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Recognition memory for complex pictures in preschool children.

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RECOGNITION MEMORY FOR COMPLEX PICTURES
IN PRESCHOOL CHILDREN

A Thesis Presented

By

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ABSTRACT

Recognition memory for complex pictures was investigated using 3 variables: meaningfulness of the target (anomalous or conventional), type of transformation in the distractor (substitution or rearrangement), and extent of transformation (whether the target and distractor were consistent or inconsistent in meaningfulness). Three- and four- year olds were familiarized with 16 different thematic scenes with which a child this age would likely have had experience. Half of the target pictures shown to a child were conventional, and half were anomalous, containing either an object or arrangement of objects that did not fit the theme. During the recognition test, targets were paired with distractors that were either conventional or anomalous (yielding the consistent-inconsistent conditions) and contained either a substitution of one object or a rearrangement of objects. Overall, recognition memory was similar for conventional and anomalous targets indicating that both types of pictures were assimilated into schemata equally well. When target and distractor were inconsistent in meaningfulness, recognition memory was facilitated. Thus, information about whether the target contained an anomaly or not was remembered. Memory for inventory was far better than for arrangement information, probably because

children were able to proficiently tag specific details about anomalous inventory. For the young child, knowledge about what items are appropriate to familiar themes is a more integral part of schemata than knowledge about appropriate spatial relationships between those items.

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CHAPTER I

INTRODUCTION

Recognition memory for complex pictures shows marked improvement throughout childhood (Mandler and Robinson, 1978); Kirasic, Siegel, and Allen, 1980). One factor that has been hypothesized to account for this developmental change is an increase in planful approaches to memory including a better understanding of how mnemonics and relationships between items can facilitate retrieval (Kreutzer, Leonard, and Flavell, 1975; Brown, 1975). Before the age of 5 years, however, children generally fail to engage in planful memory (Brown, 1975) and thus, developmental differences in the performance of preschoolers' is more likely due to improvements in other factors. For example, Vlietstra (1978) concluded that the memory of preschoolers is limited by ineffective attention; preschoolers are easily distracted by salient, but irrelevant, cues in pictures so that subsequent recognition of those pictures is poor.

One factor that may underlie improvement in memory during the preschool years is an increase in semantic knowledge (Myers and Perlmutter, 1978; Kail, 1979). Semantic knowledge refers to general, real world knowledge; facts that are independent of a particular instance. For example, knowing that the sun belongs in

the sky, that a stove belongs in the kitchen, and that a pig does not, is semantic knowledge that the young child can acquire. Sophian and Hagen (1978) found that 4 and 5 year olds were likely to use semantic categorical information to aid retrieval of pictures of items. But these children did not make strategic use of relevent semantic information to categorically organize recall of these pictorial stimuli. Perlmutter and Myers (1979) also found no evidence of strategy use in 2 - 4 year olds but by the age of 4 the children tended to recall items clustered by category. Thus, although young children's memory is nondeliberate, it is categorically organized.

If improvement in young children's memory is largely a result of knowledge growth, then an important variable to take into consideration in memory research is the knowledge the child possesses. This knowledge constitutes the child's knowledge base and most theorists view this base to be organized in systematic ways depending on the child's level of cognitive development (Piaget and Inhelder, 1973). When material can be assimilated or integrated into an existing knowledge base, then it is said to be meaningful for the child and because it is part of the memory base, it is also assumed to be more memorable (Flavell and Wellman, 1977; Brown, 1975). When

information is not meaningful, that is, cannot be integrated into a child's knowledge base, memory for that information is hypothesized to be poor (Mandler and Robinson, 1978). Thus, the primary factor in memory performance for the young child could be involuntary memory processes by which meaningful information is best remembered.

Literature Review

The present study is an investigation of the young child's recognition memory for complex pictures. The literature review is organized around the premise that semantic knowledge is a major factor in early memory. The review is divided into 5 sections: 1) a brief presentation of constructivist and schematic views of memory; 2) an examination of the research literature concerned with whether preschoolers engage in constructive activities in encoding and storing information; 3) an outline of opposing viewpoints on what processes are involved in children's recognition memory for complex pictures; 4) a discussion of the relationship between schematic knowledge and memory for complex pictures; and 5) an examination of schemata as frameworks for encoding and retrieving information about complex pictures.

Assumptions of constructivist and schematic views of memory. Schemata and the constructivist approach to memory

are inseparable: both stress the role of knowledge and cognitive abilities (Flavell, 1977). Schemata are generic knowledge structures consisting of representations of events or stimuli. Recognition of a stimulus occurs when incoming information is integrated within a schema. For incoming information to be meaningful, it must be integrated into the schema. This integrative process is the critical element within the constructivist view of memory since during integration into a schema, information is interpreted and modified. For example, parts of the information may be omitted, other parts highlighted and even elaborated and inferred. What is encoded is contingent upon whatever schema serves as organizer of this information (Paris and Lindauer, 1976; Flavell, 1977). What is omitted or inferred about a stimulus is dependent upon the previously acquired bits of knowledge that form the schema (Piaget and Inhelder, 1973).

Constructive abilities of the preschooler. The constructive nature of memory is demonstrated when adults recall information that is only implied. Adults supplement and distort the original event by integrating it with knowledge represented by the schema (eg., Bransford and Franks, 1971). The usefulness of a schematic model of memory is apparent in much of the

literature on adult memory. For example, Shank and Abelson (1979) proposed that semantic features and the role of context are important in the interpretation of text. Both involve schematic knowledge that the reader brings to the task.

Even infants are assumed to engage in limited forms of constructive activities. For instance, it has been widely observed that, for the infant, presentation of a stimulus discrepant from a previously established schema results in prolonged attention (eg., Fantz, 1964). This prolonged attention is hypothesized to be the result of attempts by the infant to integrate novel stimuli into existing schemata (Kagan, 1971).

Research with preschool children indicates that they too engage in constructive activities, omitting and inferring information from their perceptions. As children grow, they increasingly make more complex inferences (Paris and Lindauer, 1976; Schmidt, Paris and Stober, 1979). For example, Perlmutter and Myers (1976) showed preschoolers colored and black and white pictures of familiar objects. During the subsequent recognition test, children often "recognized" as previously seen a colored picture of a color-specific item when what was actually presented was a black and white picture of that item. On the other hand, when shown a black and white picture of a

color non-specific item, children were less likely to make an inference about color and more likely to correctly choose the black and white picture as familiar. Children seeing a black and white picture of a color specific item such as a banana, apparently encoded "banana", and matched it with the schema they possessed for such an object. As a consequence, inferences about the original information were made. Their choice of colored pictures indicated that they were elaborating the presented information according to established knowledge or schemata for those objects. These constructive activities are probably involuntary processes; the child integrates information into existing schemata, modifying both perceptions and schemata. In this non-deliberate way, the child maintains consistency between the real world and internal representations and builds more and more complex and differentiated schemata (Kagan, 1971).

Constructive abilities and recognition memory for complex pictures. Some researchers have suggested that young children do not engage in constructive activity when attending to complex pictures. Reese (1970) reported that a child's memory of visual information was reduced to a figurative image stripped of idiosyncratic details and relationships between items. Similarly, Siegel and White

(1975) proposed that young children's encoding of environmental events is landmark based: that they attend to single salient objects exclusively, ignoring the relationship between objects or their context. Elkind (1969) noted that pictures elicited no overall meaning or schematic label for young children, who merely enumerate the elements.

