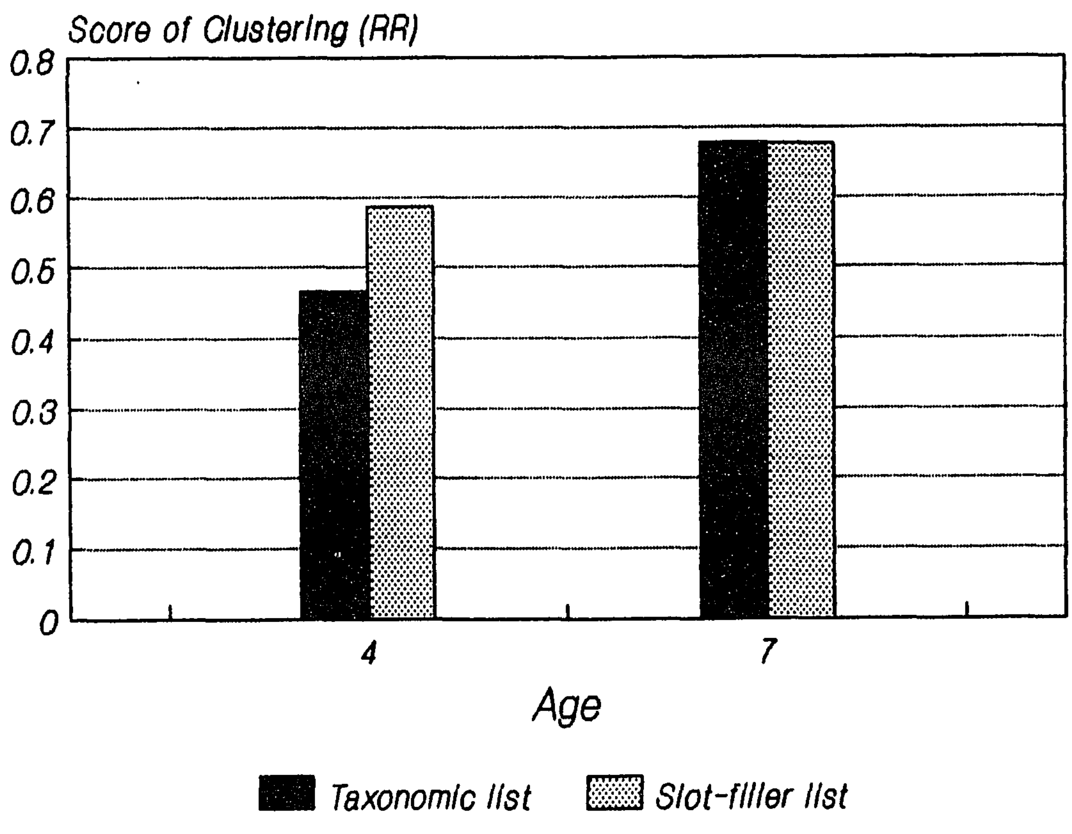


Figure 8. Score of clustering (RR) as a function of age in taxonomic and slot-filler list interaction.

Figure 9 presents the interaction of age group by social interaction. The 4-year-olds [$F(2,54) = 67.95$, $p < .001$], and the 7-year-olds [$F(2,54) = 23.22$, $p < .001$] respectively produced more in the expert-child condition than in the child-child condition and in the alone condition. There was no difference between the alone condition and the child-child condition in either age groups.

