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ABSTRACT

This paper describes two studies conducted to investigate young children's manipulative responses to materials in a free play situation and to examine the resultant learning. Study I: Each child played with either a simple or a complex set of materials during three play sessions. Learning was measured on a posttest of classification ability. Results indicated that children's ability to interact with the materials was not related to the complexity of the materials, except in the posttest. Younger children performed better after playing with simple blocks, while older children performed better after playing with complex blocks, providing evidence that a match between age and complexity of materials may be a factor in learning classification. Study II: Only 3- and 5-year-olds were studied, new materials were added, and the old blocks were redesigned to emphasize differences between the simple and complex. Instead of three sessions with one set of materials, each child had one session each with three sets of materials. Results indicated there was no significant interaction of age and complexity of materials on classification activities. There were significant age differences in manipulation scores. The study provided information on the consistency of responses across different materials and the relationships between different types of responses to the same materials. (ST)

THE INFLUENCE OF AGE AND MATERIALS ON YOUNG CHILDREN'S PLAY ACTIVITIES AND CLASSIFICATION LEARNING

A Doctoral Dissertation

by

Jean Swift Phinney

1973

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ABSTRACT OF THE DISSERTATION

The Influence of Age and Materials on Young Children's Play Activities and Classification Learning

by

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Doctor of Philosophy in Education
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This study is concerned with the way young children use manipulative materials in play and the way their use of materials in play is related to learning. Various theories of development, most notably that of Piaget, suggest that the young child does much of his learning about the world through playful, spontaneous, self-initiated encounters with objects in the environment. There have, however, been few investigations of children's playful use of manipulative materials and little is known about how children learn from unstructured play with objects in the environment.

To investigate these issues, preschool children (ages 3 to 6) at two levels of ability were observed during play sessions with either simple or complex materials, and their manipulations of the materials were

recorded. The effect of play on learning was studied in relation to multiple classification abilities as measured on a posttest. For the play sessions, similar sets of manipulative materials were developed which differed only in complexity, as follows: in the simple set the dimensions of difference (such as color, shape, and texture) all vary dependently, so that there is only one possible way to classify the materials; in the complex set, the dimensions vary independently, so that there are a number of different ways in which the materials may be classified. A system was developed for recording manipulative responses to these materials, such as classification (by color, shape, or texture), pattern making, fitting together complementary shapes, and over-all organization of materials.

The theoretical concept of "match" (Hunt, 1961) suggests that children benefit most from materials appropriately matched to their level of development. Therefore, children with limited classification ability should learn more from play with simple materials, while children with greater classification ability should learn more from play with complex materials.

The results provide limited support for the concept of match. Three-year-old children who played with the simple materials did better on a posttest of classification ability than those who played with the complex materials. With five-year-old children, the opposite was true. Those who used the complex materials did better on the posttest.

Certain activities during play were found to be related to classification ability as measured by the posttest; classification on two dimensions at once (with the complex materials) and pattern making (among the younger children) were significantly related to posttest performance. While these results suggest that certain activities during play may be reflected in learning, this interpretation is limited by the fact that the data a correlational.

The results also provide evidence that with increasing age, preschool children show a greater tendency to create patterns with unstructured stimuli and a higher degree of organization in their spontaneous arrangements of elements. Individual patterns of play were highly consistent across three sessions when the same materials were used, and amount of organization was consistent across different types of materials.

CHAPTER 1. INTRODUCTION

The play of young children has traditionally been thought by educators to be basic to development. That young children learn through play is a common theme of both early and contemporary writers about the nursery school (Froebel, 1912; Omwake, 1963; Stant, 1972). Most frequently, play is assumed to contribute to the physical, social, and emotional development of the child (Lowenfeld, 1967; Erikson, 1963; Murphy, 1956). However, a position articulated by Montessori (1912) and recently receiving increasing attention (Almy, 1966; Lunzer, 1959; Sutton-Smith, 1967) emphasizes the importance of play for intellectual development. This position is currently receiving support from the work of Jean Piaget (1968). The young child appears to do much of his learning about the world through playful, spontaneous, self-initiated encounters with objects in the environment. This view is reflected in current interest in the "open" classroom that allows the child to make many of his own choices, and in the use of learning centers where the child can initiate encounters with various materials. There have, however, been few investigations of children's spontaneous use of manipulative materials, and little is known about the way in which children learn from unstructured play with objects in the environment.

The present study is aimed at obtaining information on the way children use manipulative materials in a play situation and the way their use of materials in play is related to the resultant learning. It is in part a descriptive study, looking at changes with age in the way children use materials, and in part experimental, examining the effect of complexity of materials and the child's ability on manipulations during play and on the learning of multiple classification.

As background for the study, the following sections review the theoretical literature on play and cognitive development, experimental studies of play and cognition, the influence of materials on play, and the development of multiple classification abilities in young children.

PLAY AND COGNITIVE DEVELOPMENT

The topic of play has long been of interest to observers of the human scene (Caillois, 1961; Huizinga, 1949). Numerous books have been devoted to the study of play in children (e.g., Herron & Sutton-Smith, 1971; Lowenfeld, 1967; Millar, 1968). Yet it remains almost impossible to find a satisfactory definition for the term "play." Often, it is defined in terms of what it is not: not work, not purposeful activity, and so forth. Berlyne (1969) suggests that for psychological research the category "play" should be discarded in favor of more precise categories. However, it is a convenient word, and for the present discussion it will be retained to refer to activity that a child engages in freely, in the absence of externally imposed directions or pressure, that serves no immediate or apparent adaptive purpose.

The role of play in cognition derives much of its theoretical support from the writings of Piaget. For Piaget, cognitive development in preoperational children is dependent on active manipulations of materials. Such manipulative activities take place spontaneously, motivated by the child's innate tendency to practice existing schemata and modify them to meet new situations (Hu 1961). The development of cognitive structure depends on the child's own activities rather than on those of the teacher. Flavell (1963), summarizing Piaget's position, states that "Stable and enduring cognitions about the world around us can come about only through a very active commerce with this world....As actions are repeated and varied, they begin to intercoordinate with each other and also to become schematized and internalized." For Piaget, such interactions with the environment come about naturally, motivated by the child's innate tendency to practice existing schemata and modify them to meet new situations (assimilation and accommodation). Such cognitive encounters with the world are assumed to take place during the spontaneous activities of the child with whatever materials are available. While such spontaneous activites might generally be termed "play," Piaget avoids using the term "play" for encounters involving accommodation and development of new schemata, restricting the term to purely assimilatory activities. The problems with his narrow definition have been discussed by Klinger (1969) and Sutton-Smith (1966).

For Piaget, development proceeds in small steps; accommodative modifications in schemata "can occur only when there is an appropriate match between the circumstances that a child encounters and the schemata that he has already assimilated into his repertoire" (Hunt, 1961). Materials at the appropriate level, which provide the child with the chance to practice developing schemata, should enhance cognitive development. However, when the discrepancy between the child's level and the circumstances is too great, no accommodation can occur. Thus, the impact of play on cognitive development may depend largely on the match between the play materials and the child's level of development.

Learning through play may also be thought of in relation to the concept of competence, as discussed by White (1959). He has emphasized the satisfaction an individual derives from effective interactions with the environment in the absence of strong primary drives. He contrasts the narrow learning and concentrated attention of the typical structured instructional situation with the broad development of competence in self-directed activity, without external direction or pressure. Such absence of pressure and spontaneous interaction with the environment is characteristic of children's play.

Additional theoretical support for the role of play in cognition comes from work on exploratory behavior and curiosity. Berlyne (1960) has looked in detail at behavior such as curiosity and play which serves no obvious external purpose. He has focused on stimulus factors related to such activity and has identified a number of collative variables (novelty, surprise, conflict, incongruity, complexity) as important to play or similar apparently unmotivated behaviors. Charlesworth (1969) has extended the study of one of these variables, surprise, to show how it might function to bring about cognitive development. While it is not obvious how surprise *per se* is related to play, it seems likely that many of the investigatory and manipulative behaviors that occur in play are in response to collative variables in the materials or, conversely, are aimed at making the materials more stimulating or interesting, in what Berlyne would call diversive activity. The distinction between investigatory and diversive activities will be examined in more detail in the next section, in discussing the work of Hutt.

A different theoretical interpretation of play is that of Sutton-Smith (1967). In attempting to understand the relationship between play and cognitive development, he focuses on the opportunity provided by a playful situation for a child to vary his responses to objects, thus increasing his range of associations to these objects. "While it is probable that most of this associative and combinatorial activity is of no utility except as a self-expressive, self-rewarding exercise, it is also probable that this activity increases the child's repertoire of responses and cognitions..., an increase which has potential value for subsequent adaptive purposes...Responses developed in play may be put to adaptive use when there is a demand."

In summary, various theoretical positions suggest that important learning takes place through spontaneous, playful interactions of the young child with the environment. The concept of "match" suggests that behaviors practiced in play may be related to level of development. Work of Berlyne and others focuses on stimulus variables of the materials as an important consideration. Sutton-Smith's work emphasizes novel responses developed in play.

These theoretical positions raise a number of interesting questions for research. Do children at different levels of development respond differently to materials in terms of differing needs to practice developing schemata? Do children learn more from interactions with materials when there is a "match" between the materials and the child's level of development? In addition to possible learning, do children develop novel responses through manipulation of materials in play?

RESEARCH ON PLAY AND COGNITION

While the implications of the theoretical positions discussed above are clear, experimental evidence of cognitive change resulting from play is extremely meager. Obviously it is a difficult area to investigate. Play behavior is so diffuse and unstructured that systematic observation is extremely difficult. Bits of behavior relating to a given cognition may occur at widely separated points in time and space. The changes in question presumably proceed by small steps and take place over considerable periods of time. Klinger (1969), in discussing the role of play in problem solving, comments that solution of problems in play is rarely direct, "Rather, solutions emerge out of periodic, fragmented enactments of salient material." Elkind (1971) points out that short-term experiments based on learning theory miss the small steps involved in this type of slower, long-term acquisition, which he calls "spontaneous learning."

The problem is neatly summarized by Flavell & Wohlwill (1969): "Effects of training in producing vertical progression tend to be inversely proportional to the extent of horizontal transfer achieved. This inverse relationship represents quite possibly the key to the difference between the effects of training and controlled experience and those of the child's spontaneous, unprogrammed experience. The latter results in vertical progress that is undoubtedly slower and more haphazard, but in compensation it takes place on a much broader scale horizontally."

This statement makes clear some of the problems of research on play: the outcomes of play are broad, open-ended, haphazard, and difficult to measure. Few research paradigms deal with this problem. Early studies of play are generally observational and taxonomic: enumerations of the kinds of play and the materials used by children in naturalistic settings. Some more recent studies have focused on learning through games (Humphrey 1965, 1966). Sutton-Smith (1967) used a number guessing game to induce number conservation in five-year-old children. The competition in the game was presumed to force the children to pay attention to number cues. However, young children do not readily abide by rules; games for young children therefore require close teacher supervision (except for simple active games like "tag"). Most so-called games for preschool children are in fact teacher-directed lessons.