The findings of recent research have seriously challenged these assertions. First, it appears that Reese's (1970) proposition that very young children's visual memory lacks detail is inaccurate. Preschool children can recognize changes in detail. In particular, young children recognize changes in inventory (individual items occupying the scene) and spatial relationships among objects (Brown and Campione, 1972). Secondly, Siegel and White's (1975) proposition that very young children ignore context is inaccurate. Kirasic, Siegel, and Allen (1980) found that although 5 year olds required more time than older children to recognize whole scenes than pictures of isolated items, recognition memory in these young children was greater for items in context than items taken out of context. Using looking behavior as the dependent measure, Davis, Greco, and Daehler (1982) also found that 2 year olds attended to contextual relationships in complex pictures. Thus it is apparent

that very young children attend to relationships between objects and context in complex pictures, and do not process objects only in isolation. Contrary to Elkind's (1969) conclusions, meaningful complex pictures are encoded as a whole and the scene's conceptual meaning is interpreted and stored.

Schemata: Meaningfulness and memory. Schematic knowledge is hypothesized to be an important factor in complex picture comprehension and recognition (Kirasic, Siegel and Allen, 1980). However, unlike adults, young children may not be able to effectively integrate information into a schema if the information does not correspond very closely to the schema (Mandler and Robinson, 1978). The results of a few studies can be interpreted within this perspective. For example, Kirasic, Siegel and Allen (1980) concluded that compared to older children, the slower and less accurate recognition of complex pictures by younger children was due to less efficient encoding and retrieval of information from complex pictures. But the stimuli in their study were photographs of distinctive environmental landmarks such as bridges, buildings, and fountains, scenes for which young children probably have a limited knowledge base. Their poor recognition performance might have been due to less

well developed schemata for bridges, etc.. Similarly, Reese's (1970) observation that children fail to attend to the interaction between items was likely due to the meaninglessness of the interaction presented to the child. Not many preschoolers have a schema for a fish on the phone or a rooster carrying a flag (from Reese and Lipsitt, 1970).

When children are shown pictures of more familiar scenes, scenes for which they are likely to have a schema, their memory performance improves. Mandler and Robinson (1978) observed that when children 6 to 10 years of age were shown organized pictures, their recognition accuracy was similar to adult performance. However, when shown unorganized pictures, children's recognition accuracy declined significantly in comparison to recognition accuracy for organized pictures. In contrast, for adults, recognition of both organized and unorganized pictures was similar. Mandler and Robinson speculated that the children's performance on organized pictures was aided by their schema for those scenes. Adults were additionally able to impose meaning on unorganized arrays of objects, and their recognition memory for these scenes was facilitated. The data of Davis, Greco, and Daehler (1982) also indicate better memory for meaningful pictures: the patterns of looking behavior of 2 year olds indicated that

they were able to detect changes more readily in pictures for which they were assumed to have more well-established schemata.

The implication of these results is that memory for a complex picture is facilitated if the picture is meaningful, that is, fits into an already existing schema for the child. As children grow older, their semantic knowledge base becomes broader and schemata become more numerous. As a result, there is an increase in the probability that a picture will be meaningful, i.e., a schema to which the pictures can be assimilated exists. In this way, a schema-based model explains developmental improvements observed in complex picture recognition memory in preschool children.

Schemata as frameworks for encoding and retrieval of complex pictures from memory. If schemata act as frameworks for both encoding and retrieving information in complex pictures (Brewer and Treyens, 1981), then recognition for detail will depend on how the specific information is integrated with the schema-based knowledge. Thematically expected objects and expected relationships between objects in a picture can be readily encoded into a schema. As a result, objects which are particularly salient attributes of a schema (high-schema objects) are

more likely than low-schema objects to be recalled or recognized (Brewer and Treyens, 1981). However, adults are also likely to falsely recognize expected objects which are appropriate to the context of a picture but which were not previously presented (Brewer and Treyens, 1981; Friedman, 1979). In other words, adults have difficulty discriminating between two pictures of the same scene in which one appropriate object has been substituted for another. Shank and Abelson (1979) initially described an analogous process for sentences having the same meaning and concluded that both sentences have one representation in memory. Friedman (1979) extended this notion to pictures: any two pictures which have the same meaning are assimilated into the same schema in memory. Thus, detailed information about two different events which are assimilated into the same schema will be confused in recall.

A schema-based model also has implications for the recall of details that do not conform to an established schema. For example, during encoding, ambiguous information will be assimilated into existing schemata so that adults will distort recall according to the schema to which the information had been assimilated (Bransford and Franks, 1971). On the other hand, when an unexpected event occurs, attention becomes focused. Friedman (1979)

found that adults visually fixate on unexpected objects longer than on expected objects in pictures depicting real world scenes. According to Friedman, presentation of the scenes evoked a frame, or schema, but in order to identify unexpected objects, more analysis of their visual detail was required. Perhaps items unrelated to or inconsistent with a schema were also "tagged" as separate units (Graesser, Gordon, and Sawyer, 1979). As a consequence, discrimination memory was less accurate for typical items in a schema but more accurate for "tagged" atypical items (Brewer and Treyens, 1981; Friedman, 1979).

Friedman (1979) also found that adults more readily noticed deletions or replacements made to unexpected objects than to expected objects. She hypothesized that this difference between detection of schema-appropriate and schema-inappropriate changes in pictures was a result of differences in the assimilation of 2 pictures of the same scene. When the 2 pictures differed by an expected object, the 2 were readily confused. Whereas a picture of the same scene with an unexpected object may also be assimilated into that schema, it is done so with a "tag", thereby increasing the salience of a change involving that item.

Do schemata act as frameworks for encoding and

retrieval of information about complex pictures for children in the same way as for adults? Ratner and Myers (1981) found that 2 - 4 year olds could both identify appropriate items found in the kitchen and bathroom as well as reject inappropriate items. In addition there was an increase with age in the accuracy of identification and number of items produced. But even 2 year olds produced a greater proportion of core items which were defining features of those rooms than inappropriate items. These results indicate that for preschoolers a scene schema exists and this schema contains information about appropriate and inappropriate items in a scene. However, most of the research on children's schematic representations of familiar scenes has been done with older children. For example, Goodman (1980) found that elementary school children were less likely to recognize highly typical than atypical items in pictures of familiarized scenes. These results replicate in children the results Freidman (1979) and Brewer and Treyens (1981) found with adults.

Statement of the problem

The present study was an investigation of the preschooler's memory for complex pictures. Three variables hypothesized to influence recognition memory for complex pictures were investigated. These three variables

were 1) the meaningfulness of the target pictures: conventional versus containing an anomalous item or arrangement of items; 2) type of transformation exhibited in the distractor during a forced-choice recognition test: substitution versus rearrangement of items; and 3) the extent of the transformation between a paired target and distractor, that is, whether target and distractor were consistent (both conventional or both anomalous) or inconsistent (one conventional, the other anomalous).

The first variable was concerned with the meaningfulness of the familiarized target pictures and its influence on memory. The review of the relevant literature provided considerable evidence that recognition memory for unorganized complex pictures is relatively poor for young children. Yet the research on this issue is limited. For example, very little is known about what happens to memory if a picture which is otherwise meaningful, contains an unusual object or rearrangement of items so that they occupy unusual places in the scene. In this study, subjects were shown pictures of common scenes during familiarization trials (eg., bathroom, park). Half of the scenes were conventional in the sense that the specific objects included and their locations

within the scene were typical. But half of the scenes contained an anomaly. These anomalous scenes included either 1) an object which was not appropriate or 2) one or two objects which occupied unconventional or inappropriate locations. These anomalies did not drastically alter the organization of the picture but were designed to interfere with the schematic representativeness or theme of the drawing: eg., in the park scene, replacing flowers with a telephone (substitution) or switching the flowers with the sun (rearrangement). If an anomaly disrupted the meaning of a picture to the extent that a young child could not assimilate it into a schema, recognition memory for these targets would be expected to be poor relative to memory for conventional targets. But Friedman (1979) proposes that an anomaly should not change the general representativeness of a scene; the anomaly is tagged or "stuck on" to the schema to which the picture is being assimilated. Since the changes introduced in the anomalous targets might not be of sufficient magnitude to disrupt encoding of the stimuli into schemata, it could also be hypothesized that recognition memory would be comparable for conventional and anomalous pictures. Young children might be able to assimilate both types of pictures into existing schemata, dealing with the

anomalies in such a way that they would not totally disrupt the meaning of the pictures.