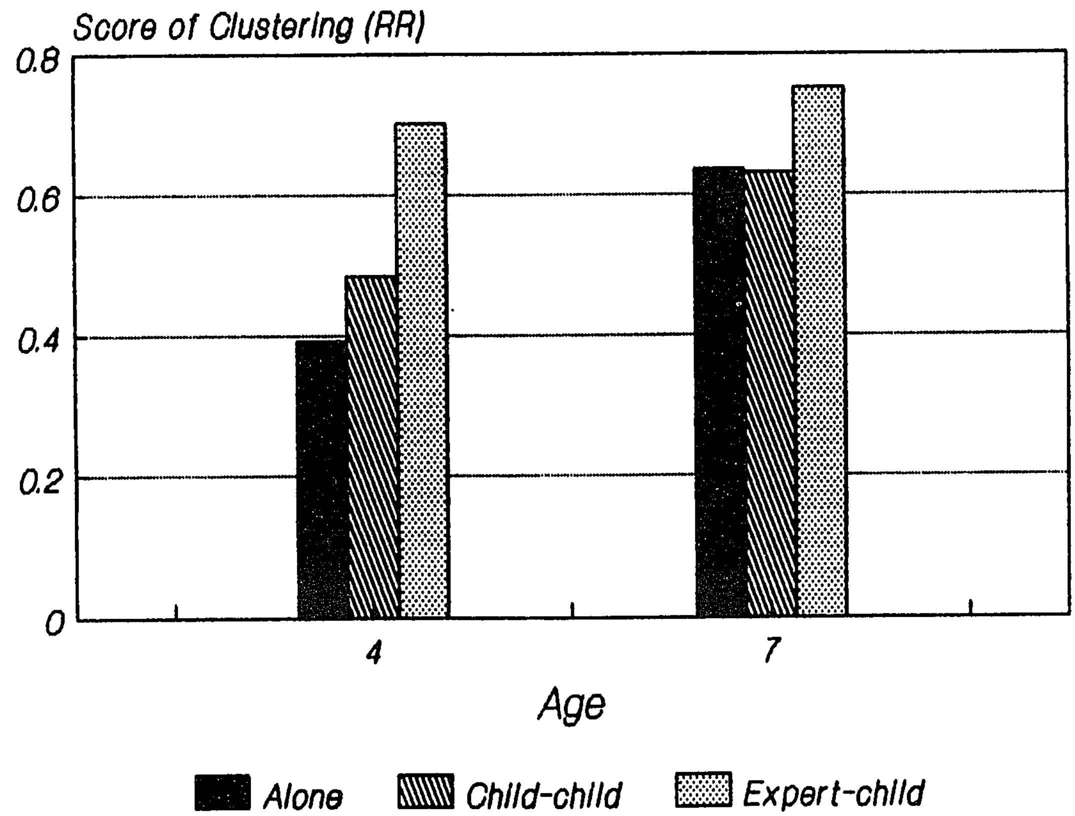


Figure 9. Score of clustering (RR) as a function of age in alone, child-child, and expert-child condition interaction.

It is noteworthy that the 4-year-olds showed higher clustering of the slot-filler list than of the taxonomic list in each interaction [alone: $t(18) = 3.05$, p

$< .005$; child-child: $t(18) = 3.60$, $p < .005$; expert-child: $t(18) = 2.66$, $p < .01$], whereas for 7-year-olds, there were no significant differences between these two lists in each social interaction. For the 4-year-olds, although the interaction of the list type by social interaction was not evident [$F(1, 54) = .08$, n.s], for the slot-filler list 4-year-olds showed higher clustering in the child-child condition than in the alone condition (Student Newman-Keuls test, $p < .05$), whereas for the taxonomic list there was no significant difference in these two interaction conditions. They showed higher clustering in the expert-child condition than in the child-child condition and in the alone condition in the taxonomic list and slot-filler list (Student Newman-Keuls test, $p < .05$). For the 7-year-olds, they showed higher clustering in the expert-child condition than in the child-child condition and in the alone condition (Student Newman-Keuls test, $p < .05$), whereas there was no significant difference between the alone condition and the child-child condition in either lists. The results of post hoc are presented in Table 12.

TABLE 12

Student Newman-Keuls Post hoc Test (*: $p < .05$)

Age &	Taxonomic list			Slot-filler list		
Instruction	G1	G2	G3	G1	G2	G3
4-year-olds						
Remember (G1)						
Sorting (G2)				*		
Strategy (G3)	*	*		*	*	
7-year-olds						
Remember (G1)						
Sorting (G2)						
Strategy (G3)	*	*		*	*	

Discussion

This Experiment was designed to explore the links between certain types of social interaction and certain types of memory development in which subjects were given equally explicit memory goals across the conditions. The data are consistent with prior findings attesting to the importance of the slot-filler category. Particularly, in regard to category structures' relation to goals, the goal of the event is incorporated into the structure itself in the case of scripts; thus when a script could be used to aid memory it instigated a goal which in itself may make the memory task more meaningful (Nelson, 1986). The results showed that when younger children have shared knowledge, the implicit goal of the slot-filler knowledge is coordinated with the explicit memory goal effectively.