A possible experimental paradigm for investigating play is that of incidental learning. Postman (1964) distinguished two types of experiments on incidental learning. In Type I, the subject is exposed to stimulus materials but is not given instructions to learn; he is subsequently tested for retention of certain aspects of the material. In Type II, the subject is exposed to stimulus material and given a specific learning task; he is subsequently tested on some aspect of the material other than the assigned task. Type I, clearly, is closer to the situation of children at play. However, little research has been done with preschool children. Existing research indicates that incidental learning increases to about age 12, presumably due to increasing ability to divide attention (Maccoby, 1969; Siegel & Stevenson, 1966; Hale, Miller & Stevenson, 1968). This suggests that young children have little ability to attend to more than one thing at once, a suggestion borne out by research in other areas. Of course in Type I learning, attention is not necessarily divided; the child may attend and respond to any one of several aspects of the material. Berlyne (1963) feels that the collative properties of stimuli will have a considerable importance in determining when incidental learning will take place.

Postman (1964) sums up his review by pointing out that there is, in fact, no reason for a conceptual distinction between intentional and incidental learning. "What is learned depends on the responses elicited by the stimuli in the experimental situation. Manipulation of the instruction stimulus represents only one of the many different ways in which these responses can be determined." Postman's position suggests that to understand the learning that occurs during play we should look at the behaviors that take place as a child manipulates materials and attempt to understand the variables that affect them, instead of looking only at the outcomes. The behavior during play would be seen as a mediating variable to the learning that results. After observing and recording behavior, it could be determined whether certain observed behavior was in fact related to learning.

A most interesting and suggestive bit of research along these lines is reported by Morf (1959). In the course of his training studies on inclusion, some children, who had responded incorrectly to the inclusion problem, were given no training but were instead given the opportunity to manipulate freely the experimental materials. The resulting behavior was observed and recorded. Of 43 subjects, between the ages of 4 and 7, 14 engaged in purely playful imaginative and manipulative behavior. Twenty subjects mixed playful imaginative behavior with rudimentary grouping activities. Nine subjects became deeply involved in grouping and regrouping the objects. From this last group, one protocol is given of a four-year-old's play with seven blue cars and three yellow ones. The child rearranged the cars repeatedly, in parades, races, parking areas, etc., with apparent attention to the colors and numbers. After the free play, the subjects were again given the inclusion problem. Of the 20 who engaged in some grouping activities, 7 improved from initial complete failure to achieve partial success. Of the nine who engaged in intensive grouping activites, eight had, interestingly, achieved partial success in the pretest. Of these, two achieved complete success after free play. The one who had failed initially achieved partial success. Although no statistical results are given, these data are most suggestive. Improvement was apparently related to the activities engaged in spontaneously with the materials. Furthermore, those subjects who engaged in the most grouping activity were those who had a transitional stage. This study suggests that the initial ability level is an important variable in the kind of behavior engaged in during free play, and that the kind of behavior, in turn, is related to learning.

A quite different experimental approach to learning through play involves introducing specially designed materials into the natural environment, e.g., a nursery school, and simply allowing children to play with them as they wish. Keislar & Phinney (1971) devised a self-instructional toy to teach children to associate nine different animals with their natural habitats. The nine animal cards had tabs on the back so that each one could fit only into the slot under the appropriate habitat. An accompanying reference book allowed the child, through use of pictured tabs, to look up any animal and see him pictured in his natural habitat. In two different Head Start classrooms, one third of each group was briefly shown the mechanics of the toy, including how to use the reference book. The toy was then left in each classroom for four days. Results showed that the 37 children improved as a group from a pretest mean of 1.8 (at the chance level) to a posttest score of 5.4 (out of a possible 9). Thirty-two percent of the subjects made either no errors or only one on the posttest.

A study of the same sort, but covering a considerably longer period, has been carried out by Olson (1970). He devised a pegboard toy in which checkers fit only into the larger holes on the diagonals. After the toy was left in the nursery school for seven months, the children in the school performed significantly better on a test of diagonality than children in another similar nursery school where the toy had not been used. Through trial and error, children who played with the toy had apparently discovered the diagonal pattern.

In summary, few research paradigms are available to deal with the learning that occurs in spontaneous, undirected activity. When materials are simply left in the environment, it is extremely difficult to control extraneous variables and gain any insight into the specific factors that influence the learning. The incidental learning literature suggests that it is important to look at the behaviors that occur during play as a mediator of learning. The behavior is probably related to the initial ability level, as suggested by Morf, as well as to the stimulus properties of the materials. Further research needs to focus on the interrelationships among ability level, materials, and response patterns during play.

INFLUENCE OF MATERIALS ON PLAY

The influence of materials on play has been investigated in a number of ways. Several studies have dealt with the effect of novelty on toy preferences. Mendel (1965) showed that young children (3 1/2 to 5 1/2 years old) in a free choice situation reliably preferred novel toys over toys with which they had previously had a chance to familiarize themselves. Relative complexity of stimulus materials also appears to be preferred by children (Cantor, 1963). However, preference in a free choice situation is not necessarily a measure of the amount and kind of involvement with a toy. The most novel or complex toy may be initially chosen, but the child may not continue to play with it for long. It is important to look at what actually goes on during interactions with materials.

Pulaski (1970) looked at the actual play patterns (specifically, fantasy production) of 5, 6, and 7 year old children in interaction with toys of varying degrees of structure. She found that minimally structured materials elicited a greater variety of themes. However, in general, children at this age already showed well-established predispositions toward certain fantasy themes, so that the effect of variation in the materials was not great.

Perhaps the most pertinent work in this area is that of Corinne Hutt(1966, 1970). Working within Berlyne's theoretical framework she considers play as a form of diversive exploration, that is, exploratory behavior that aims at increasing stimulation. Using a specially designed "novel object" capable of being manipulated in various ways and providing various kinds of feedback (visual, and/or auditory or none) she noted the time children spent in free play with the object and the specific kinds of responses made. In her analysis she distinguished between two kinds of behavior that are affected differently by characteristics of the materials. Specific exploration is behavior aimed at gaining information about a stimulus, or at understanding what the object can do. It is affected largely by the complexity of the stimulus, and typically decreases with repeated exposure. Diversive exploration, on the other hand, typically takes place after specific exploration. The child has found out what the object can do and is now concerned with increasing stimulation from it. The amount of time spent with an object in diversive activity is a factor in how much the child can do with it. Repeated exposure does not necessarily result in a decline of responses. This distinction between specific and diversive exploration has important implications for the role of materials in play. A complex, highly structured toy may elicit much initial specific exploratory behavior, but soon loses appeal if it provides little possibility for diversive behavior. Simpler toys, such as traditional blocks, would elicit little specific exploration, since there is little to learn about blocks. However, there is literally no end to the things the child can do with them, a fact which may account for their perennial popularity. In diversive or play behavior, then, the toy that will sustain interest is one that allows the child to do a variety of different things with it. Presumably this variety of possibilities allows the child to use it in accordance with his own concerns and abilities.

In summary, the effect of materials used in a free play context may be profitably differentiated in terms of specific and diversive exploration. Specific exploration will be affected particularly by collative properties such as novelty and complexity (although obviously these factors interact with the child's age, ability, etc.). Diversive behavior, which is closer to our definition of play, will be more a product of what the child can do with the materials, i.e., the possibilities for manipulation and arrangement allowed by the materials, and what the child's individual predisposition and abilities incline him to do.

DEVELOPMENT OF MULTIPLE CLASSIFICATION ABILITIES IN CHILDREN

In order to study behaviors related to cognitive development as they occur in play, it is necessary to select a particular area of development as a focus for both observation and selection of materials. Piaget (Flavell, 1963) distinguishes two modes of interaction with the environment that are related to cognitive development. One, physical experience, leads to understanding of the qualities and properties of things, such as shape, color, and form. The other, logico-mathematical experience, leads to an understanding of the relations among things and of the properties of our actions on things. From the former, one learns, for example, that objects have certain physical properties; from the latter, one learns that objects can be grouped in various ways on the basis of their different properties, and that the same object can become a member of a number of different groups. The ability to classify objects consistently on one dimension and then shift one's criteria and classify on another dimension, which will be called multiple classification, develops during the preschool and early elementary years (Inhelder & Piaget, 1964). It seems likely that this ability develops from repeated manipulation, grouping and regrouping of objects, such as frequently occurs in children's play. Furthermore, the occurrence of such activity could presumably be influenced by the specific materials a child is exposed to. Use of materials that vary on only one dimension should aid learning to sort consistently; objects that vary systematically on a number of dimensions might provide cues that would stimulate grouping and regrouping, and thus give practice in multiple classification. The development of such abilities, therefore, seems a worthwhile area to investigate within the theoretical context discussed, that is, learning through play.

The young child's ability to classify objects has been examined from a number of different points of view. The studies of Olver & Hornby (1966) show the changes with age in the kinds of groupings made of common objects. Kagan, Moss, & Sigel (1963) have looked at classificatory behavior in terms of differences in cognitive styles. Sigel and his associates have looked at similar behavior in terms of developmental changes (Sigel, 1964), with disadvantaged children and as affected by the level of representation (Sigel & McBane, 1967; Sigel & Olmsted, 1970). Most of this research is concerned with the type of classification used by children, rather than with the ability to change the classification originally used. Typically, also, this research has used either real objects, or pictures, or words for real objects.

The physical dimension preferred by children as a basis for classification has been studied using geometric forms varying typically in shape, color, and sometimes size (Suchman & Trabasso, 1966). There is considerable evidence that young children prefer color but that around age five or six the preference shifts to form. Strong dimensional preferences interact with discrimination learning (Wittrock & Hill, 1968) and are presumed to inhibit the ability to shift criteria for sorting (Kofsky & Osler, 1967).

The ability to classify consistently and to subsequently shift criteria for sorting has been investigated by Piaget and his associates as part of his extensive study of classification (Inhelder & Piaget, 1969). Piaget describes in detail the developmental changes in children in terms of the kinds of groupings they make in response to the instructions to put together things that are alike. From early "graphic" collections, which have no consistent criteria for grouping, the child proceeds to "nongraphic" collections in which the criteria are consistent but the grouping is not necessarily exhaustive. Finally, the operational child can plan in advance several alternative ways objects could be grouped and understands the hierarchical relationship among groups. Piaget also investigated the responses of children asked to classify objects in a different way, after an initial sort. The following table gives the percentages of children at ages 5 to 9 who could make successive, consistent classifications on different criteria.

Age		5	6	7	8-9
No. of subjects		(12)	(17)	(18)	(13)
Criteria:	0	27%	12%	5%	0%
	1	46	12	11	0
	2	27	47	56	31
	3	0	29	28	69

For Piaget, consistent and exhaustive classification is difficult for the young child because of his failure to coordinate intension (the defining property of a class) and extension (all the members of the class so defined). His inability to shift criteria is related to his lack of anticipation or planning. He typically arrives at his first classification scheme by trial and error, rather than by conscious selection. Thus, when asked to sort in a different way, he is apt to hit upon the same dimension as he used before. Unlike the operational child, he has not made a systematic inventory of the materials.

A study of multiple classification by Kofsky & Osler (1967) confirms the difficulty of young children in reclassifying objects, but goes beyond previous studies in examining stimulus variables. In their experiment, three sets of materials were used. Set A varied on four dimensions, with two values of each, to give 16 items; Set B varied on two dimensions, one with two values, the other with eight, to give also 16 items; Set C used two dimensions, with two values each, for a total of four tiems. Set C resulted in the greatest number of adequate initial sorts and reclassifications among five-year-olds. Set B resulted in the next best performance when form and color were the relevant dimensions, but resulted in the poorest performance when size and number were relevant. Thus, they found that the younger children (5-year-olds) were able to reclassify more easily (1) with fewer items (4 versus 16); (2) with form and color as relevant dimensions; and (3) with fewer irrelevant dimensions present.