The second variable of interest in this study was whether preschoolers showed comparable memory for both the inventory and the spatial arrangement of items in a scene. During the forced-choice recognition test, each familiarized target was paired with a distractor depicting that same scene but in which there was either a substitution or rearrangement of items. Two year olds do notice substitutions made in familiar room scenes (Davis, Greco, and Daehler, 1982) and three year olds can reconstruct spatial relationships among items of furniture in dollhouse rooms (Myers, Perlmutter, and Cohen, unpublished manuscript). Older children remember inventory and spatial information when it is schematically organized (Mandler and Robinson, 1978). Based on these results, preschoolers in the present study were expected to be sensitive to both spatial and inventory details. Mandler and her collegues found that recognition memory for organized pictures was similar for both substitution and rearrangement transformations. Thus it was hypothesized that recognition memory for inventory and arrangement of objects would be similar.

The third variable involved recognition of targets

when paired distractors were consistent in meaningfulness or inconsistent in meaningfulness. According to Friedman (1979), if two different conventional pictures of a scene are assimilated into the same schema, discrimination between conventional target and conventional distractor is made more difficult than discrimination between conventional target and anomalous distractor. Mandler and Stein (1974) found that recognition accuracy in children varied with the extent of the transformation in the distractor. If a distractor was inconsistent with the conceptual meaning of the target picture, subjects were more likely to correctly identify the target picture, than if a distractor and target were consistent in meaning. Paris and Mahoney (1974) found that 7 - 11 year olds had difficulty discriminating between target and distractor pictures which depicted consistent semantic relationships between items, but they readily discriminated targets from distractors which violated explicit or inferred relationships. On the basis of these findings, it was hypothesized that recognition memory would be greater for conventional targets paired with anomalous distractors than for conventional targets paired with conventional distractors.

If children are more likely to remember a conventional traget in an inconsistent than consistent

pair, then similarly, will children be more likely to remember an anomalous target in an inconsistent than consistent pair? Assuming that the children would be able to integrate anomalous targets into schemata, but retain some information about the presence of an anomaly, it was hypothesized that recognition memory for anomalous targets would be less accurate when paired with anomalous distractors than when paired with conventional distractors.

Friedman (1979) found that adults more readily noticed substitutions involving unexpected objects than expected objects in complex pictures. In the anomalous pictures of the present study, the unexpected object in the target is substituted for by another anomalous object in the distractor. And in conventional target - conventional distractor pairs, only expected objects are involved in changes. Thus, it is hypothesized that recognition memory would be better for anomalous targets paired with anomalous substitution distractors (anomalous consistent pair) than for conventional targets paired with conventional substitution distractors (conventional consistent pair).

Friedman (1979) also found that recognition memory was more accurate for changes in spatial location of

unexpected than expected objects. But the present study does not duplicate Friedman's rearrangement transformation. In the present study, all rearrangements involved expected objects; it was the arrangement of objects that was either expected or unexpected. If unexpected arrangements are tagged in a manner similar to the way the presence or location of an unexpected object might be tagged, changes involving unexpected arrangements may be more salient than changes involving expected arrangements of objects. So, it was also hypothesized that recognition memory would be better for anomalous consistent pairs involving rearrangement transformation than for conventional consistent pairs involving rearrangement.

In summary, memory for anomalous versus conventional pictures was investigated and it was hypothesized that 1) children would be able to detect substitution and rearrangement transformations in the distractor equally well; 2) recognition memory would be better for familiarized pictures in inconsistent pairs than consistent pairs; and 3) recognition memory would be better for anomalous consistent pairs than conventional consistent pairs for both substitution and rearrangement transformations.

CHAPTER II

METHOD

Subjects

Subjects were 64 3 and 4 year olds attending day care centers and nursery schools in a large university community; half of the children were male, half were female. Subjects ranged in age from 2 years, 11 months to 5 years, 0 months. The median age was 4 years 2 months (SD = 6.5 months). A total of 71 children were tested, 7 of whom were dropped from the study: one (a 3 year old boy) for leaving the task, two (3 year old girls) for failing the training trials, and four (two 3 year old girls, one 4 year old girl, and one 4 year old boy) for making 8 or more errors on the recognition test.

Stimuli

Stimuli were 112 xeroxed, 5 x 7 inch black and white pictures of 16 different scenes. The 16 scenes were chosen because they were common in the every day life of a young child (see Table 1). Pictures were held inside acetate pages and each child's set of pictures was inserted into a three-ring notebook prior to the session.

Seven different pictures were created for each of the 16 scenes. Three of these served as target pictures during familiarization trials, and four as distractors paired with targets during recognition testing. Each

Table 1

The 16 scenes: their themes and inventory of items

Theme	1[a]	2[a,b]	3[a,b]	4[a,b,c]	5[d]	6[e]	7[f]	(background)
1. park	tree	bench	sun	flowers	clock	tricycle	telephone	
2. house/yard	house	lawn mower	dog	car	couch	truck	desk	street grass
3. playground	slide	big swing	baby swing	see saw	bed	wagon	dresser	swing set grass
4. ocean	little fish	boat/ person	big fish	crab	high chair	octopus	baby buggy	water sand
5. farm	barn	tractor	sheep	cow	plane	donkey	train locomotive	fence grass
6. winter	bare tree	snowflakes	snowman	sled	boy in swim trunks	kid in snowsuit	girl in sunsuit	clouds hill
7. camping	evergreen	deer	tent	camp fire	guitar	picnic table	trumpet	river mountains
8. pond	ducklings	snake	duck	frog	cooking pot	turtle	tea kettle	pond grasses
9. treetop	nest	adult bird	baby birds	squirrel	ice cream cone	owl	toothbrush	treetrunk limbs
10. bathroom	bathtub	towels/ rack	toilet	sink	bananas	stool	pumpkin	walls

Table 1 Continued

Theme	1[a]	2[a,b]	3[a,b]	4[a,b,c]	5[d]	6[e]	7[f]	(background)
11. kitchen	sink	refrigerator	Table/chair	stove	pig	drawer &	rooster	
12. storytime	adult/w child on lab w/book	stand-up lamp	easy chair	window	panda	door	tiger	rug walls
13. mealtime	carton/w milk pour-ing	spoon & fork	plate/ food	mug	book	cup/ saucer	wrapped present	tabletop chairtop
14. grocery store	shelves	adult	food boxes cans	child in cart	bunny	bag of groceries	kitty	aisle/ shelves food sign
15. doctor	examining table	doctor	eye chart	scale	mailbox	coat rack	street light	
16. circus	circus stool	clown	balloons	bear	backhoe	seal	bulldozer	circus ring

[a] conventional scene items
[b] items rearranged to create anomalous target and rearrangement distractors
[c] item replaced to create anomalous target and substitution distractors
[d] anomalous inventory item inserted to create anomalous target
[e] item inserted to create conventional substitution distractor
[f] item inserted to create anomalous substitution distractor

picture consisted of line drawings of 4 discrete objects or units (eg., a couple of snowflakes is one unit) plus background (eg., water, walls, ground).

The 3 target pictures included one conventional picture, portraying a typical representation of the scene, and 2 anomalous pictures. The 4 items present in each conventional scene are listed in columns 1 through 4 of Table 1. The anomalous targets for each scene were identical to the conventional target except that in the case of anomalous inventory, a standard item in the conventional scene was replaced by an item unusual for that scene. The conventional item which was replaced to yield the anomalous inventory picture is indicated in the fourth column of Table 1; the anomalous item introduced is indicated in column 5. For example, in the park scene, the anomalous inventory target was constructed by replacing the flowers with a clock. The anomalous arrangement target was produced by rotating items so that one or two of them occupied inappropriate positions in the picture. For example, in the park scene, the sun, flowers, and bench were rotated so that the sun was on the ground and the bench was in the sky. The three items rotated to yield the anomalous arrangement target picture are indicated in columns 2, 3, and 4.