In regard to interaction between age and category knowledge, and the social interaction, both younger and older children in the taxonomic list and the slot-filler list respectively showed better memory performance in the expert-child interaction than in the child-child interaction and in the alone condition. That is, the various methods used by expert are effective, depending on the degree of the children's category knowledge.

In the developmental constraints on social interaction, the 4-year-olds showed the higher numbers of recalled items and higher clustering scores for the slot-filler list in the child-child interaction than in the alone condition, and the 7-year-olds showed no significant difference in memory performance of both recall lists between the child-child interaction and the alone condition. These findings can be interpreted to show that younger children's better performance in the child-child interaction can be attributed to shared slot-filler category knowledge (e.g., French, Boynton, & Hodges, 1991; Hudson, 1990; Peters, 1986). In the older children, although they have shared knowledge, the child-child interaction does not evoke better performance than the alone condition, and evokes lower performance than the expert-child interaction. This implied that older children are less dependent than 4-year-olds on shared knowledge as the supportive feature in child-child interaction, and also implied that there exists no overt cognitive conflict between the two subjects' categorical knowledge, that is, they have well-organized slot-filler and taxonomic category knowledge in the current study. Each child's ability to use category knowledge does not afford an obvious advantage to a collaboration; in fact, they may prefer to memorize independently.

There is a cultural factor that may be affecting results. Korean school-aged children, beginning in kindergarten are used to teacher-oriented learning styles rather than peer interaction. This tendency is shown in the Song and Park (1993) study of academic socialization in Korean children. According to that study, in the second-grader's attitudes towards learning, the school fondness tendency (Positive R = 84.8) is higher than the willingness to study with peers or individually tendency (Positive R = 40.7). In their study school fondness means that the children like go to school because of their teacher, and school setting. So, the expert-child context may be for Korean older children a more familiar and well-learned social context than is the child-child context. The task is presented by an experimenter who is an expert, in much the same way that the teacher is in similar school settings.

CHAPTER IV

GENERAL DISCUSSION

The goal of this research was to investigate the role of social context in promoting individual memory processes in interaction with the developing knowledge base over the preschool to school years. In two Experiments, Nelson's slot-filler category hypothesis received further support under the experimenter's instruction and various social interaction conditions.

The children's memory performance at both ages was influenced by their generalized event representations (i.e., schema based slot-filler category). Preschool children appear to be schema-bound, whereas first grade children have begun to use their schemas more flexibly. Younger children appear to be able to use the slot-filler category structure to search memory more effectively. Older children also have built up more scripts as well as other types of general knowledge structures; that is, taxonomic category knowledge structure enters into their memory systems as well. Moreover, the salience and familiarity associated with the slot-filler category knowledge structure make it more memorable; as for example, birthday parties may be well remembered because they are entertaining. The schema-based slot-filler categories are assumed to enter into semantic organization as the first and most salient. Category structures are more abstract and advanced semantic structures that draw on and organize the earlier context-derived categories (Yu & Nelson, 1993).

The findings are consistent with the previous studies of the slot-filler model (e.g., Lucariello & Nelson, 1985; Nelson & Nelson, 1990). The use of the slot-filler knowledge structure is also found in older children. Hence there is remarkable continuity in knowledge organization, with slot-fillers salient at both ages. This finding is also shown by the Lucariello, Kyratzis, and Nelson (1992) study in which: 7-year-olds exhibit distinctive primary response modes by recognizing the distinctive demands of different task contexts; 7-year-olds understand thematic relations for the picture match task and more readily elicit spatiotemporal associations throughout childhood (Greenfield & Scott, 1986).

The variability of the interrelation between strategy use and knowledge may reflect that children decide how particular tasks should be approached. As such, the extent of variability under a given set of conditions, and the relative differences in this spread with age, can be important sources of information about the development of memory competence. The results of this study appear to be that the younger children show little use of a organizational strategies even under high-support condition (strategy instruction) and their familiar category knowledge condition (slot-filler list). Some of the older children can use strategies with their familiar category knowledge when given high support for strategy use, but others of them do not. These results can be interpreted from a Vygotskian perspective. According to Vygotsky (1978), the course of development is unique for each individual, and there are many different roads to cognitive competence and maturity. Thus, different children may follow different paths to skill in using strategies and knowledge. Indeed, even similar levels of memory performance may reflect different personal patterns (especially, older children' strategic status in Experiment 1), that is, when given high support for strategy use, differences in ability among the children become relatively more important, and variability should be wider. In the strategy instruction condition in Experiment 1, adaptive "give and take" between experimenter and child provides structure for the memory task when it is needed, but it also involves demands that stretch the child's competence and influence the eventual incorporation of the external help into the child's own memory processes. In this social interaction, category knowledge or strategies in many different contexts becomes internalized. The control of the task that was once in the hands of the partner or driven by the characteristics of the category knowledge structure, comes to be in the mind of the child.