Recently Denney (1972) showed how the instructions given affect the groupings children make in free classification. She used two different procedures, one similar to that of Piaget (Inhelder & Piaget, 1964), the other like that used by Vygotsky (1962), in requesting children aged 2, 4, 6, 8, 12, and 16 to group stimuli consisting of 38 blocks of four colors with 9 or 10 shapes of each. The types of groupings formed varied significantly under the two procedures. Her study is interesting for her method of recording and scoring the types of groupings that occurred. She was able to group all the responses into four categories: groupings with no similarity, groupings based on form, groupings based on color, and building with similarity (primarily form). She apparently did not consider the number of blocks used in a grouping. She did not find most of the types of groupings recorded by Piaget, and found no evidence of distinguishable stages of development. Furthermore, she found no significant sex differences in classification behavior. However, she points out the problems of making sure younger children understand the instructions, and suggests the need for more intensive study of classification in younger children.

Kofsky (1966) made a scalogram study of classificatory development in an attempt to establish a sequence of steps leading to operational classificatory behavior. Using different tasks to tap each ability, she found the following developmental sequence to prevail generally: consistent sorting (using one consistent attribute to group three or more blocks); exhaustive sorting (consistent sorting of all of 9 objects which varied in shape and color); understanding of multiple class membership (based on verbal responses to questions); and horizontal reclassification (using 8 blocks consisting of 2 shapes with 4 colors of each).

As have been noted, a problem in testing for multiple classification ability is that of being sure that the directions are understood. In most studies, the subject is first asked to put together the things that are alike or the things that belong together (e.g., Kuhn, 1972). Pilot studies by the author indicate that children often interpret this to mean things that fit together or that look nice together. When the principle of sorting on the basis of an attribute is made clear, many children can perform the task. After a child has made an initial classification, he is typically told: "Now put them together in a different way" (Heald & Marzolf, 1953; Kofsky & Osler, 1967; Inhelder & Piaget, 1964). Again pilot studies indicate that many four- and five-year-old children do not understand these verbal directions as meaning to sort on a different dimension. A frequent response is to sort on the same dimension but make a different arrangement of the items inside the sorting boxes. In the related case of cross classification (matrices), Jacobs & Vandeventer (1971) showed that brief training of first grade children on matrix problems improved performance immediately and four months later. Presumably, the basic skill was not taught in that time; rather, the training made clear what the task required and how it should be approached. This suggests that tests for classification should include training in what is required. In addition, since number of stimulus objects, dimension preference for color and form, and number of irrelevant demensions have been shown to affect this ability (Kofsky & Osler, 1967), these factors should be taken into consideration in a testing situation.

It should be noted that multiple classification ability is distinct from concept formation; most four- and five-year-old children already know the concepts (e.g., color, shape, and size) used in the typical test (Kofsky, 1966; Osler & Kofsky, 1965). The task requires, rather, the ability to focus on one dimension and ignore irrelevant dimensions to make an initial classification, and then to shift attention to a less salient or less preferred dimension for a second grouping. This latter ability might be assumed to develop in free play through habituation to the most salient dimension, allowing attention to shift to another dimension (Jeffrey, 1968). Observational data on free play sessions should show whether children spontaneously shift their attention among dimensions in any systematic way.

While multiple classification ability is distinct from concept formation, it is probably related to concept identification. In both free classification and in a typical concept identification task, the child must identify a particular dimension or concept as relevant in a given situation. Of course in free classification the child can initially decide which dimension is to be relevant. However, in subsequent sorts, his choice is increasingly limited. He must remember the dimensions used previously and identify new dimensions that can serve as a basis for a new classification. Osler & Kofsky (1965) have shown that increasing complexity (that is, number of irrelevant dimensions) interferes with concept identification, especially in young (four-year-old) children. These results are in agreement with the previously cited work of the same authors (Kofsky & Osler, 1967) on free classification.

While there have been a number of descriptive developmental studies of multiple classification, there have been very few attempts to manipulate or teach the ability to shift criteria for sorting. Most of the work in this area has been done by Sigel and his colleagues (Sigel, 1971). His teaching procedure consists of having children participate in a small group with a teacher who presents common objects and leads the children in discussions of their properties and the ways they are like or different from other objects (e.g., Sigel, Roeper, & Hooper, 1966). This training apparently produces some improvement in classification as well as in conservation tasks. However, generally the results have not been permanent; in one study, experimental and control groups tested after eight months did not differ significantly (Sigel, 1971). Sigel suggests that gains will not be maintained unless there is continued support in the educational environment and opportunities for building on existing skills with more complex materials (ibid.). Having available in the classroom materials structured to present various levels of dimensional complexity might provide such support, giving children a chance to practice classification skills at increasing difficulty levels.

A number of studies have used matrices as a means of investigating classification ability. While multiple classification requires focusing on one dimension and ignoring one or more others, cross classification, as in a matrix, requires simultaneous attention to two dimensions. There have been a number of recent developmental studies of the ability to handle matrices (Siegel & Kresh, 1971; MacKay, Fraser, & Ross, 1970; Bruner & Kenney, 1966; Overton, Wagner & Dolinsky, 1971; Parker & Day, 1971). Two recent studies have given children training on matrix tasks. After giving first graders 30 minutes of instruction, Jacobs and Vandeventer (1971) obtained significant improvement on matrix tasks immediately and after four months. Parker, Rieff, & Speer (1971) trained children at three age levels on a matrix task; children aged 6 and 7-1/2 made significant improvement, but four-and-a-half year old children did not benefit from training. Apparently there has been no recent experimental investigation of the relationship between multiple classification and cross classification. Inhelder & Piaget (1964) consider the two processes synchronous; "they express one and the same general operational mode of organization." Free play with materials that allow for multiple classification or cross classification might result in improvement on matrix tasks as well as on reclassification tasks.

In summary, testing to determine children's level of classification ability presents a number of problems. Performance on multiple classification tasks depends partly on the child's understanding of what is required. In addition, the number of dimensions and values used and the number of stimulus objects presented affect performance, as do the specific dimensions selected, e.g. color or size.

Multiple classification skills probably develop through experience manipulating and grouping objects in various ways. Piaget's theory and Hunt's concept of match, as discussed earlier, suggest that, given material at an appropriate level, children will practice their developing classificatory abilities and try out newly emerging skills. Observation of play with materials that allow for various kinds of groupings should give some clues to the spontaneous processes involved in the development of classification abilities.

THE ROLE OF MATERIALS IN EARLY EDUCATION

In addition to the theoretical questions to which this study is addressed, practical issues are involved, concerning both the choice of materials for early education and the levels at which they are appropriate. Current views of early education stress the importance for cognitive development of a broad variety of experiences, rather than limited specific training (Kohlberg, 1968). However, as Goldschmid (1971) points out, "Even if we prefer the child to discover new relationships and act upon objects on his own, as opposed to having to follow a tightly structured curriculum..., we still need to know what specific kinds of environment, materials, and stimulation the child should be exposed to in order to enhance his cognitive development." In spite of general agreement on the importance of manipulative materials and great popular interest in "educational" toys, there is little information to guide nursery school teachers in the selection of materials. Almy (1966) has pointed out that there is a striking similarity of materials and equipment from one nursery school classroom to another, whether the children are three-year-olds, four-year-olds, or five-year-olds. In order to select appropriate materials and understand at what level they could best be used, more information is needed about how children at different ag , use specific materials and what outcomes can be expected from their play with materials.

PROBLEM AND HYPOTHESES

The theoretical positions discussed above strongly suggest that young children learn from spontaneous, playful use of materials in the environment. Piaget's theory suggests that activities during play and the learning that results may depend largely on a match between the materials and the child's level of development. Furthermore, a child's play may be expected to result in learning particularly if he performs activites related to that learning. However, there is little empirical evidence to support these ideas.

The purpose of the present research was to study young children's manipulative responses to materials in a free play situation and the learning that results. Two studies were conducted. In both, preschool children at two levels of ability were observed during play sessions with materials at two levels of complexity. Complexity was defined with respect to the number of ways in which the materials can be classified. In the simple materials, the dimensions of difference (such as color, shape, and texture) all vary dependently, so that there is only one possible way to classify the materials. In the complex materials, the dimensions vary independently, so that no two pieces are exactly alike; there are thus a number of different ways in which they may be classified. In Study I, each child was observed playing with one type of materials (either a simple or a complex set) during three play sessions. In Study II, each child played with three different types of materials (either simple or complex) in a single session. In Study I only, following the play sessions, learning was measured on a posttest of classification ability.

On the basis of the literature discussed, classification ability can be assumed to develop in interaction with materials that permit sorting. A child who is just developing the ability to classify consistently on one dimension should practice this ability more readily with simple materials which can be classified in only one way and which provide no irrelevant cues. However, more complex materials, which vary independently on a number of dimensions, may present too confusing an array for this child, so that classification will not be practiced. The child who can already classify consistently on one dimension and is becoming aware of multiple class membership has nothing to learn from the simple materials and thus is unlikely to practice classification with them. The complex materials, which vary independently on a number of dimensions, should provide him with an opportunity to explore various ways of classifying objects. Therefore, the following hypothesis is made:

Hypothesis 1. Among children with limited classification ability, more spontaneous classification during play will occur with simple materials than with complex materials; among children with advanced classification ability, more classification during play will occur with complex materials.

Moreover, the simple materials, by providing redundant cues for classification on one dimension, should promote learning of initial classification ability among children who cannot yet consistently classify on one dimensions. However, the more advanced child, who can already classify on one dimension, has nothing to learn from the simple materials. For him, play with the complex materials should promote learning of multiple classification, suggesting the following hypothesis:

Hypothesis 2. For children with limited classification ability, greater improvement in classification ability on a posttest will result from play with simple materials than with complex; for the more advanced children, greater improvement will result from play with complex materials.

The literature reviewed suggests that the actual responses a child makes are an important determinant of what he learns. The child who engages in more classification during play should show greater learning than the one who does not. The following hypothesis is made:

<u>Hypothesis 3.</u> Within ability groups, the amount of classification during play will be related to posttest performance in classification ability.

In addition to the above hypotheses, the research was aimed at obtaining descriptive information on children's spontaneous use of materials, as a basis for further study of the way play activities relate to learning. Of particular interest in this connection were the effect of different materials on play activities, and developmental changes in children's spontaneous use of materials.

In order to pursue these research goals, the first, and more extensive, study was aimed at examining the major hypotheses and descriptive questions. On the basis of initial results, the second study was planned and conducted to focus more on the descriptive questions.

CHAPTER 2. STUDY I

The first study was planned to examine the three hypotheses stated previously, concerning the effect of ability and complexity of materials on young children's play activities and on resultant learning. The study was also aimed at obtaining descriptive data on children's spontaneous use of manipulative materials, in order to gain understanding of the development of classification ability in play. The research required the development of new methods and materials to meet the needs for (1) a pretest of classification ability; (2) appropriate materials for children to use in a play situation; and (3) a system for observing and recording the spontaneous use of materials.

The experimental design was a simple 2 x 2 design, with two levels of ability and two types of materials, simple and complex. Two groups of children, selected as high or low in classification ability on the basis of a pretest, were randomly assigned to play with either simple or complex materials. Each child had three play sessions with the materials and was then given a posttest of classification ability. The dependent measures were of two main types: scores for manipulations during the three play sessions, primarily the amount of spontaneous classification; and scores on the classification posttest.