The 4 distractors for each scene included 2 involving

substitution of items and 2 involving rearrangement of items. For one of the 2 substitution distractors, the conventional scene was maintained by replacing an item in the target with a different basic level category item that was appropriate for the theme of that picture. In the other, an anomalous substitution occurred; the item that was inserted in the picture was inappropriate to the theme. The conventional and anomalous substitution items are listed in columns 6 and 7, respectively, in Table 1 and always replaced the item in column 4. Substitution items were similar in size, shape and detail to the item they replaced.

The remaining 2 distractor pictures consisted of rearrangement transformations; one rearrangement again yielded a conventional picture for a scene, the other resulted in an anomalous picture. To create the rearrangement transformation, the positions of 2 of 3 items in each of the target scenes were switched. The 3 items in a scene that were involved in rearrangement transformations were the same 3 that were rotated to create the anomalous arrangement target (columns 2, 3, and 4 in Table 1). The pictures were constructed so that either the conventional or anomalous substitution distractor could be paired with the conventional or

anomalous inventory target for the recognition test; likewise, either the conventional or anomalous rearrangement distractor could be paired with the conventional or anomalous arrangement target.

Design

The effects of three different variables on recognition memory were of interest: 1) meaningfulness of the target picture: conventional versus anomalous; 2) type of transformation exhibited in the distractor: substitution or rearrangement; and 3) extent of the transformation between a target and its distractor: consistent or inconsistent. All three variables were within-subjects variables.

Meaningfulness of the target. During familiarization, each child was shown one target picture from each of the 16 scenes. For 8 of the scenes, the conventional target was shown. Four anomalous inventory targets and 4 anomalous arrangement targets comprised the remaining 8 scenes. For every 4 subjects, 2 saw the conventional target of a particular scene, 1 saw the anomalous inventory target, and 1 saw the anomalous arrangement target for a scene.

Type of transformation. During the forced-choice recognition test, each target picture was paired with 1 distractor picture of the same scene. For the 8

conventional target pictures shown to a child, 4 were paired with substitution distractors and 4 were paired with rearrangement distractors. Of the 8 anomalous targets shown to a child, the 4 anomalous inventory targets were paired with substitution distractors (2 conventional, 2 anomalous) and the 4 anomalous arrangement targets were paired with rearrangement distractors (2 conventional, 2 anomalous). Thus each child received a total of 8 rearrangement transformations and 8 substitution transformations.

Extent of transformation. For half of the scenes target and distractor were consistent (both were conventional or both were anomalous) and for the other half of the scenes, target and distractor were inconsistent (one conventional, one anomalous). Of the 8 conventional target pictures shown to a child, 2 each were paired with conventional substitution, conventional rearrangement, anomalous substitution, and anomalous rearrangement distractors. For the 4 anomalous inventory targets, 2 were paired with conventional and 2 with anomalous substitution distractors. For the 4 anomalous arrangement targets, 2 were paired with conventional and 2 with anomalous rearrangement distractors.

A summary of the 8 kinds of target-distractor pairs

is shown in Table 2; each of these 8 kinds of pairings occurred twice over the 16 trials for every child. Each target of every scene was paired with each of its distractors an equal number of times across subjects.

Order of presentation of the 16 target-distractor pairs was random for each child with 4 restrictions: 1) each of the 8 kinds of target-distractor pair was represented once in both the first and second block of 8 trials; 2) conventional targets or anomalous targets could not be presented more than 3 times in succession; 3) distractors containing a substitution change or distractors containing rearrangements could not appear more than 3 times in succession; and 4) consistent or inconsistent target-distractor pairs could not be presented more than 3 times in succession. Presentation of the target on the right or left of the distractor occurred equally often over the 16 trials and also varied randomly with the restriction that the target's relative position not be the same more than 3 times in a row.

The dependent measure was the frequency of errors on each of the 8 kinds of target-distractor pairs. Errors were classified into 3 types: 1) "wrong" errors were those where the child simply chose the distractor as the picture that was seen before; 2) "same" errors were those where the child declared that the target and distractor

pictures were the same and thus decided that both had been seen before; and 3) "unsure" errors were those where the child noticed that the target and distractor were not the same but would not or could not choose either one as having been seen before.

Procedure

The child was seated in a child-sized chair at a small table with the Experimenter. First, 8 training trials were administered, 4 to acquaint the child with the Experimenter and 4 to familiarize him or her with the experimental task. On the first four trials the Experimenter showed the child 4 pictures of single objects and asked "What is this a picture of?". Each child was instructed to turn the page when he or she wanted to look at the next picture. After completing these four trials, the child was told that he or she would see 2 pictures, one that had just been seen and one that was not shown; the child was instructed to choose the one he or she saw before. All children could correctly identify all 4 pictures; 4 more training trials followed. On these trials, a picture of a child interacting with an object was shown. The child was instructed to look at each picture carefully and turn the page when ready to see the next one. After looking at the 4 familiarization pictures

the Experimenter announced "Now I am going to show you 2 pictures, one is a picture you just saw and the other one is a little bit different. I want you to tell me which one you saw before.". The Experimenter turned the pages to present the pairs of pictures and asked "Which picture did you see before?" After the child made a choice the Experimenter asked "How do you know you saw this picture before; what is different about this other picture?". This question was asked in order to train the children to look for small changes in detail. Any errors were corrected and the child's response to the "what's different" question was provided if necessary. For example, if the child pointed to a similarity between the two pictures, the similarity was noted by the Experimenter: "But this picture has a --- also.". If the child could not recognize or point out the difference between target and distractor for at least 3 of the pairs, he or she was not tested further.

After training, the child was familiarized with each of the 16 scenes. Instructions to the child were "Now I have 16 pictures, that's this many (showing the thickness of pages), and I want you to look at each one carefully and try to remember them so we can play this game some more. Turn the pages when you are ready.". The Experimenter reminded the child to look at the pictures carefully if he

or she began turning the pages rapidly.

After familiarization, the child was tested for recognition of the target pictures. Instructions to the child were "Now I'm going to show you 2 pictures at a time. One is exactly the same as a picture you just saw, and one is a little bit different. I want you to tell me which one you've seen before.". As the Experimenter turned the page for each trial, the child was asked "Now which one of these did you see before?". After the child chose one picture, the Experimenter asked, "How do you know you saw that one?". If the child declared that the 2 pictures were the same, the Experiemtner asked, "Are you sure? Look at them carefully.". If the child insisted that they were the same, a "same" error was recorded. If the child declined to pick one, the Experimenter asked, "Do you think they are the same?". If the child replied "Yes", the Experimenter asked, "Are you sure? Look at them carefully.". If the child insisted, again, a same error was recorded. If the child replied, "No", the Experimenter asked, "Which one do you think you saw?". If the child still declined to answer, an "unsure" error was recorded.

Sessions with the children were tape recorded and during the recognition test each child's choice of left or right

picture was recorded. Audio tapes were transcribed and coded for the child's answers to the question "How do you know you saw that one?". These answers illustrated whether the child could pick out the discrepancy between target and distractor and base the judgement of familiarity on that information, rather than relying on guesswork.

The number of errors for each child on each type of target- distractor pair were calculated and the data were analyzed by a 2 (age: older versus younger than the median age) x 2 (block) x 2 (target: conventional versus anomalous) x 2 (transformation: rearrangement versus substitution) x 2 (extent of transformation between target and distractor: consistent versus inconsistent) repeated measures analysis of variance. The age comparison provided a grouping variable in the design. Individual cell mean comparisons were made using Bonferroni t-tests. Additional ANOVA's were carried out to test specific hypotheses about errors on rearrangement and substitution transformations. Furthermore, the relationship between type of error and type of target-distractor pair was tested with a Cochran Q test.