On the point of their competence in strategy use, individual subjects were classified as strategic if their clustering was at least one standard deviation above chance level, with a faster mean within latencies than mean between latencies, as used in this study. The results showed: first, along this continuum, the young child does not utilize strategies in the context of deliberate memory tasks; second, somewhat later, in the early school years, a child may behave strategically in some situations that require remembering, but the deployment of strategies can be in part determined by the salience of the stimulus materials; third, during childhood, category knowledge plays a major role in their memory performance.

Younger children's nonstrategic pattern in this study is inconsistent with the previous studies of the emergence of their spontaneous use of strategies (e.g., Baker-Ward, Ornstein, & Holden, 1984; Flavell & Wellman, 1977). However, this pattern is consistent with the explanation which gives the knowledge base a central position in children's memory performance. Thus, younger children will rely on their own category knowledge rather than going beyond that category knowledge in their strategy efforts. Their memory behaviors may reflect an automatic activation of the rich and elaborate associations within a well-established conceptual system (e.g., Ackerman, 1987; Bjorklund, 1985, 1988; Geis & Lang, 1976). In this study over 60% of the older children are able to use schematic structures to guide retrieval automatically, without affecting it by deliberately strategy use. It is not implied that older children are necessarily limited to only one automatic retrieval mechanism. The result of older children's strategy use appears somewhat later than previously observed. The rest of the older children have competence in strategy use. This position is also raised by Bjorklund's (1988) argument that categorical structure is also used initially in an automatic or unintentional mode before it comes under strategic control. Thus this study suggestes that there may be a developmental progression from a dependence on the implicit and automatic use of familiar schemas to a more explicit and deliberate use of schemas in memory.

The results of Experiment 2 with younger and older children suggest that shared knowledge is a central feature of social interaction that allows children to take advantage of the bridging and structuring. Scripts provide a framework of shared knowledge between individual interaction at both ages. Children appear to benefit from engaging in activities requiring memory with partners who have skills in the task at hand. They gain from both guidance and participation, shared processes in which children's and adults' roles are inseparable (e.g., Rogoff, 1990).

When exploring the contribution of age and task variables to interactive styles and looking at social exchange, it appears that, dominant styles may be more beneficial at the initial stages of interaction if the younger child is a novice (when they received a taxonomic list), and cooperative styles may be more beneficial at later stages when the child's competence has increased (when they received a slot-filler list). The social agent scaffolds the child's performance, gradually allowing him/her more and more participation until the child is able to take a more active role (e.g., Bruner, 1975, 1983)

The interesting finding is that peer interaction in older children having shared knowledge does not affect memory performance. This is because there are many important distinctions to be made among different kinds of peer interaction. Research has shown that such distinctions themselves can affect the quality and quantity of learning that takes place within the relationship. For example, peer interaction can differ in their degree of conflict (Bearison, Magzamin, & Filardo, 1986), in their degree of mutuality and equality (Berndt, 1987), and in their patterns of reciprocal discourse (Damon & Killen, 1982). Thus, in this study, too little conflict in the category knowledge and low levels of mutuality in peer interaction can mitigate against the productive memory environments typically established in children's peer relations. Cultural attitudes toward learning may also be a factor that needs to be included in the interpretation. Further studies exploring each of these within-relationship qualities, independently or in conjunction with one other, can aid in determining a peer relationship's propensity to foster learning beyond the simple fact that it occurs between age mates.