METHOD

Pretest

The pretest was developed to select two groups of children at different levels of ability to classify and reclassify stimuli. In terms of the experimental questions, the low ability group should be unable to classify consistently on one dimension, since it is hypothesized that this group will practice classifying more and profit more from simple materials which allow for classification in only one way. The high ability group should be able to make an accurate initial classification and show some ability to shift to a second dimension for classifying stimuli since it is hypothesized that this group will profit more from materials that allow for multiple classification.

Since no standardized test of free classification ability is available, pilot work was conducted to develop an appropriate measure. It soon became apparent that a major problem in testing for classification was making the child understand what was required. The procedure generally used in previous studies is to ask the child to put together pieces that are alike; after an initial trial, the child may be asked to do it again, a different way. It was found that many children, especially the younger, clearly did not understand such instructions. A common initial response was to put together pieces to make a picture (as in the "graphic collections," noted by Inhelder & Piaget, 1969). However, after a demonstration of the task, these children could often make an accurate classification. The making of a graphic collection appeared to result from their mental set, rather than from inability to classify. Similarly, when asked to do it a different way, many children would repeat their initial classification, for example, by color, but arrange the objects differently within each group. Again, a demonstration of the task enabled some children to shift to a new dimension.

To deal with these problems, an orientation sequence was developed, in which the task was demonstrated and the child was assisted to make an accurate classification and a reclassification on a new dimension (see Appendix A for details).

The pretest itself consisted of two free classification tasks (Subtest 1 and 2). For Subtest 1, the stimuli were nine cardboard cut-out pieces consisting of three shapes with three colors of each. The child was shown the stimuli and three low boxes, and was told to put together in one box the pieces that were alike in some way. The child was scored 9 points if all pieces were correctly placed; 5 to 8 points were given for partially correct classifications, depending on the number of correct placements. Arrangements with less than five correct were judged to be chance placement and were given no score.

The stimuli were then removed from the boxes and mixed up, and the child was asked to do it a different way. The child was scored 9 points if all pieces were correctly placed using a different dimension; 5 to 8 points were given for partially correct classifications using a different dimension.

For Subtest 2, the stimuli were nine new cardboard stimuli, of three shapes with three colors of each. However, a third dimension, pattern, was added. One piece of each shape and color was striped; one of each was dotted; and one, left plain. The procedure and scoring were the same as in Subtest 1, except that if a child made a correct second classification on a new dimension, he was asked to reclassify on a third dimension.

The test and scoring can be summarized as follows:

		maximum possible score
Subtest 1. (color and shape)		
	A. Initial classification	9
	B. Reclassification on new dimension	9
Subtest 2. (color, shape, and texture)		
	A. Initial classification	9
	B. Relcassification on new dimension	9
	C. Reclassification on third dimension	9
		45

<u>Pretest reliability.</u> The pretest was given to 41 children in a Los Angeles area Children's Center. The children ranged in age from three years five months to six years eight months. Scores on the pretest ranged from 12 to 45, with a mean of 27.1 and standard deviation of 8.6. A split-half reliability coefficient was calculated by correlating alternate items of the test. This procedure was somewhat limited by the fact that the test had only five items. Nevertheless, a reliability of .68 (as corrected by the Spearman-Brown formula) was obtained. This figure appears to be quite satisfactory considering that the first and subsequent items in each subtest measured different abilities; the first item involved initial classification ability, and the second and third involved ability to shift to a new dimension. Analysis indicated that in this population these two abilities had a very low correlation ($r = .04$). (This

result is probably attributable in part to the fact that most of the children could make an initial classification, so that this ability did not discriminate between high and low ability children.)

To get an estimate of the relationship of the pretest to other indices of mental development, the book form of the Coloured Progressive Matrices was given to all the children. Scores on this test correlated .53 with the pretest scores, suggesting that competence on the pretest was to some extent but not closely related to a standard measure of mental ability.

Selection of subjects

The scores of the 41 children tested were analyzed in order to select as subjects children high and low in classification ability, as defined previously. It was immediately clear that the children did considerably better on the pretest than was expected on the basis of previous literature. Table 2-1 shows the percentage of children at each age who could make successive consistent classifications on different dimensions. Six of the 9 three-year-olds and all but one of the 16 four-year-olds made at least one accurate free classification. All of the five-year-olds and all but one six-year-old made a consistent classification. A substantial proportion of the four-, five-, and six-year-olds also made a consistent reclassification on a different dimension. These results are well ahead of those reported by Piaget and others; for example, the performance of five-year-olds, as reported in Table 2-1, can be compared with the results of Inhelder & Piaget (1969), cited on page 16. The higher performance

Table 2-1. Relationship of Age to Number of Dimensions used in Multiple Classification.

Number of Dimensions Used	Age (and Number of Subjects)			
	3 n=9	4 n=16	5 n=10	6 n=6
	%	%	%	%
0	33	6	0	17
1 only	67	56	30	33
2 only	0	38	50	33
3	0	0	20	17

in the present case lends support to the idea that children often do not understand what is required in a classification task and that the orientation sequence, by clarifying the task, led to improved performance.

In order to select subjects for the study, the pretest scores were used, as they not only measured consistent classifications but also gave partial credit for nearly accurate groupings, as explained above. In terms of the initial statement of the experimental problem, low ability would be defined as the inability consistently to make an accurate initial classification; that is, a score of less than 18 points on test items 1.A and 2.A combined. High ability would be represented by accuracy on items 1.A and 2.A plus at least partial scores on 1.B and 2.B; that is, a score above 18 but less than 36. However, the unexpectedly high performance of the children required some adjustment of the criteria used in selecting subjects.

A frequency distribution of pretest scores (Appendix B) shows three distinct clusters of scores, one around 18, another around 27, and a third around 36. The lowest cluster consisted generally of children who had made some errors on the initial classification, although several children who had made two accurate initial classifications were included. None of these children could shift to a new dimension as a basis for classification. These 14 children, with scores ranging from 12 to 21 (mean = 17.8), were selected as the low ability group.

The high cluster consisted of children who showed the ability to shift to a second dimension as a basis for reclassifying stimuli, but could not shift to a third dimension. These 11 children, with scores ranging from 36 to 40 (mean = 36.5), were assigned to the high ability group.

The middle group, with scores from 23 to 30, were not used in the experiment. Two children with perfect scores of 45 also were not used.

While the high and low groups both had somewhat greater ability than was originally planned, it was judged that they were close enough to the desired range for an initial study.

Materials

Materials at two levels of complexity represent the key treatment variable for the study. After a number of pilot studies, two sets of wooden blocks (27 blocks each) were developed to meet two requirements. (1) The two sets had to be similar in all respects except for complexity; the simple set could be classified in only one way, while the complex set provided greater variety of elements and permitted multiple classification. (2) The blocks had to provide interesting and novel manipulative possibilities for young children, so that children would react to them spontaneously in a free play situations.

In order to assure that the materials would be interesting for children to play with, a number of different simple manipulative materials were tried out in pilot studies. Wooden blocks seemed to have immediate appeal to children because of the variety of possible responses that they allow. They were found to be used spontaneously by children in a number of ways: for making pictures, designs, and constructions, as well as for grouping and classifying in various ways. A number of different shapes were tried out, and it was observed that shapes which fitted together in different ways provided more interesting possibilities than the usual squares, circles, and triangles. The shapes finally selected have curved edges, some concave and some convex, so that they can be combined in various ways.

To meet the requirement for two similar sets of blocks that differ only in complexity, the two sets of blocks use the same three dimensions of color, shape, and texture, with the same three values of each. However, in the simple set, the dimensions vary dependently; that is, a piece of a given shape is always the same color and texture. There are nine blocks of each of three types, to make a total of 27 blocks (see Fig. 2-1). Thus, the blocks can be classified in only one way; the three dimensions provide redundant cues for a classifying task.

In the complex set, the same three dimensions of color, shape, and texture vary independently, so that no two pieces are alike. All the pieces of a given shape vary in color and texture. Since the blocks represent three values for each of three dimensions, there are a total of 27 blocks (see Fig. 2-2). The blocks can be classified and relcassified on three different dimensions; in order to classify on one dimension, the child must ignore the other two dimensions.

Observing and recording children's use of materials

A major problem for this, or any, research on play is that of

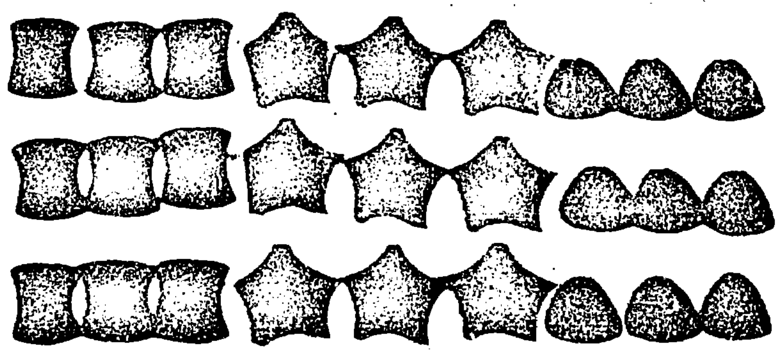


Figure 2-1. Simple blocks, which permit only one type of classification.

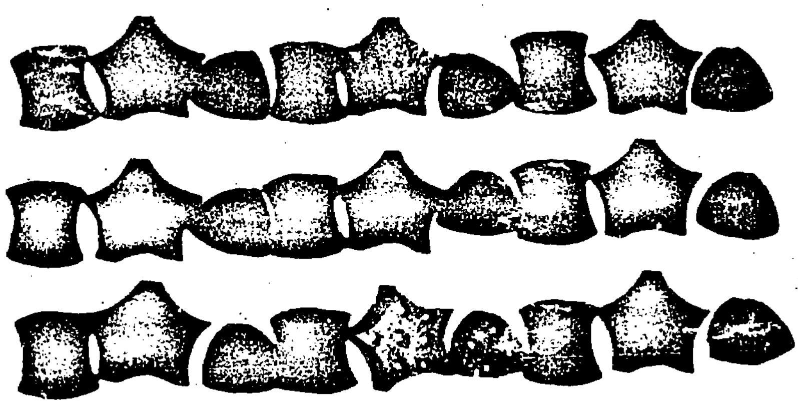


Figure 2-2. Complex blocks, which permit multiple classification.

finding a way to record behavior so that it can be measured and studied. An important aspect of this study was therefore the development of an instrument for recording manipulations of materials during play. In pilot studies with the blocks, notes were made of manipulative responses that children made. Various categories of responses were noted, such as: dramatic play, constructions, pictorial representation, classification (by color, shape, and texture), and designs. Since the focus of the study was on how children learn to classify from playing with materials, it was evident that records should be made primarily of manipulations based on apparent recognition and utilization of the physical properties (color, shape, and texture, in this case). These manipulations were found to be of several types: <u>classification,</u> the combining of elements on the basis of similarity; <u>pattern</u>, the combining of elements on the basis of systematic contrast; and <u>complementarity</u>, the combining of elements by fitting together matching shapes. Other aspects of the manipulations that were found to be easy to record and might be of potential interest were total number of blocks in use, and orientation of the blocks, whether flat, piled up, or on their sides.

Pictorial representation and construction were found to be ambiguous categories for observers to agree on; the most reliable evidence that a combination of blocks was meant to represent something was the child's spontaneous verbalization that he was making "a house" or "a man." Therefore it was decided to record verbalizations but not to attempt to interpret whether or not a combination was meant to represent something.

Several other categories that had been noted were rejected as being not relevant to the study. For example, dramatic play with the blocks appeared to be generally independent of recognition of physical characteristics and is very likely more closely related to personality variables than to the cognitive factors of interest here.