CHAPTER III

RESULTS

The mean error rate for all children was 22.3%. This error rate was significatly less than chance ($t = 2.43$; $p < .05$), indicating that the children were able to recognize many of the complex pictures they had seen before. Predictably the younger children made more errors than the older children, 25.8% and 18.8%, respectively. The ANOVA yielded a significant main effect of age ($F(1,62) = 6.63$; $p = .0147$; see Appendix A). There were no interactions involving age, indicating that the improvement in recognition memory for older children was similar across the 2 kinds of target, 2 kinds of transformation, and extent of transformation.

Recognition memory for conventional and anomalous targets was quite similar. Mean error rates were 21.9% and 22.7%, respectively, a difference which was not significant. Young children were able to recognize both types of pictures equally well. These results suggest that the changes introduced in the anomalous targets did not disrupt the theme and children were able to assimilate anomalous as well as conventional pictures into existing schemata. Spontaneous verbalizations of the children during familiarization trials also indicated that the theme of the anomalous targets was still apparent.

Sometimes the children incorporated the anomaly into the theme, for example, "The lady is with her rabbit at the grocery."; "The worm (snake) is unhappy in the water.". Sometimes the children acknowledged the anomaly, for example, "How does he drive the boat underwater?"; "A clock outside - that's silly.". And sometimes the children ignored the anomaly, for example, "The grandma is reading the boy a story.", (ignoring the panda on the wall); "Sun, bench, flowers, tree.", (ignoring the sun on the ground, bench in the sky).

The type of transformation exhibited in the distractor, substitution versus rearrangement of items, influenced performance markedly. Children made less than half the number of recognition errors on targets paired with a substitution distractor (14.1%) than they did on those paired with a rearrangement distractor (30.5%). The ANOVA revealed a significant main effect for transformation ($F(1,62) = 38.95$; $p < .001$). Furthermore, children recognized targets paired with substitution distractors more easily than targets paired with rearrangement distractors regardless of whether the targets were conventional or anomalous. Mean error rates for conventional targets paired with substitution and rearrangement distractors were 13.7% and 30.1%,

respectively, whereas mean error rates for anomalous targets paired with substitution and rearrangement distractors were 14.4% and 30.9%, respectively. The ANOVA yielded a nonsignificant interaction of target with transformation.

The extent of the transformation, whether target and distractor were consistent or inconsistent in meaningfulness to the theme, affected recognition memory. Overall, recognition memory was better for targets in inconsistent pairs than consistent pairs. Mean error rates were 17.0% and 27.6%, respectively, a difference which was significant ($F(1,62) = 21.18$; $p < .001$). The overall ANOVA, however, revealed 2 significant 2-way interactions involving the extent of transformation: 1) target with extent of transformation ($F(1,62) = 6.06$; $p = .05$) and 2) type of transformation with extent of transformation ($F(1,62) = 10.16$; $p = .0022$). There was no significant 3-way interaction between target (conventional or anomalous), type of transformation (substitution or rearrangement), and extent of transformation (consistent or inconsistent). However, the pattern of error rates involving target and extent of transformation appeared to differ markedly between rearrangement and substitution transformations. These 2-way interactions can be better understood by examining the results of two subsequent

ANOVA's in which the data involving rearrangement and substitution test pairs were analyzed separately.

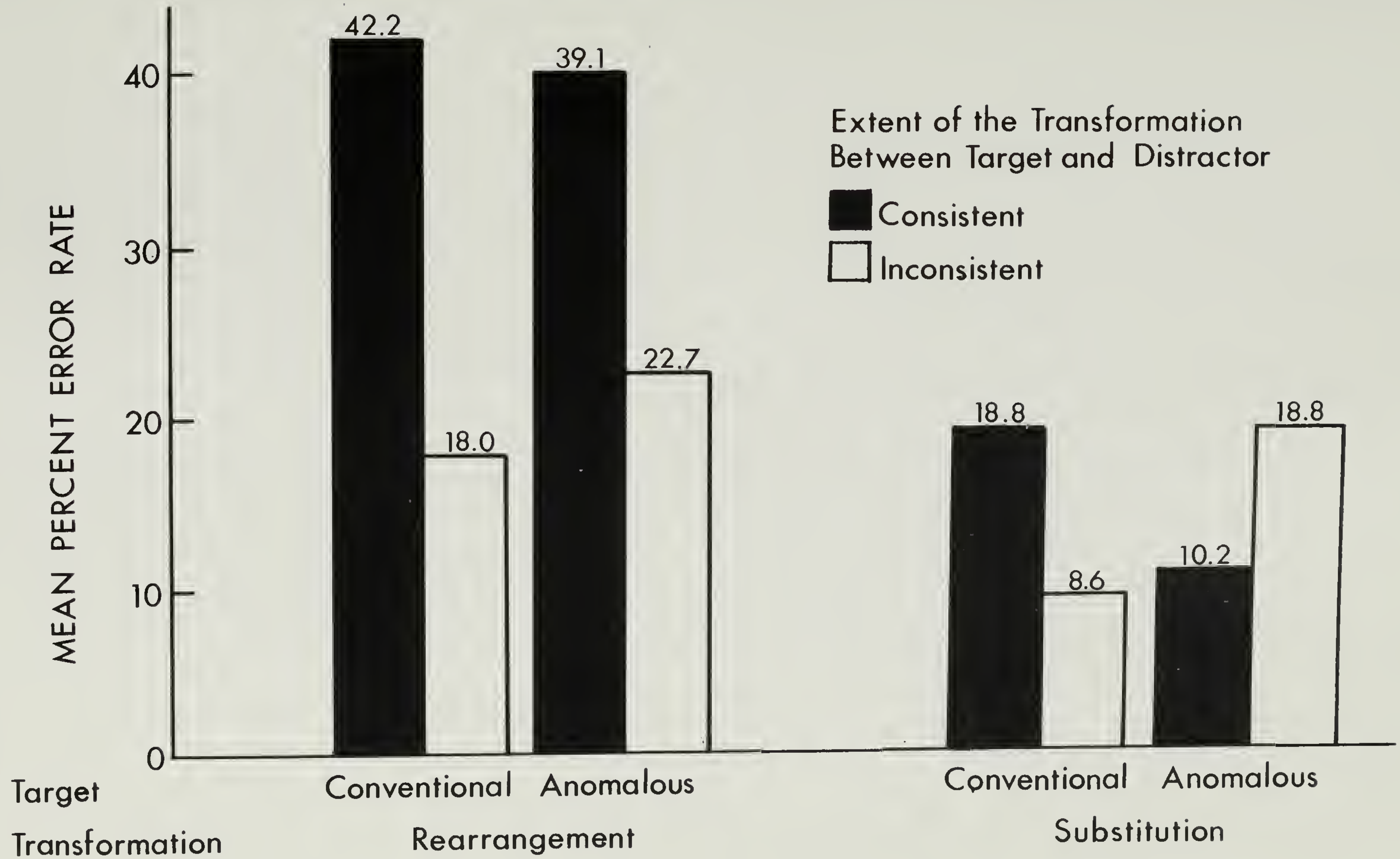
Rearrangement transformation

For picture pairs involving a rearrangement transformation the only significant effect obtained was a main effect of extent of transformation on recognition memory. When target and distractor pair were consistent children were less likely to correctly chose the target as previously seen than when target and distractor were inconsistent. The mean error rate on consistent pairs was 40.6%, twice the error rate of 20.3% on inconsistent pairs ($F(1,62) = 21.21$; $p < .001$; see Appendix B). As can be seen in Figure 1, this effect was similar for both conventional and anomalous target pictures. Post hoc Bonferroni t-tests indicated that these differences were significant for conventional targets ($t= 4.9938$; $p < .01$) and anomalous targets ($t= 2.4826$; $p < .05$). Thus, children were more likely to recognize the target when the rearrangement distractor was inconsistent with the target, one being anomalous, the other conventional than when the distractor and target were consistent, either both anomalous or both conventional.