Appendices

Appendix A

The Adjusted Ratio of Clustering (ARC) score (Murphy, 1979) was used as an index of clustering in the recall. The Adjusted Ratio of Clustering (ARC) has a fixed maximum value of 1.0 and a fixed chance value of zero. This score is defined as [r - E(r)]/[max - E(r)], where 'r' is the number of intracategory repetitions observed in recall and 'max' is the maximum number of repetitions in the recall list and defined as n - c, where 'n' is the total number of items recalled and 'c' is the number of different categories. 'E(r)' is the expected (chance) number of category repetitions occurring in a list and computed as $(\Sigma n^2/N) - 1$, where 'n' = number of items recalled from a category.

Appendix A-1: The results of ARC in Experiment 1.

TABLE 1-1

ANALYSIS OF VARIANCE OF ARC ACROSS AGE, LIST TYPE, AND INSTRUCTION

Source of Variation	DF	F	Signif of F
Main Effects			
Age	1	57.19	.001
List type	1	24.62	.001
Instruction	2	51.50	.001
2-way Interactions			
Age x List type	1	13.62	.001
Age x Instruction	2	3.30	.05
List type x Instruction	2	1.04	n.s
3-way interaction			
Age x List x Instruction	2	.02	n.s

TABLE 1-2

Mean score of ARC by Age group, List type and, Instruction (s.d.s in parenthesis)

Age & List type	Instruction Remember	Sorting	Strategy	Mean
4-year-old				
Taxonomic	.481	.551	.755	.596
	(.138)	(.120)	(.057)	
Slot-filler	.622	.746	.903	.757
	(.105)	(.096)	(.092)	
7-year-old				
Taxonomic	.759	.733	.925	.806
	(.054)	(.111)	(.097)	
Slot-filler	.761	.800	.928	.830
	(.065)	(.093)	(.151)	
Mean Taxonomic	.620	.642	.840	.701
Mean Slot-filler	.692	.773	.916	.818

Appendix A-2: The results of ARC in Experiment 2.

TABLE 2-1

ANALYSIS OF VARIANCE OF ARC ACROSS AGE, LIST TYPE, AND SOCIAL INTERACTION

Source of Variation	DF	F	Signif of F
Main Effects			
Age	1	25.35	.001
List type	1	7.14	.01
Interaction	2	39.23	.001
2-way Interactions			
Age x List type	1	11.71	.005
Age x Interaction	2	3.23	.05
List type x Interaction	2	.20	n.s
3-way interaction			
Age x List x Interaction	2	.36	n.s

TABLE 2-2

Mean Score of ARC by Age group, List type, and Social interaction (s.d.s in parenthesis)

Age & List type	Social Interaction: Alone	Child-child	Expert-child	Mean
4-year-old				
Taxonomic	.507	.556	.778	.614
	(.101)	(.148)	(.143)	
Slot-filler	.603	.720	.922	.748
	(.135)	(.065)	(.100)	
7-year-old				
Taxonomic	.745	.763	.894	.801
	(.135)	(.091)	(.124)	
Slot-filler	.727	.729	.896	.784
	(.151)	(.110)	(.123)	
Mean Taxonomic	.626	.660	.836	.708
Mean Slot-filler	.665	.725	.909	.766

Appendix B.

The result of tests of difference in means of latencies

between two items within a category.

	Condition	List	N of mean	t/F	p
4-year-olds					
1.	Sorting	Slot-filler	2	t=2.23	.089
2.			3	F= .112	.897
3.			2	t=1.59	.127
1.	Strategy	Taxonomic	2	t=2.26	.076
2.			2	.70	.279
3.			2	1.06	.200
4.			2	.76	.264
5.			2	.57	.314
6.			2	1.05	.202
1.	Strategy	Slot-filler	3	F= .28	.772
2.			3	.59	.610
3.			4	2.88	.167
4.			4	1.71	.302
5.			4	1.52	.340
6.			3	.55	.626
7-year-olds					
1.	Remember	Taxonomic	2	t=1.05	.203
2.			2	.62	.299
3.			2	.49	.335
4.			2	.82	.249
5.			2	1.17	.181
6.			2	.34	.383
7.			3	F=1.70	.321
8.			3	.38	.715
9.			3	.78	.535
10.			3	.72	.556