Precise, unambiguous definitions were developed for each category of manipulation, so that observers could agree on their occurrence. The following definitions were used for each category and subcategory:

1. CLASSIFICATION: Any grouping of three or more blocks alike on one or more dimensions. For the complex blocks only, classification is further broken down by color, shape, texture, and combination (of any two of the preceding attributes).

2. PATTERN: A systematic combination of three or more elements on the basis of contrast and in accord with a clearly discernible rule. It consisted of the following subcategories:

Symmetry: correspondence of shape, color, or texture on either side of a median.

Alternation: colors, shapes, or textures succeeding each other in a regular sequence.

Pairs: two or more identical groups of two objects each.

Triplets: two or more identical groups of three objects each.

3. COMPLEMENTARITY: A combination of blocks in which edges are fitted together with no attention to the over-all pattern.

4. ORIENTATION OF BLOCKS: The way the blocks were combined, without attention to their properties. It consisted of the following subdivisions:

Flat: Blocks spread out flat on the table

Piled: Blocks stacked one on top of another

Upright: Blocks set up on edge

Mixed: Some combination of the above

5. _NUMBER OF BLOCKS_: Total number of blocks being used by child at the moment of observation.

6. _VERBALIZATION_: Any comments by the child about what he was making or doing.

A time-sampling technique was decided on as the best method for recording manipulations. A 30-second interval was found to be the shortest manageable unit; that is, at 30-second intervals the observers noted and recorded any applicable manipulations. Classification, pattern, complementarity, and orientation of blocks were recorded simply with a check. A child could receive several checks in a given interval; for example, an arrangement could show both symmetry and complementarity; or a regular alternation of color could occur in a pile of blocks classified by shape.

The number of blocks were recorded by writing down the approximate number of blocks in use at the moment of observation. Verbalizations were recorded verbatim whenever they occurred during the play sessions.

The forms developed for making the records are shown in Appendix C.

Scoring. Scores in each of the main categories of manipulation were obtained for each child by totaling the number of checks for that category in each of the three sessions. A maximum score of 20 checks per session (2 per minute for 10 minutes) or 60 for three sessions was possible in each category for every child. These scores were used in computing observer reliability and in studying the relationship among experimental groups.

Subjects

The subjects were 24 children from a Los Angeles area Children's Center. They were selected as high or low in classification ability on the basis of a pretest, as explained above. Of the 14 low ability children, one refused to participate, leaving 13 (6 girls and 7 boys). Their average age was 54.5 months and ranged from 44 to 77 months. The 11 low ability children ranged in age from 53 to 80 months, with a mean of 66.3. There were 7 girls and 4 boys.

Procedure

The children in the high and low ability groups were randomly assigned to play sessions with either the simple or the complex materials. The play sessions were initiated about two weeks after the pretest, in a spare room used as a library. The children were told simply that they would have a chance to play with some new toys, and were invited individually to accompany the experimenter.

When he entered the room, the child was seated at a low table and one set of blocks (either simple or complex, depending on his group assignment) was placed before him, in a haphazard array. He was told that he could do whatever he liked with the blocks. None of the children showed any hesitation in immediately beginning to play with the blocks.

Each child was allowed to play for ten minutes. If he indicated that he was through sooner, he was allowed to leave; however, this occurred rarely. After ten minutes, the child was told that there was no more time, but that he would have another chance to play with the materials. On subsequent days, each child was invited to come play with the blocks, until he had had three sessions. All 24 subjects completed the three sessions.

For the majority of the sessions, two observers, seated unobtrusively beside or slightly behind the child, made simultaneous records. However, since agreement between raters was high (as explained in the results), the presence of two observers for all sessions was judged unnecessary. A tape recorder with background music provided a pre-recorded voice announcing 30-second intervals. At the announced times, the observers recorded manipulations that were evident at that moment, using the form shown in Appendix C, as described above.

After completion of the three play sessions, the children were given a posttest of free classification ability. The posttest consisted of an orientation sequence similar to that used on the pretest, and two free classification subtests, similar to those used on the pretest but with different stimuli. The scoring was similar to that of the pretest; thus, a total score of 45 was possible. One child who completed the play sessions left the school and so did not receive the posttest; another child refused to take the posttest. Therefore 22 children completed the posttest.

RESULTS

The results from the study are of three distinct types, in relation to the main questions posed: first, descriptive data on the manipulations of the blocks in play and the differences among experimental groups; second, performance of the children on the classification posttest, and third, the relationship of posttest scores to the manipulations exhibited during play.

Manipulations during play

Observer reliability. Twenty-four children completed three sessions each, for a total of 72 play sessions. For 45 of these sessions, two observers simultaneously recorded behavior. Reliability was calculated by correlating the observations of the two sets of records for each subcategory of manipulation. Table 2-2 shows the correlations between observers for each session, and also the mean occurrence for each subcategory of manipulation. For all types of manipulation except those of rare occurrence (below 1) correlations between observers were high (.72 to .99). For the most commonly occurring manipulations (with a mean above 10), correlations ranged from .86 to .99. For example, inter-observer reliability for the subcategory symmetry for the three sessions was .88, .94, and .86, indicating a high degree of agreement between observers on the occurrence of the subcategory.

With manipulations that occurred only a few times there was much greater room for discrepancy. There was frequently either complete agreement on their occurrence ($r = 1.0$, as in classification by color,

Table 2-2. Inter-observer Reliability for Each Category of Manipulation (Based on 24 Children in each of Three Sessions).

Category of Manipulation	Mean Occurrence	Session I	Session II	Session III
Classification:				
Shape: 	10.3	.89	.92	.96
	10.0	.92	.90	.86
	9.1	.94	.97	.77
Color: Yellow	.2	1.00	-	-
Blue	.5	.63	-	-
Red	.5	1.00	-	-
Texture: plain	.2	-	-	-
striped	.2	-	-	-
dotted	.2	-	-	-
Combo: C+S	2.1	-	-	1.00
C+T	.3	-	-	-
S+T	0.0	-	-	-
Pattern:				
Symmetry	7.8	.38	.94	.86
Alternation	.5	.34	-	.90
Pairs	1.5	.80	.72	.99
Triplets	.6	-	.33	.13
Complementarity:	14.1	.95	.93	.91
Orientation:				
Flat	18.1	.98	.99	.96
Piled	12.7	.96	.88	.94
Upright	8.3	.99	.97	.96
Mixed	9.6	.98	.95	.87

Note: Blank spaces indicate that no occurrence was noted by one or both observers. In addition, where the mean occurrence is low, correlations probably mean little. Reliability coefficients represent correlations between the ratings of the same two observers.

red) or one observer noted the behavior and the other did not, so that no correlation can be calculated. In addition, when a manipulation did not occur at all in a given session, no correlation can be calculated, although there was perfect agreement between observers that it did not occur.

These reliability figures were sufficiently high that use of a single observer appears to provide satisfactory data. For 27 sessions, therefore, results are based on the ratings of one observer. For sessions recorded by two observers, scores were averaged to give a mean that was used in further analysis. In cases where only one observer scored a session, that single score was of course used in the analysis.

Effects of age and complexity of materials on manipulations. The mean scores in each category were totaled across the three sessions to give a mean occurrence for the entire sample and for each experimental group. (See Table 2-3.) The first hypothesis concerned an interaction of ability with complexity of materials, specifically that among low ability children more classification would occur with simple materials, while among high ability children, more classification would occur with complex materials. This interaction was not found, as can be seen from the first line of Table 2-3. Both high and low ability groups engaged in more classification with the simple blocks; the low ability group engaged in more classification with both sets of blocks than did the high ability group. However, an analysis of variance showed that these differences are not significant. Similarly, none of the other categories showed significant effects of

Table 2-3. Mean Manipulation Scores by Category and by Experimental Groups (Based on Ability).

Category of Manipulation	All Groups	Experimental Group			
		Low Ability		High Ability	
		Simple	Complex	Simple	Complex
	n=24	n=7	n=6	n=5	n=6
Classification:					
Total	31.3	36.3	28.7	31.5	22.7
Shape	29.3	36.3	27.3	31.5	21.3
Color	1.3	0.0	1.6	0.0	1.0
Texture	.5	0.0	0.0	0.0	1.0
Combination	2.4	0.0	0.0	0.0	4.3
Pattern:					
Total	10.4	7.4	7.9	17.0	10.7
Symmetry	7.8	5.9	4.9	13.5	8.1
Alternation	.5	.2	.5	1.4	.1
Pairs	1.5	.6	2.5	1.2	1.7
Triplets	.5	.7	0.0	.9	.8
Complementarity:	14.1	8.5	14.6	14.5	19.8
Orientation:					
Flat	18.5	10.4	23.4	27.5	15.5
Piled	12.7	14.2	17.3	6.0	11.8
Upright	8.3	9.1	3.3	6.9	13.8
Mixed	9.6	6.3	9.4	9.4	13.9

ability or materials, although the difference between ability groups on total pattern score approached significance ($p = .08$).

These results generally show considerably less difference among groups than had been expected. Further examination of the data suggested that the pretest, which was the initial basis for grouping, tapped too narrow a range of the child's ability. It seems likely that a broad range of characteristics was responsible for differences among children in the way they used the blocks. Therefore chronological age, as a broader and more general criterion of ability, was used to divide the children into groups. The younger group of 14 children had a mean age of 51.1 months (range: 45 to 58 months). The older group of 10 children had a mean age of 69.0 months (range: 59 to 80 months).

When the data were reanalyzed, the hypothesized interaction of ability (age, in this case) with complexity of materials in terms of classification was again not found. However, a number of significant age differences were obtained. Table 2-4 shows the means for older and younger children for each main category of manipulation and for total time spent in play. The older children have consistently higher scores on all pattern measures. The use of symmetry is significantly greater for the older children ($p < .001$) and the total pattern score is also significantly higher ($p < .001$).

Unlike pattern scores, classification scores did not differ significantly between age groups. However, classification on the most subtle dimension, texture, and classification on the basis of two dimensions at once (combination) were exhibited only by the older

Table 2-4. Mean Manipulation Scores by Category and by Age.

Category of Manipulation	Younger	Older	Significance of Difference
Classification:			
Total	29.6	34.6	-
Shape	26.8	21.8	-
Color	1.6	1.0	-
Texture	0.0	1.0	-
Combination	0.0	4.3	-
Pattern			
Total	5.6	17.5	$p < .001$
Symmetry	3.5	13.9	$p < .001$
Alternation	.3	.9	-
Pairs	1.4	1.7	-
Triplets	.3	.9	-
Average Total Time (minutes)	25.5	29.4	$p < .05$

children.

In order to study further the relationship among age and classification and pattern scores, correlations were computed, as shown in Table 2-5. Age was found to be highly correlated with pattern scores ($p < .001$) but not significantly with any of the classification scores. The highest correlation between classification scores and age was a negative correlation with color classification, a finding that supports previous evidence for the preference of younger children for the color dimension. Correlations between total classification scores and pattern scores are virtually zero, suggesting that these two types of responses are independent.

The measures of orientation were not found to bear any clear relationship to the central question of this study. Although scores for these categories show consistency across sessions, they show no significant effect of age or complexity of materials and no clear relation to the posttest. Likewise, the number of blocks used was found to show no interesting differences among groups. These categories are therefore felt to be unimportant for the present study.

Consistency of individual patterns of responses. Consistency was examined by computing correlations of all subcategories of manipulations among the three sessions for all categories with mean occurrence of 1 or more (since categories with occurrence of less than 1 were found to have low observer reliability). The substantial number of significant correlations (see Table 2-6) indicates that individual children were apt to repeat the same types of manipulations across sessions. For example, a child who made complementary combinations

Table 2-5. Intercorrelations of Age, Classification Scores, and Pattern Scores.