Substitution transformation

In contrast to the results for rearrangement test

Fig. 1. Mean percent error for conventional and anomalous targets paired with consistent and inconsistent rearrangement and substitution distractors.


42.2
39.1
18.0
22.7
18.8
8.6
10.2
18.8
40
30
20
10
0
MEAN PERCENT ERROR RATE
Extent of the Transformation
Between Target and Distractor
Consistent
Inconsistent
Target
Transformation
Conventional
Anomalous
Rearrangement
Conventional
Anomalous
Substitution

pairs, when the distractor consisted of a substitution transformation, targets in inconsistent pairs were not always better remembered than targets in consistent pairs. For conventional targets, the mean error rate was greater on consistent pairs (18.8%) than on inconsistent pairs (8.6%). These results are comparable to those obtained for rearrangement transformation. But for anomalous targets the mean error rate was less on consistent pairs (10.2%) than on inconsistent pairs (18.8%; see Figure 1). This interaction of target with extent of transformation was significant ($F(1.62) = 7.86$; $p < .01$; see Appendix C). Post hoc Bonferroni t-tests indicated that for conventional targets, the greater error rate on consistent than on inconsistent pairs yielded a significant difference ($t = 2.42$; $p < .05$). But for anomalous targets, this difference in error rates was not significant ($t = 1.66$; $p > .05$).

An interesting question in these results is why, contrary to expectation, children are making more errors when an anomalous target is paired with a distractor containing a conventional item (inconsistent pair) than when both target and distractor contain an anomalous item (consistent pair). One reason may be the children's confusion between what they just saw and what they know to be true, as reflected in their verbalizations. Two-thirds

of the errors involving the anomalous inventory target - conventional distractor pairs were accompanied by the S saying something to the effect that, "A ---- doesn't belong in the ------." while referring to the target, "So I saw this one.", while referring to the distractor. It seemed as though the children's recognition decisions were swayed by what they knew to be thematically correct and this overwhelmed any memory of the familiarized anomaly. It is also interesting that this tendency to make thematically correct inferences did not occur under the rearrangement transformation. Perhaps children this age are more likely to make interences about inventory than arrangement of items in a scene.

<u>Errors on consistent and inconsistent pairs</u>

It has already been noted that for both conventional and anomalous targets, children made more errors on rearrangement than substitution test pairs. A more stringent test of children's memory for these two kinds of transformations was carried out by examining error rates for targets in only conventional consistent pairs. This comparison is a stringent test because when viewing a conventional target and conventional distractor, memory for details is necessary to correctly identify the target. The child could not rely on general semantic knowledge

about the theme of the picture to discriminate target from distractor since both pictures were representative of the theme portrayed. Mean error rates for pairs involving substitution was 18.8%, significantly less than error rates for the pairs involving rearrangement, 42.2% ($t= 3.66; p < .05$). This result is confirmation that children had better memory for details about inventory than arrangement of items.

Friedman (1979) found that adults made significantly more recognition errors when substitution involved expected items than when substitution involved unexpected items. She considered this evidence for the assimilation of the 2 pictures containing expected items to the same schema. On the other hand, she hypothesized that unexpected items were tagged, facilitating recognition for those items. In the present study, young children also tended to make more recognition errors when substitution involved expected, conventional items than when substitution involved unexpected anomalous items. Error rates on these consistent conventional and anomalous pairs were 18.8% and 10.2%, respectively. This difference was not significant ($t= 1.90; p > .05$) but the trend was in the expected direction.

Based on Friedman's ideas concerning substitution, it was also predicted that recognition memory would be poorer

for expected than unexpected arrangements of items. However, this pattern was not found. Mean error rate for conventional targets paired with conventional rearrangement distractors was 42.2%, and that was similar to the rate for anomalous targets paired with anomalous rearrangement distractors (39.1%). The difference was not significant ($t = .51$; $p > .05$).

In summary, the examination of error rates indicated that 1) there was improvement in recognition memory with increasing age, but no interaction of age with any of the other variables; 2) error rates were comparable between anomalous and conventional targets; 3) for both conventional and anomalous targets, children made significantly more errors on target-distractor pairs involving rearrangement transformation than on pairs involving substitution transformation; 4) for targets paired with rearrangement distractors, and for conventional targets paired with substitution distractors, children made significantly more errors on consistent target-distractor pairs than on inconsistent pairs; 5) however, the children were more likely to make errors on inconsistent than consistent pairs when anomalous inventory targets were paired with substitution distractors.

<u>Type of error</u>

The data were further examined for frequency of the 3 types of judgement that were counted as errors. Children either 1) chose the distractor picture as familiar, 2) declared that target and distractor were the same and refused to choose between them, or 3) noticed that target and distractor were different but would not or could not choose one as familiar. Of the total of 228 errors committed by all children, 135 (59.2%) were "wrong" answers, 57 (25%) were "same" answers, and 36 (15.8%) were "unsure" answers. Errors were predominantly "wrong" answers for 6 of the 8 kinds of target-distractor pairs (see Table 3). The percentage of errors that were "wrong" answers for these 6 pairs ranged from 60.9% to 87.5%. The two conditions in which "wrong" answers were not the predominant basis for errors both involved consistent rearrangement pairs. In these two conditions, the percentage of errors that were "wrong" answers were only 33.3% and 48.0%, respectively. Moreover, these two conditions accounted for 46 of the 57 "same" errors. All together, rearrangement pairs accounted for 54 of the 57 "same" errors.

The predominance of "same" answers for rearrangement pairs indicates that children had difficulty discriminating between pictures which differed by the

Table 3

The Relationship between Type of Error and Target - Distractor Pair

	Picture Pair							
Meaningfulness of Target and Distractor	Similar				Dissimilar			
Transformation	Rearrangement		Substitution		Rearrangement		Substitution	
Target	Conv.	Anom.	Conv.	Anom.	Conv.	Anom.	Conv.	Anom.
Frequency of errors	# (%)							
Wrong	18 (33.3)	24 (48.0	18 (75.0)	10 (76.9)	14 (60.9)	22(75.9)	8 (72.7)	21 (87.5)
Same	30 (55.6)	16 (32.0)	2 (8.3)	1 (7.7)	6 (26.1)	2 (6.9)	0	0
Unsure	6 (11.1)	10 (20.0)	4 (16.7)	2 (15.4)	3 (13.0)	5(17.2)	3 (27.3)	3 (12.5)
Sum	54 (100.)	50	24	13	23	29	11	24
% of Total = 228 errors	(23.68)	(21.93)	(10.53)	(5.70)	(10.09)	(12.72)	(4.82)	(10.53)

position of 2 items. This difficulty was enhanced when the target and distractor were consistent in thematic respresentativeness. Equally interesting was the fact that of the small sum of 3 "same" answers given for target-distractor pairs involving substitution of an item, all 3 were for pairs that were consistent in thematic representativeness (row 2 of Table 3). Not once did a child declare that a conventional picture and anomalous picture were the same when the discrepancy involved one conventional item versus an anomalous item. Apparently this discrepancy was a salient one.

Of the 36 "unsure" errors, where children declined to pick one picture from a pair as familiar, most occurred in the consistent anomalous rearrangement pair (10) followed by the consistent conventional rearrangement pair (6) (see Table 3). The number of "unsure" errors for the other pairs ranged from 2 to 5. Although these errors were more evenly distributed across testing conditions, children were again more confused by the consistent rearrangement pairs than any other pairs.