1.	Remember	Slot-filler	4	F=2.94	.162
2.			3	.18	.846
3.			3	.43	.686
4.			3	.60	.606
5.			2	t= .25	.412
6.			2	.54	.323
1.	Sorting	Taxonomic	2	t= .93	.225
2.			3	.63	.298
3.			2	t= .24	.415
1.	Sorting	Slot-filler	2	t=1.05	.202
2.			2	1.24	.171
3.			2	t= .97	.217
4.			2	.26	.410
5.			3	F=1.41	.370
6.			3	4.04	.141
7.			3	2.72	.212
1.	Strategy	Taxonomic	4	F= .27	.842
2.			4	.63	.635
3.			4	2.91	.164
4.			4	.03	.993
5.			4	1.97	.261
6.			3	.54	.629
7.			3	.45	.673
8.			3	2.05	.275
9.			3	.87	.502
10.			2	t=1.36	.154
1.	Strategy	Slot-filler	4	F= .97	.489
2.			4	2.15	.237
3.			4	.61	.642
4.			4	1.21	.415
5.			4	.33	.808
6.			4	.84	.537
7.			3	1.05	.450
8.			3	5.07	.109

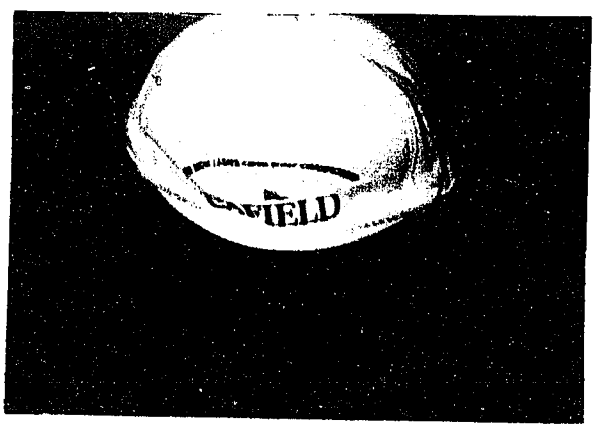
Appendix C

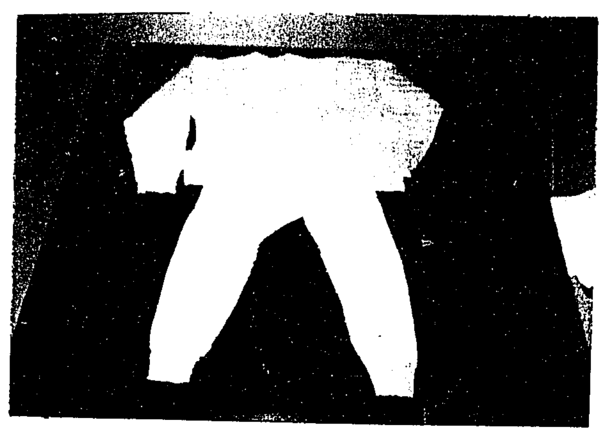
Photographic lists

Appendix C-1: Taxonomic list

ANIMALS

CLOTHING





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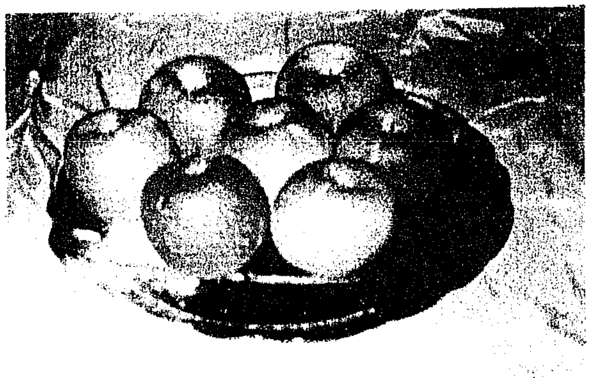
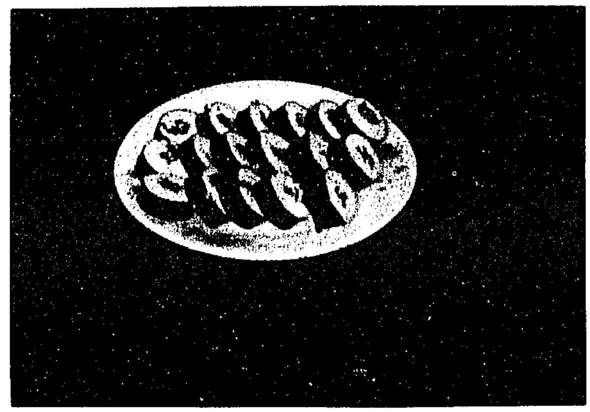
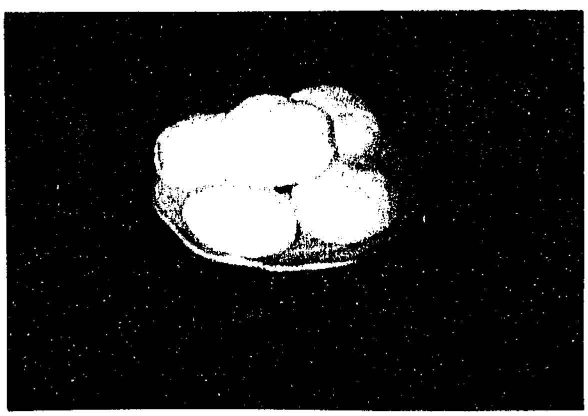
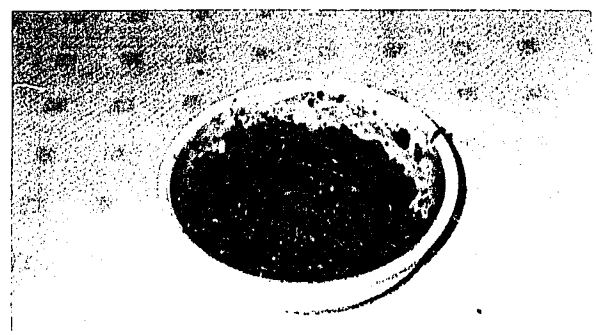