	Age	Classification				
		Total	Shape	Color	Texture	Combin-ation
Classification						
Total	-.05					
Shape	-.07	.97***				
Color	-.45	.34	.18			
Texture	.18	.42	.15	.39		
Combination	.11	.47	.19	.34	.88***	
Pattern	.77***	-.07	-.05	-.12	-.09	-.06

*** $p < .001$

Table 2-6. Inter-session Reliability for Manipulation Categories with Mean Occurrence Greater than One.

Category of Manipulation	Sessions I & II	Sessions II & III	Sessions I & III
Classification:			
Shape: 	.45*	.38	.29
	.68*	.62**	.47*
	.77*	.13	.22
Pattern:			
Symmetry	.61**	.52**	.33
Pairs[1]	-.17	.69***	-.13
Complementarity	.73***	.60**	.73***
Orientation:			
Flat	.73***	.65***	.59**
Piled	.81***	.56**	.71***
Upright	.71***	.52**	.50*
Mixed	.64***	.30	.48*

* $p < .05$; ** $p < .01$; *** $p < .001$

[1]This manipulation had a low mean occurrence of 1.6 which accounts in part for the low inter-session correlations.

of blocks in the first session tended to do the same in the second and third sessions. These results suggest that the categories selected for observation reflect stable patterns that have been reliably recorded.

Trends in categories of manipulations. The mean occurrence of manipulations across the three sessions was examined to see whether the children showed consistent changes, that is, whether there were significant increases or decreases in the various categories as the children became more familiar with the blocks. Table 2-7 shows the mean occurrence of each category of manipulation across the three sessions, as well as the mean time spent for each session. An analysis of variance was computed to test for significant trends. It can be seen that complementarity and all forms of classification except combination declined, along with time spent. The decreases in complementarity and in time were found to be significant ($p < .05$). The results in the categories of pattern and orientation are less consistent. Alternation showed a significant increase ($p < .05$) and the other forms of pattern showed mixed, non-significant changes. In orientation, use of flat arrangements declined ($p < .001$) across sessions.

Sex differences. A t-test for differences between the sexes was computed for all categories of manipulation. The differences between the sexes were not significant for any category, and results for boys and girls were therefore combined for all analyses.

Table 2-7. Mean Manipulation Scores Across Sessions, by Category.

Category of Manipulation	Sessions I	II	III	Significance of Increase or Decrease
Classification:				
Total	11.6	10.5	9.3	-
Shape	10.8	10.1	8.5	-
Color	.3	.2	.2	-
Texture	.2	0.0	0.0	-
Combination	.3	.2	.6	-
Pattern:				
Total	3.5	4.1	3.2	-
Symmetry	2.8	3.1	2.2	-
Alternation	.1	.1	.4	$p < .05$
Pairs	.5	.6	.4	-
Triplets	.1	.3	.2	-
Complementarity:	6.0	4.5	3.8	$p < .05$
Orientation:				
Flat	8.4	6.5	4.3	$p < .001$
Piled	3.9	4.0	4.5	-
Upright	1.5	3.3	3.4	-
Mixed	3.8	2.6	3.4	-
Time (minutes)	9.6	9.1	8.5	$p < .05$

Posttest performance

The posttest scores ranged from 10 to 45 with a mean of 25.1 and standard deviation of 10.4. The reliability of the posttest was examined by correlating alternate items of the test, as was done for the pretest. A correlation of .77, as corrected by the Spearman-Brown formula, indicates a satisfactory degree of reliability, in view of the small number of items. As with the pretest, there was virtually no correlation between initial classification and reclassification ability (r = .01). The posttest correlated .65 with the pretest, suggesting considerable stability in the abilities measured over the period of about two weeks between the pretest and the posttest.

Effects of age and complexity of materials used in play on posttest scores. The total posttest scores and scores for each subtest are given in Table 2-8 for each experimental group. The second hypothesis stated that for children with limited classification ability, greater improvement in classification ability would result from play with simple materials than with complex, while for more advanced children, greater improvement would result from play with complex materials. As can be seen from Table 2-8, this interaction of ability with complexity of materials was in the predicted direction on the subtest measures and on the total classification score. That is, the low ability children who used the simple materials did better on the posttest than those who used complex materials. For the high ability children the reverse was true; those who used the complex materials did better than those who used simple materials. This relationship is shown graphically in Fig. 2-3. The interaction

Table 2-8. Posttest Scores by Experimental Groups (Based on Ability).

Posttest Scores	Low Ability		High Ability	
	Simple	Complex	Simple	Complex
Subtest 1	12.1	9.8	14.8	15.7
Subtest 2	9.0	6.8	10.8	19.5
Total (p=.056)	21.1	16.5	25.6	35.2

Table 2-9. Posttest Scores by Experimental Groups (Based on Age).

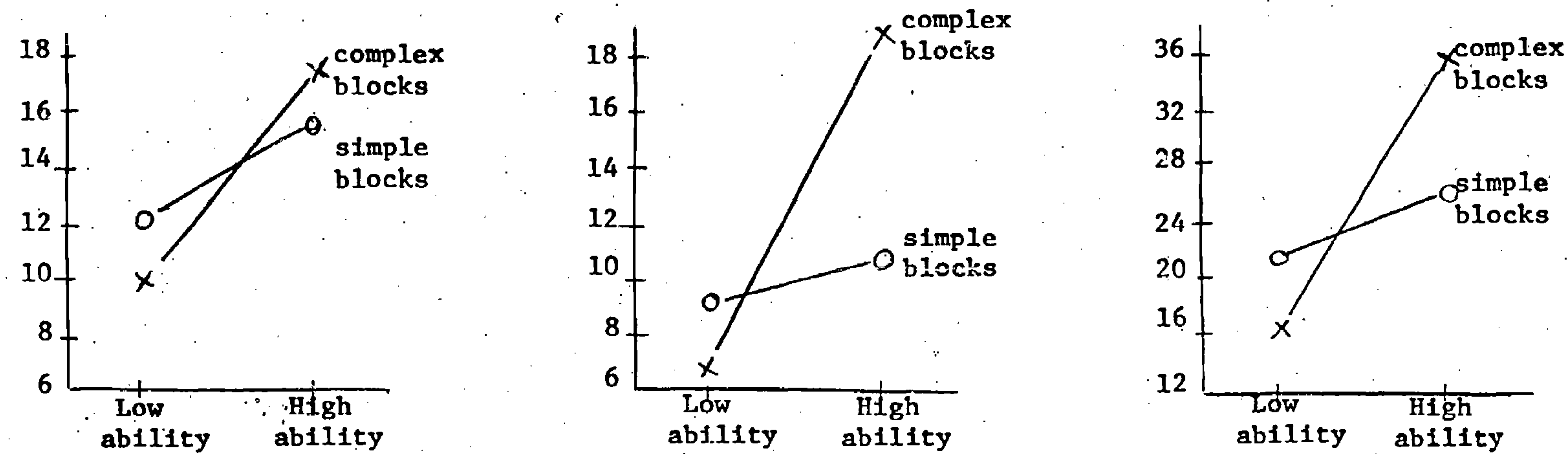
Posttest Scores	Younger		Older	
	Simple	Complex	Simple	Complex
Subtest 1 ($p < .05$)	13.1	9.6	13.5	17.0
Subtest 2	9.0	9.0	11.3	19.8
Total (p=.054)	22.1	18.6	24.8	36.8

approached significance on Subtest 2 ($p = .056$), but was not significant on Subtest 1 or on the total. Thus these results provide limited support for the second hypothesis.

Results from the play sessions, as explained above, suggested that age was a more reliable general criterion of ability than the pretest. Therefore the subjects were divided by age into younger and older children as explained previously, and the data were reanalyzed. Table 2-9 gives the means for each group as reconstituted by age. The interaction is again in the predicted direction; on both subtests and on the total score, the younger children performed better after playing with the simple blocks, while the older children performed better after playing with the complex blocks. An analysis of variance showed this interaction to be significant on Subtest 1 ($p < .05$); it bordered on significance on the total posttest ($p = .054$). The relationship is shown graphically in Fig. 2-4. The results are particularly striking for the older children; those who used the complex blocks scored 12 points higher on the posttest than those who used the simple blocks. Posttest scores showed no significant main effect for complexity of materials, but age was significant ($p < .05$), as would be expected.

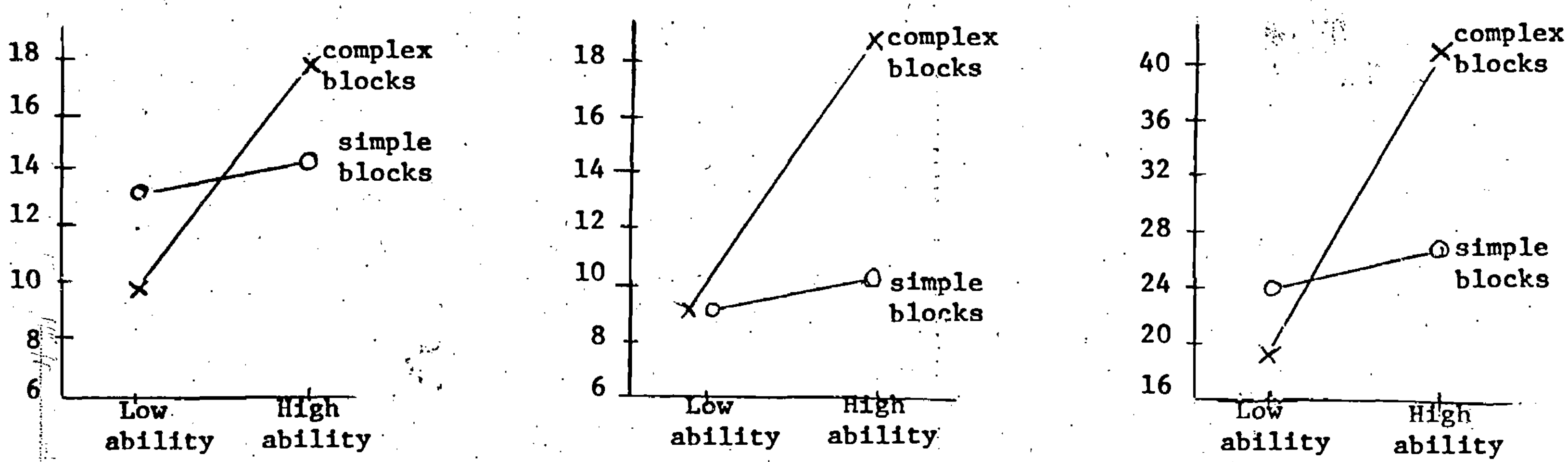
Relationship of posttest scores to manipulations during play

It was theorized that the actual responses of a child in a free play situation would be related to what he learned in that situation. Hypothesis 3 stated that within ability groups, the amount of classification during play would be related to posttest performance.



Subtest 1 Subtest 2 (p=.056) Total Posttest

Figure 2-3. Interaction of Ability and Complexity of Materials on Posttest Scores.



Subtest 1 (p < .05) Subtest 2 Total Posttest (p=.054)

Figure 2-4. Interaction of Age and Complexity of Materials on Posttest Scores.

To examine this relationship, correlations were computed between posttest scores and manipulation scores for classification and pattern. Table 2-10 shows these correlations for all groups combined, for older and younger subjects, and for those using simple and complex blocks. (Age was used rather than ability because of findings reported above that it provided a better basis for grouping children than did pretest scores.)