A Cochran Q test was used to test the relationship between type of error and kind of pair. This relationship was found to be significant ($Q = 371.928$; $p < .001$). Thus, when making errors, children were more likely to

detect the difference between target and distractor and were less likely to be "unsure" when substitution was involved. On the other hand, children were less able to detect the difference between target and distractor and were less confident of making a choice when rearrangement was involved, especially when target and distractor were consistent.

CHAPTER IV

DISCUSSION

The results of manipulation of the 3 variables, target meaningfulness, type of transformation, and extent of transformation will be discussed in terms of the role schemata play in recognition memory. First, recognition memory for anomalous and conventional target pictures was similar, indicating that young children are able to assimilate both types of pictures equally well into schemata. Unlike anomalous pictures used in other studies (eg., Mandler and Robinson, 1978) where scenes consisted of unorganized arrays of objects, the anomalous pictures in the present study consisted of 1 or 2 misplaced objects or the presence of one inappropriate item. The children's comparable memory for conventional and anomalous pictures in this study indicated that the latter were not rendered unorganized by these anomalies. Comments often spontaneously made by the children also indicated that they could identify the anomalous pictures as thematic scenes. Some examples have already been mentioned in the results section. Other instances included, eg., "The grandma is reading the kid a story with a panda on the wall."; "The sled is flying.".

A reason that children assimilated anomalous as well

as conventional targets into schemata may have been because they did not perceive the anomalies as such. However, this explanation seems unlikely. For one thing, children would spontaneously exclaim about the presence of anomalies, eg., "You're not supposed to sit on a window!"; "Bananas don't go in the bathroom!". Another indication that children could discriminate between conventional and anomalous scenes was that pairing inconsistent pictures resulted in better recognition memory for targets. This facilitation suggests that children possess schemata which contain limits for appropriate attributes of a pictorially represented theme.

Secondly, there was a profound effect of type of transformation, rearrangement versus substitution, on recognition memory. Children exhibited greater recognition accuracy for targets paired with substitution than rearrangement distractors. These results are contrary to those with older children (Mandler and Robinson, 1978; Mandler and Stein, 1974) who attended equally well to inventory and spatial information. However, these results coincide with data obtained by Friedman (1979) who found that adults were more likely to detect substitution than rearrangement transformations. She concluded that an inventory of objects was present in schematic representations of pictures but that information about

spatial location was either less likely to be stored or more easily forgotten. This difference between memory for inventory and arrangement information will be considered at other points throughout the remainder of the discussion.

Thirdly, the extent of the transformation between target and distractor, consistent or inconsistent, had a significant effect on recognition memory. Since the results for rearrangement and substitution transformations differed markedly, they will be discussed separately. For both conventional and anomalous targets tested with rearrangement transformations, more errors occurred on consistent than on inconsistent pairs. Children were required to remember specific details about the arrangement of items in order to recognize the target in a consistent pair. But when pictures were inconsistent, children could rely on memory about whether or not the familiarized picture contained an anomaly. Just recalling that the picture was conventional or contained an anomaly would discriminate the target from an inconsistent distractor since one was conventional and the other was anomalous.

This facilitative effect of inconsistency on memory can be considered a general form of "tagging": the picture

is assimilated into a schema while the existence of, but not details about, an anomaly is "stuck on". Although general tagging may have occurred, this would not enhance performance in an anomalous consistent pair since both target and distractor were anomalous. Indeed, the frequency of error on anomalous consistent pairs was no less than that for conventional consistent pairs. A specific tag, (Graesser, Gordon, and Sawyer, 1979) eg., the sun is on the ground; the pig is in the kitchen, would need to be retrieved in order for recognition memory to be facilitated for these pairs.

Just as assimilation of a conventional picture into a schema results in loss of memory for details (Friedman, 1979), perhaps without specific tagging of anomalous arrangement, assimilation of an anomalous picture into a schema also results in loss of memory for specific details. Because anomalous pictures were assimilated as well as conventional pictures, it makes sense that the variables that affect memory for anomalous and conventional pictures are similar.

Like the rearrangement transformation, memory for conventional targets paired with substitution distractors was poorer for consistent pairs than inconsistent pairs. These results provide support for Friedman's (1979) proposition that assimilating 2 conventional scenes into

the same schema results in confusion between the 2 pictures. But the opposite occurred for anomalous inventory targets: recognition memory was poorer when the distractor was inconsistent (conventional) than when it was consistent (anomalous). When faced with a conventional distractor children tended to "recognize" that distractor as familiar more than the anomalous distractor. Often, children who made this error commented, eg., "A clock doesn't belong in the park... I saw the tricycle." even though they were familiarized with the "clock". In fact, according to the real world knowledge that these young children were likely to have accumulated, the conventional distractor may, indeed, have been more familiar. In other words, these young children may have been making inferences about inventory from the schemata to which the pictures were assimilated, thus distorting their memory of that information.

When shown an anomalous distractor, recognition memory for an anomalous target was better than when the distractor was conventional. For example, if the target containing the clock was paired with the distractor containing the telephone in the park, the children were more likely to correctly select the target with the clock. These results for substitution can be accounted for by

Graesser, Gordon, and Sawyer's (1979) notion of specific tagging. When shown 2 anomalous pictures, the children were able to remember more than just the presence of an anomaly. The tag was more specific, allowing the children to remember the anomalous object and correctly identify the target. Yet the tagging of anomalous items, though more specific, is still precarious when the child is faced with information conventional to the schema to which an anomalous picture has been assimilated.

Recognition memory for anomalous targets paired with anomalous distractors was also better than that for conventional targets paired with conventional distractors but only when substitution was involved. Again, memory for anomalous targets was probably facilitated by the children's ability to specifically tag anomalous inventory during familiarization. Since this facilitation occurred only with substitution and not rearrangement transformation, these results are evidence that the children were more proficient at tagging anomalous inventory than anomalous arrangement information. Children this age can notice whether an arrangement is anomalous or not but cannot remember specific spatial locations. On the other hand, children not only identify anomalous inventory but also remember specifically what the anomalous object was.

Why do differences exist in children's memory for inventory and arrangement information? As noted earlier, Friedman (1979) concluded that there must be an object inventory in schemata, but nothing analogous for arrangement information. Schemata then, are defined more by inventory than arrangement of items. If so, inventory would be the more salient attribute of pictorial stimuli.

The types of errors made by the children also suggest that inventory is more salient than arrangement. When 2 pictures were consistent in meaningfulness and differed by arrangement of items, 44.3% of the recognition errors were "same" errors, a result of children not discriminating between target and distractor. On the other hand, not once did a child fail to notice a difference between consistent target and distractor involving substitution.

Further examination of the results for consistent pairs reveals the ambiguity of arrangement relative to inventory information. Goodman and Golding (1983) have proposed that when information is ambiguous, what is anomalous and what is conventional is not relevant or determinable. The consequence of ambiguity of aa stimulus is that recognition memory is similar for anomalous and conventional information. In the present study, this result was obtained for rearrangement transformation: in

consistent pairs, memory for anomalous and conventional targets was similar. On the other hand, if a stimulus is unambiguous, the schema-conventional information does not require active processing and attention is freed for the processing of information anomalous to the schema. Thus, more attention is given to anomalies, and the result is better memory for anomalies than for conventional information. In the present study, this result was obtained for substitution transformation: in consistent pairs, memory for anomalous targets was better than that for conventional targets.

That inventory was less ambiguous than arrangement information supports Friedman's (1979) proposition that schemata contain more information about inventory than spatial arrangement of objects. Both the present study with preschoolers and Friedman's (1979) with adults found that inventory was more salient. But Mandler and Robinson (1978) found that for both elementary school children and adults, inventory and arrangement were equally salient. These contrasting results suggest a modification to Friedman's proposition about the contents of schemata.