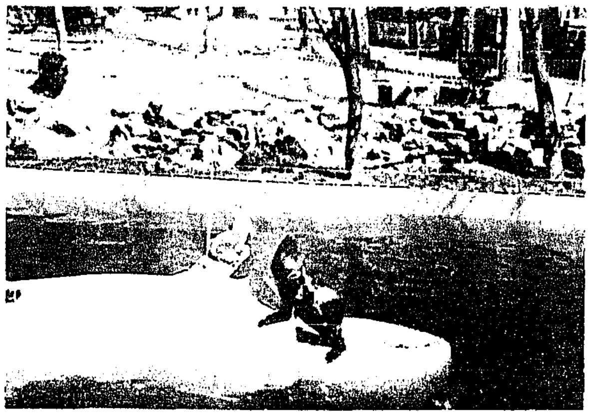


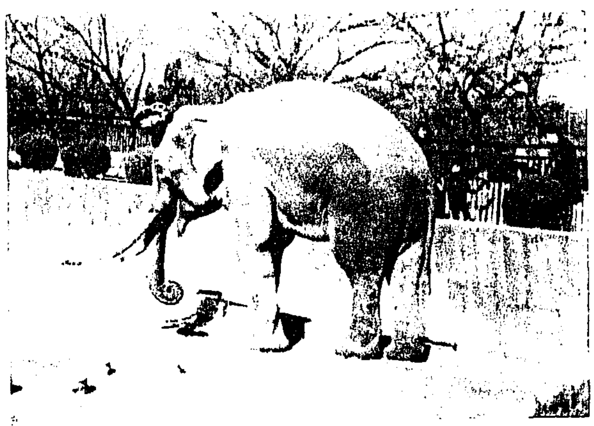


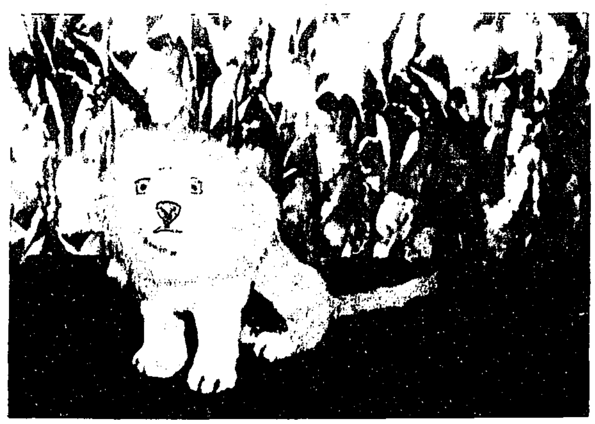


Appendix C-2: Slot-filler list

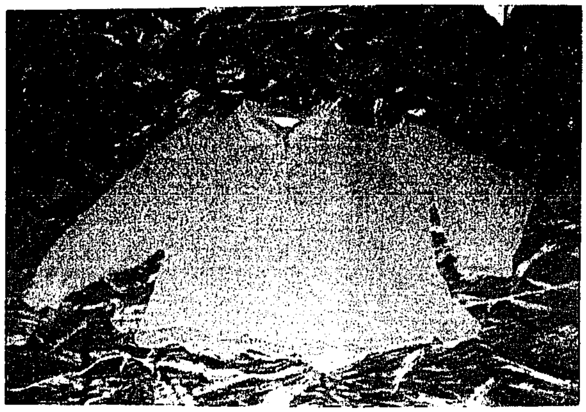
ZOO ANIMALS



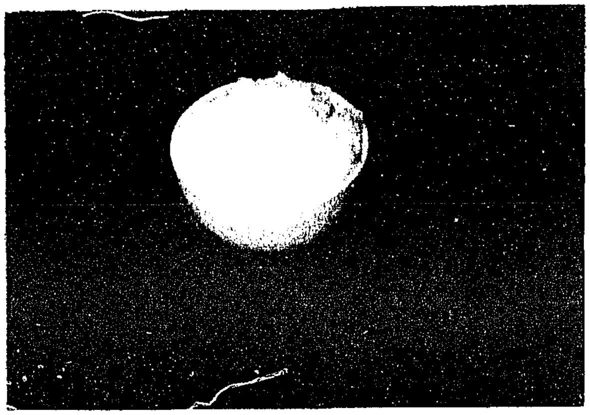