Total classification scores show a very low, non-significant correlation with posttest scores. However, classification on the most subtle dimension (texture) and on two dimensions at once (combination) are more highly correlated with posttest performance. Among children using the complex materials, the correlation of combination classifications with posttest scores is significant ($p < .05$). An interesting and unexpected finding is the high correlation of pattern scores with posttest scores. For the total group and for the younger children, the correlations are positive and significant. For the older children they are negative but non-significant. Correlations between manipulations and posttest do not of course establish a causal relationship; the two scores may simply represent different measures of a related ability. These results therefore provide only suggestive evidence for hypothesis 3. The implications of these findings are presented in the Discussion section.

<u>Additional data on classification and pattern making</u>

The pretest and the play sessions provided additional data that is of interest to the present study but which cannot be subsumed

Table 2-10. Correlations of Total Posttest Scores with Classification and Pattern Scores by Age and Materials.

Category of Manipulation	All Groups Combined	Age		Materials	
		Young	Old	Simple	Complex
Classification					
Total	.13	.06	.13	.12	.21
Shape	.01	.07	-.18	.12	.02
Color	.15	.15	.56	-	.09
Texture	.40	-	.49	-	.48
Combination	.60	-	.69	-	.70*
Pattern					
Total	.50*	.59*	-.50	.55	.38

*$p < .05$

under the three topics discussed above. Although it was found that the pretest did not provide an effective basis for grouping children in terms of the experimental hypotheses, it nevertheless furnished some interesting data concerning children's responses to materials. In contrast to the play sessions, the pretest was a structured situation in which the child was presented with a specific task. The results provide interesting data pertaining particularly to classification in a structured situation.

It will be recalled that the pretest consisted of two subtests; on each subtest, the child was told first to put together pieces that were alike (Part A), and then asked to do it a different way (Part B). Thus the child had several different occasions to exhibit classification ability. Looking first only at initial classification, of the 41 subjects tested, 20 were consistently accurate on both subtests and 7 were inaccurate on both. However, for a third of the children (14), initial classification responses were inconsistent across occasions. Ten children who initially did not make consistent classification made consistent classifications when asked to do it again a different way. For example, a child would initially get 7 of the 9 stimuli correctly grouped by color; when asked to do it a different way, he would sort again by color, getting all 9 correct. Other children made inconsistent classifications on both trials of the first subtest but then performed perfectly on the second subtest. A few children were accurate on the first subtest but failed to classify consistently on the second. It is interesting that many more children showed improvement across occasions than showed decline, suggesting that simply handling the materials or becoming familiar with the task aided performance. Considerable improvement occurred on Subtest 2 (over Subtest 1), in spite of the fact that Subtest 2 should theoretically have been harder because of the added dimension of texture. In sum, performance on the first trial was, for many children, a poor predictor of performance on subsequent trials.

The pretest data were also examined to investigate what sorts of groupings children made when they did not classify accurately The data include detailed records of what colors and shapes were placed in each box on each trial, so that inaccurate responses could be analyzed. The inaccuracies were of several types. A few showed no discernible order; these included responses in which the child failed to use all three boxes, or did not put equal numbers of pieces in each box. A substantial number of responses were partially correct; the child typically started out with a consistent scheme but then lost track of the principle. Most interesting were a third type of responses, using obvious regularity but without classification. Instead of grouping together three pieces of one color, the child would select one of each shape and each color to combine in a box. Children who made this type of response were scored as inaccurate in terms of classification, even though they exhibited a clear awareness of the properties of the stimuli. This type of response was particularly characteristic of older children; in all cases these children made an accurate classification on the subsequent trial or subtest.

As a result of inconsistencies and regular but non-classification responses, many children who could in fact classify failed to do so on the initial trial. Of the 41 children who took the pretest, 17 or about 40% failed to classify on the first trial. However, of these, 12 made an accurate classification on a subsequent trial or subtest, leaving only 5, or about 12% as consistent nonclassifiers.

A more detailed analysis was made of classification performance of the 24 experimental subjects, including classification during play. Since classification scores from the play sessions included any grouping of three or more elements, the records were checked for evidence of complete, accurate classifications of all 27 blocks during play. All cases of consistent classification were by shape for the complex blocks, and, for the simple blocks, by all dimensions simultaneously, except for one girl who twice classified the complex blocks by shape and color combined. All except five of the 24 children made at least one accurate classification of all the blocks during play. Of the five, one accurately stacked the blocks by shape after conclusion of the play session, though she did not do so during play.

A pattern of classification performance on the pretest and in play was developed for each child by recording simply whether a child performed accurately or not on a given occasion (see Appendix D). Of particular interest in these data is the pattern for three children who made no successful classifications at all during the pretest, with 9 stimuli, but successfully classified the 27 blocks during play (subjects 4, 6, and 12, Appendix D). Of the 24 experimental subjects, 10 failed the first trial of the pretest, but all except two of these subsequently exhibited the ability to make an accurate free classification, either on another trial or in free play. As with the total group pretested, the results on the initial trial provide a poor estimate of classification ability of these 24 children.

These results cast some doubts on the accuracy of attempts to measure classification ability or assign children to stages of development on the basis of performance on a single trial of free classification, as is done in much recent research (e.g., Denney, 1972; Kuhn, 1972). Evidence from the present study suggests that presenting a group of stimuli to a child and giving him one chance to put together pieces that are alike provides a very limited test of classification ability.

Even the ability to anticipate and verbalize possible dimensions for classification, which Inhelder and Piaget (1969) consider to be an indication of operational thinking in terms of classification, was not found to be unambiguously related to performance. For example, one six-and-a-half-year-old boy, after classifying by shape on the pretest, said, "Now I'll do them by color." However, after placing five pieces correctly by color, he subsequently shifted his basis for classifying or forgot what he was doing and finished with no discernible regularity. On the next subtest, he made a classification that was not only accurate by color, but, like a matrix, had all the shapes in the same relative position in each box. A competent five-year-old girl, after classifying by color, was asked to do it again a different way; she comment, "Oh, different colors but all the same shape." However, she did not follow through on her verbalized intention, even though on the previous subtest she had first classified accurately by color and then shifted accurately to shape.

The play sessions furnished additional informal information, not reflected in manipulation scores, on how children use materials in an unstructured situation. Virtually all the children appeared to begin working with the blocks in a rather haphazard way, with no advance planning. A child was never heard to say, "I think I'll make a house" (for example), nor did any child sit and contemplate the blocks more than a few seconds before beginning to play. However, a variety of organized forms, patterns, and classifications emerged from the acitivity. Regularity seemed to develop as the child's chance configuration suggested something to him, which he then carried further. Several blocks together might suggest a head and hat. (Often a child would verbally register surprise at having made something recognizable.) He might then proceed to add a body, arms, and legs. Or a child would start a pile, using whichever blocks were nearest him, with no apparent selection of particular blocks. When three or four blocks were piled up, he might notice a chance alternation of red and yellow blocks, and then carefully select more red and yellow blocks to complete the pile. Some children would carry through the pattern until all the appropriate blocks were used; others, particularly the younger ones, would maintain the system for a while, then lose track of it. This happened frequently with symmetry. A simple symmetrical pattern would develop, apparently by chance; the child would then appear to search for pieces that he might add to retain the symmetry. Some children would add several blocks that maintained the symmetry, then begin adding randomly. One of the older children repeatedly made symmetrical patterns using all 27 blocks.

These results are based merely on the observers' impressions and have no statistical reliability. However, they provide an interesting lead for further research.

DISCUSSION

The many and somewhat diffuse results of this study can perhaps best be discussed in terms of two main focuses of this study: first, descriptive information on spontaneous use of different materials by children of different ages; and second, the way such use of materials may be related to learning.

Spontaneous use of materials by children of different ages

While complexity of materials did not have a significant effect on play activities and did not interact with age in influencing play, significant age differences were found in several categories of manipulation and in time spent with the blocks. The fact that older children scored higher on all pattern measures but did not differ significantly from younger children on classification measures suggests that the creation of regular patterns may represent more mature behavior than simple sorting. Making patterns requires attention to the shape, color, or texture of the blocks, as well as to the overall configuration. Classifying, on the other hand, appears to be an easier task. Correctly stacking by shape can be accomplished by simply matching one shape to the shape below it in a pile, without attending to the whole grouping. Nearly all the children, including the very youngest and even several of those who had not been able to classify correctly on the pretest, exhibited the ability to stack the blocks correctly by shape. Classifying on dimensions other than shape was uncommon for either age group; however, only older children classified by texture or by two dimensions at once.

These differences may account in part for the significant difference in time spent with the blocks between the two age groups. Classifying by shape was relatively easy for both groups, and almost all the children sorted the blocks by shape several times. However, the older children were able to go beyond this relatively simple activity and try out other ways to combine the blocks. The younger children, who lacked the resources to create patterns or work with the more subtle dimensions, apparently found play with the blocks less interesting and were more likely to leave before the end of the session. It has been frequently noted, of course, that older children have a longer attention span. The ability of older children to produce more varied kinds of combinations may make the materials more stimulating and thus be related to a greater attention span.

This interpretation is supported by the analysis of trends in activities across the three sessions. As was noted previously, there was a slight decrease in all subcategories of classification (except combination) and a greater decrease in complementarity. This decrease is probably related to the decrease in total time spent; the less time children played with the blocks, the less time they had to score in each category. Thus the decline in classification may indicate an approximately constant rate of classifying but shorter sessions. Conversely, categories that do not show a decrease had to increase somewhat in rate in order not to show a decline. Thus the trends for all categories of pattern and for combination classifications suggest that in these areas there was sustained or increasing interest.

It will be recalled that pattern making also appeared spontaneously in older childrens' responses in the pretest; for example, a child would put one of each color and shape together in one box, instead of three of one type, thus failing the classification task. This age-related tendency spontaneously to make patterns both in play and in a structured situation, where pattern is not required or is even in conflict with the task, probably deserves research attention as a factor in cognitive development. The tendency to make patterns may be related to the increasing tendency with age for behavior to be governed by "plans" (Zaporozhets, 1957). However, Zaporozhets studied planning in the context of a task, maze learning. With increasing age, the child was more apt to pause and study the maze before attempting to solve it. In the present study, plans seemed not to be thought out in advance but rather to develop as the child responded to chance configurations. The important age difference appeared to be the older child's ability to carry out a plan (for example, to use all 27 blocks in a symmetrical pattern), while the younger child would lose track of his apparent intent. In sum, the interesting and varied patterns that appeared in the play situations were fascinating evidence of the children's developing abilities and deserve further study.

Turning to another aspect of the play activities, we note that the two different sets of materials failed to elicit any significant differences. These results were disappointing in view of the fact that the materials were specially designed to permit the study of different responses to simple and complex sets of stimuli. Apparently the differences between the two sets, so obvious to adults, were not evident to the children, or at least did not influence their play. A possible explanation of this fact lies in the characteristics of the blocks. As had been pointed out, shape was by far the most used dimension for the complex blocks, while color and texture were largely ignored. It may be that shape, which determines to some extent how the blocks can be combined physically, is inherently predominant in block play over the purely surface characteristics of color and texture, which don't affect how the blocks can be used. Thus, although shape varied independently from color and texture in the complex blocks, the dimensions other than shape were not widely utilized in play. Therefore, play with the complex blocks did not differ appreciably from play with the simple blocks, in which color and texture varied with shape. In order to elicit different activities, the two sets of blocks should be more obviously different.