The pictures that Friedman used were very complex and detailed, containing as many as 34 items in a picture. The pictures that Mandler and Robinson (1978) used contained only 6 nonoverlapping items and a perspective

line. Similarly, in the present study, pictures consisted of 4 or 5 items plus background. For adults and older children, perhaps arrangement is remembered as well as inventory in less complex, organized pictures; for young children, inventory is far more salient than arrangement of items in the same kind of picture. But if a picture contains many items, the rearrangment of 2 items could be less likely than substitution to be detected by an adult. Thus, the greater salience of inventory over arrangement that is obtained with preschoolers can appear in adults who are overwhelmed with information.

For the young child, even an anomalous arrangement can be undetected while inventory is noted. For example, one child in the present study who was still particularly interested in the task after completing the recognition test, was asked which pictures were "silly". He proclaimed that the anomalous park scene, (sun on ground, bench in sky) was OK. After being asked to look again carefully, he was questioned, "Does the sun belong on the ground?" to which he replied, "Oh, is that on the ground?...the sun doesn't go on the ground! That's a silly picture.". In this picture the child failed to note the anomalous arrangement. The child knew that the sun belongs in the sky but when shown the picture of the sun

on the ground, the inventory of the picture, not the arrangement of those items, was used to judge the picture conventional. However, this same child was able to identify other seemingly more subtle anomalies such as the big bird with a worm, not the squirrel, belongs on the branch above the baby birdies in their nest. Arrangement is not always ignored, but for the younger child spatial arrangement is often not as salient as inventory.

In the present study, it was originally planned that after the recognition test each child would see the target pictures again and pick out the "silly" ones. Unfortunately, the limited attention span of this age group would not allow for this additional questioning. Such information would have been valuable as to whether there is a relationship between identification of an anomaly and recognition memory under the various conditions.

In summary, preschool children are able to assimilate into memory and retrieve information about familiarized conventional and anomalous scenes equally well. Overall, when 2 pictures are consistent in representativeness to a theme, children have more difficulty discriminating target from distractor. When 2 pictures are inconsistent, recognition performance is facilitated by memory for general information about whether the target contains an

anomaly or not. That they assimilate this general information indicates that children this age possess schemata which contain expectations about the inventory and arrangement of items appropriate to the themes they represent. It is these expectations contained in schemata that Freidman (1979) and Brewer and Treyens (1981) use to explain patterns of recognition memory for complex pictures in adults. However, young children's attention to inventory and arrangement information differs markedly. Under every condition, memory for inventory was better than memory for arrangement. This result indicates that inventory of items is a more salient attribute of pictorial stimuli than arrangement of those items. In addition, differences in memory for conventional and anomalous inventory and arrangement suggest that inventory information is less ambiguous for the young child. This in turn allows children to more proficiently tag specific details about inventory than arrangement information. In conclusion, knowledge about what items are appropriate to familiar themes is a more integral part of schemata of the young child than knowledge about appropriate spatial relationships between those items.

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APPENDICES

Appendix A

Summary table for overall analysis of variance

Source	Sum of Sources	degrees of freedom	Mean Square	F	p
Age	1.27	1	1.27	6.63	.0125
error	11.84	62	.19		
Block	.25	1	.25	1.75	.1908
BlockxAge	.02	1	.02	.11	.7420
error	8.86	62	.14		
Target	.02	1	.02	.09	.7608
TargetxAge	0.00	1	0.00	0.00	1.0000
error	10.36	62	.17		
Block x Target	.14	1	.14	.87	.3583
BxTxA	.02	1	.02	.10	.7563
error	9.97	62	.16		
Pair[a]	2.85	1	2.85	21.18	.0000
PairxAge	.19	1	.19	1.42	.2374
error	8.34	62	.13		
BlockxPair	.04	1	.04	.25	.6155
BxPxA	.04	1	.04	.25	.6155
error	8.55	62	.14		
Target x pair	1.13	1	1.13	6.06	.0166
TxPxA	.19	1	.19	1.03	.3158
error	11.55	62	.19		
BxTxP	.005	1	.004	.03	.8667
BxTxA	.10	1	.10	.71	.4025
error	8.52	62	.14		
Change[b]	6.89	1	6.89	38.95	.0000
Changexage	.02	1	.02	.09	.7673
error	10.97	62	.18		
Block x change	0.00	1	0.00	0.00	1.0000
BxCxA	.02	1	.02	.09	.7688
error	11.11	62	.18		

Appendix A Continued

Source	Sum of Sources	degrees of freedom	Mean Square	F	p
Target x					
Change	0.00	1	0.00	0.00	1.0000
TxCxA	.14	1	.14	1.00	.3216
error	8.73	62	.14		
BxTxC	.56	1	.56	3.49	.0666
BxTxCxA	.06	1	.06	.39	.5359
error	10.00	62	.16		
Pair x					
change	2.44	1	2.44	10.16	.0022
PxCxA	.04	1	.04	.15	.7034
error	14.90	62	.24		
BxPxC	.004	1	.004	.03	.8672
BxPxCxA	.04	1	.04	.25	.6162
error	8.59	62	.14		
TxPxC	.19	1	.19	1.32	.2554
TxPxCxA	.19	1	.19	1.32	.2551
error	8.99	62	.15		
BxTxPxC	.10	1	.10	.67	.4158
BxTxPxCxA	.004	1	.005	.03	.8704
error	9.02	62	.15		

[a]Pair = extent of transformation between target and distractor

[b]Change = type of transformation exhibited in distractor

Appendix B

Summary table of Anova involving rearrangement

P*	Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
	Mean	47.53125	1	47.53125	190.89	.0000
	Age	.78125	1	.78125	3.14	.0814
1	Error	15.44750	62	.25899		
	Block	.13500	1	.13500	.62	.4358
	Block x Age	.03125	1	.03125	.15	.6962
2	Error	12.59375	62	.20313		
	Target	.01781	1	.01781	.04	.8486
	Target x Age	.07031	1	.07031	.33	.5672
3	Error	13.17188	62	.21245		
	Block x Target	.63281	1	.63281	3.72	.0583
	Block x Target x Age	.07031	1	.07031	.41	.5227
4	Error	10.55688	62	.17011		
	Pair	5.28125	1	5.28125	21.21	.0000
	Pair x Age	.03125	1	.03125	.13	.7243
5	Error	15.44750	62	.25899		
	Block x Pair	.03125	1	.03125	.18	.6722
	Block x Pair x Age	0.00000	1	0.00000	0.00	1.0000
6	Error	10.72875	62	.17288		
	Target x Pair	.19531	1	.19531	1.04	.3124
	Target x Pair x Age	.38281	1	.38281	2.03	.1589
7	Error	11.67188	62	.19828		

Appendix B Continued

p*	Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
	Block x Target x Pair	.07031	1	.07031	.39	.5333
	Block x Target x Pair x Age	.07031	1	.07031	.39	.5333
8	Error	11.11938	62	.18918		

Appendix C

Summary Table of Anova Involving Substitution

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
Age	.50	1	.50	4.20	.0446
Error	7.38	62	.12		
Block	.13	1	.13	1.05	.3093
Block x Age	0.00	1	0.00	0.00	1.0000
Error	7.38	62	.12		
Target	.01	1	.01	.08	.7758
Target x Age	.07	1	.07	.74	.3942
Error	5.92	62	.10		
Block x Target	.07	1	.07	.46	.4989
Block x Target x Age	.01	1	.01	.05	.8214
Error	9.42	62	.15		
Pair	.01	1	.01	.06	.8040
Pair x age	.20	1	.20	1.55	.2174
Error	7.80	62	.13		
Block x Pair	.01	1	.01	.08	.7845
Block x Pair x Age	.07	1	.07	.68	.4131
Error	6.42	62	.10		
Target x Pair	1.13	1	1.13	7.86	.0067
Target x Pair x Age	0.00	1	0.00	0.00	1.0000
Error	8.88	62	.14		
Block x Target x Pair	.03	1	.03	.30	.5852
Block x Target x Pair x Age	.03	1	.03	.30	.5852
Error	6.44	62	.10		