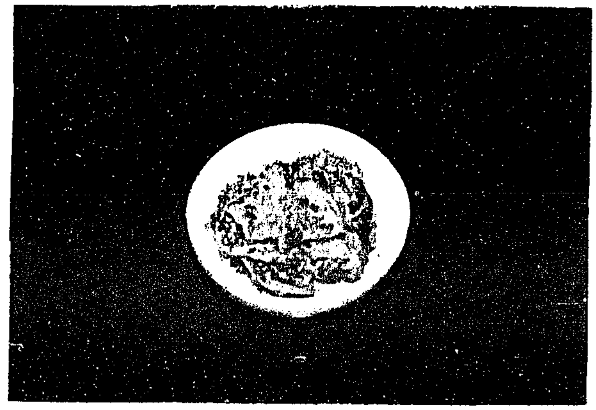


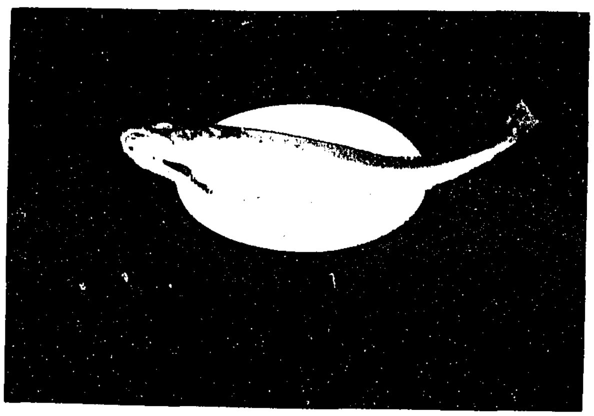
CLOTHING GOING TO SCHOOL

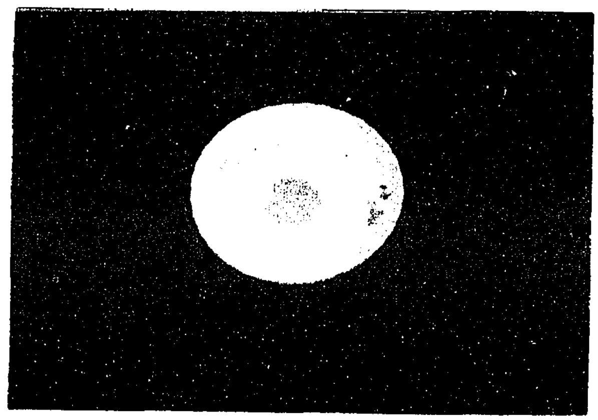


BREAKFAST









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