Play activities and learning

A primary aim of this study was to elucidate the relationship between play activities and learning. The posttest results provide suggestive evidence that a match between age and complexity of materials used in play may be a factor in the learning of classification. However, these results are difficult to interpret for several reasons. First, the failure to obtain differences between simple and complex materials or an interaction of materials with age on any of the manipulations during play means that any learning that took place was not produced by any observable differences in manipulations among experimental groups. Second, the fact that there were few significant trends in manipulations across the three sessions means that there is no internal evidence for learning during the play sessions. Third, the significant correlations between posttest scores and certain play activities, especially pattern making and classification on two dimensions at once, tell us only that these types of performance are related, but not that the play activities caused the learning. Finally, the posttest results, although as predicted, are somewhat surprising considering that the children were exposed to the materials for only three ten-minute sessions, or a total of thirty minutes.

In spite of these limitations, the results are of sufficient interest to warrant further considerations. It will be recalled that classification in play was generally not related to posttest performance. However, among children using the complex materials, classification on two dimensions at once correlated significantly with posttest scores. These results make sense when one recalls that all except five of the children had exhibited the ability to make an initial classification on the pretest. Thus classification on the most salient dimension, shape, did not involve practicing a new ability but rather exercising an ability they already had. Thus it is not surprising that total classification (which was largely by shape) did not relate to posttest scores. On the other hand, relatively few of the children could reclassify on a second dimension; exploring the less salient dimensions and combining dimensions as a basis for classifying might provide an opportunity for learning. Thus, within the limitations mentioned above, the data on combination classification provide very limited support for the third hypothesis, namely, that classification activities during play are related to performance on a classification posttest.

Even more interesting in some ways are the unpredicted correlations between pattern making and posttest scores, especially for the younger children. It will be recalled that pattern making in play was also significantly correlated with age. Thus, for the older children, making patterns was presumably easier than it was for the younger and perhaps required less attention to the attributes of the blocks. It seems reasonable to suppose that for the younger child, making patterns required careful attention to the attributes he was working with and might thus be related to heightened awareness of attributes on the posttest.

Another possible interpretation of the posttest data is that perceptual learning occurred in play as a result of visual examination of the blocks. Visual examination seemed to occur whenever a child was searching for a particular block to meet the needs of a pattern or classification. Although this behavior was not measured in this study, it was the observers' impression that there was a clear difference in latency times between immediate selection, usually of the nearest block, for use in a haphazard grouping, and the choice of a particular block for use in a pattern, generally preceded by obvious search behavior. Differences in learning between simple and complex materials may be related to time spent looking at the array in an effort to select a particular type of block. This should take less time with the simple blocks, since many of the blocks are identical. A study of latency in block selection might provide data on children's recognition and utilization of physical attributes and bring out differences not found in this study between simple and complex materials.

The difficulty in interpreting the posttest results may also be related to a limitation of the present study in selecting classification as the only outcome to be measured. Classification was selected somewhat arbitrarily as a reasonable learning outcome to expect from play with manipulative materials. It seems likely that children's playful use of materials leads to learning in other areas, such as how to create patterns, how to combine and build with blocks, or how to make pictures from abstract shapes. Assessment of these outcomes, along with classification, might have given a better understanding of what was learned in the play sessions. For the purpose of the present research, this study was perhaps patterned too much on traditional learning experiments, where the experimenter decides in advance what is to be learned. Research on learning in play should be more open-ended, so that the child can reveal what he is learning. It should probably begin with observations to determine the kinds of playful responses that children make, and then consider what kinds of learning might result. Some of the more interesting findings of the present study resulted from open-ended observation rather than from hypothesis testing.

Summary

Results from this study show the predicted interaction of age and complexity of materials on the posttest of classification ability, as well as a number of interesting relationships among age, manipulations, and posttest scores. These results remain somewhat difficult to interpret in view of the fact that activities during play show neither significant differences between experimental groups nor an interaction of age and materials. The question of the way in which manipulations led to an interaction on the posttest therefore remains unclear, although some speculation on this question has been presented.

An attempt to gain further information on this latter question was made in the second study, which focussed on the manipulation of several types of simple and complex materials by children of distinctly different age groups. It was felt that more descriptive data on children's use of materials was needed before differences in learning from those materials could be understood.

CHAPTER 3. STUDY II

In order to supplement the findings of the first study, a second study was carried out to obtain more varied descriptive data on the ways in which children of different ages respond to materials differing in complexity. A number of changes were made in the second study, in an attempt to reveal greater differences among the groups than were found in the first study.

First, subjects were selected from two distinct age groups: three-year-olds and five-year-olds. In the first study, age was found to provide clearer results than ability, as measured by the pretest. However, in that case, the two age groups were obtained simply by splitting the previously formed ability groups in two; thus there was no age gap between the groups. By using only three- and five-year-olds in the second study, it was hoped that clearer age differences would be revealed.

Second, the blocks were redesigned in an attempt to emphasize the differences between simple and complex blocks. Analysis of manipulations in the first study showed that with the complex blocks, shape was by far the most used dimensions, while color and texture were largely ignored. It was hoped that by making the three dimensions equally salient, this problem could be eliminate.

Third, two sets of new materials were introduced to provide more varied opportunities for children to reveal different manipulative responses. Instead of three sessions with one set of materials, each child had one session with each of three sets of materials. It was found in the first study that there were no interesting trends across the three sessions; children typically adopted one style of interaction with the blocks and repeated this on each occasion. It seemed likely, therefore, that variety of materials in the second study would provide more opportunity for varied types of manipulation than did repeated experience with one type, as in the first study.

Fourth, the total treatment time in the second study was considerably shorter than in the first. The three different sets of materials could be presented in succession on one day, in a total of about fifteen minutes. This allowed for observation of more children (32 in the second study, as opposed to 24 in the first). This fact was felt to be an advantage in studying the varied responses of children to the materials. However, little learning would be expected to take place in such a brief period. Therefore, a posttest was not given in the second study.

In addition to providing further descriptive data on children's use of materials in play, this study gave another opportunity to test Hypotheses 1, namely, that younger children would classify more during play with simple materials while older children would classify more during play with complex materials. As in the previous study, a 2 x 2 design was used, with two distinct age levels and two sets of materials, simple and complex.

METHOD

Subjects

The subjects were three- and five-year-old children in a Los Angeles area Children's Center. They were selected on the basis of age alone. All the three-year-olds in the center were included in the study; three children who had just had their fourth birthdays were added, to make a total of 14 younger subjects, ranging in age from 39 to 51 months, with a mean of 43 months. A total of 18 five-year-olds, ranging in age from 61 to 71 months, with a mean of 66 months, were included.

Materials

Three different types of materials were used, each consisting of "simple" and "complex" sets, as with the blocks used in the previous study. Each set consists of 27 pieces which vary on three dimensions with three values of each. In the simple versions, the dimensions vary dependently; for example, a piece of a given shape is always the same color and texture. In the complex versions, the dimensions vary independently, so that no two pieces are alike. All the materials are designed to provide varied manipulative possibilities for young children and to allow for a number of ways in which they can be organized and classified. In addition to wooden blocks, two other types of materials were introduced to provide more varied opportunities for children to respond to simple and complex materials. The three types are as follows:

1. Wooden blocks. Two new sets of blocks (simple and complex) were developed in an attempt to overcome a problem with the blocks used in the previous study, namely that shape was by far the most used and apparently most salient dimension. In order to equalize

the saliency of the three dimensions, simpler, less distinctive shapes were used, and the textures were made more obvious. In other respects, the blocks were similar to those used in the previous study.

2. Pictures of houses. The second type of materials consisted of small pictures of houses of three different types, with three different textures, cut out of paper of three different colors. As previously, in the simple set the dimensions varied dependently; in the complex set, the dimensions varied independently. Each set of houses was accompanied by a large sheet of paper on which streets were outlined. The houses were gummed so as to stick to the large sheet on contact. In mounting the houses on the sheet, each child had the opportunity of exhibiting varying degrees of classification, pattern, and organization.

3. Pictures of flowers. The final type of materials used consisted of small pictures of flowers of three different types and three sizes, cut out of paper of three different colors. Sets were simple or complex, as previously defined. Each set of flowers was accompanied by a large blank sheet of light green paper; flowers were gummed to adhere to the sheet. In mounting the flowers on the sheet, the children could organize or classify them in a variety of ways.

Procedure

Three-year-olds and five-year-olds were randomly assigned to either the simple or the complex materials. Each child was individually invited to come to a small room adjoining the classroom to try out some new toys. A set of blocks (either simple or complex, depending on his group assignment) was placed in front of the child and he was told that he could do whatever he liked with them. The children generally showed no hesitation and typically began at once to play with the blocks. Each child was allowed to play for eight minutes before the next activity was introduced. If he indicated that he was through playing sooner, the next activity was begun.

The child was then shown either the houses or the flowers. (The order of presentation was alternated within each treatment group.) In the case of the houses, the pictures were spread out in front of the child, and he was shown the sheet on which they could be mounted. He was told: "Here are some pictures of houses. I'll spread them out so you can see them. Now here is a sheet with some streets marked on it. The houses have paste on them, so they'll stick when you put them on the sheet. You can put the houses on in any way that you like." All the children responded appropriately to the materials. Most pasted all the pictures to the sheet, but some children indicated that they were through before all the pictures were mounted. They were allowed to stop at that point.

The procedure was essentially the same for the flowers. The materials were presented to the child and he was told he could put the flowers on the sheet in any way that he liked.

Recording and scoring use of materials

The manipulations with the blocks were recorded in the same manner as the manipulations in the first study. The same form was used to record manipulations in the categories of classification, pattern, complementarity, and orientation of blocks. As before, observations were made at 30-second intervals, signaled by a pre-recorded tape. Any manipulation that was evident at the time of observation was recorded with a check in the appropriate space. The score in each category was the total number of checks. Since the sessions lasted a maximum of eight minutes, a child could obtain a maximum score of 16 in each category of manipulation.

The activities with the houses and flowers made a permanent record of each child's responses that could be scored at a later time. Slightly different categories had to be used in scoring the pictures, as compared to the blocks. Arrangements were scored for classification and pattern, as defined below; however, there was no equivalent with the pictures for complementarity or orientation. A new category of organization was added.

Scoring for houses:

Classification was defined as three or more houses of one color, texture, or type in one block. To score as classification, the similar houses had to be alone in a given block; or, if non-similar houses shared the block, three or more of one type had to be in a contiguous row. The classification score for each subject was the total number of houses so grouped, except that the maximum possible score was limited to 18 (instead of the theoretical possible of 27 if all houses were used). This limitation was imposed to avoid unfair biasing against subjects who did not mount all 27 houses.

Pattern was defined as two or more groups of two or three houses, each of which showed a definable pattern; for example, several groups of three houses consisting of two yellow houses with a blue between them, or several identical pairs consisting of a blue house to the left of a yellow house. The pattern score was the total number of houses included in the pattern, except that the maximum possible score was limited to 18, as above.

Organization involved the orderly arrangement of houses, independent of their attributes, and was scored on a five-point scale, as follows:

1. Houses randomly scattered, at various angles; no attention to streets;

2. Most houses aligned, but some scattered; little attention to streets;

3. All houses aligned but some sideways, some overlapping streets;

4. All houses neatly in blocks, but irregularly-sized groups; or, neat alignment but little attention to streets; clear sense of order;

5. Two or three houses neatly placed in each block.

Scoring for flowers:

Classification with respect to flowers was defined as three or more similar flowers no more than one quarter inch apart, if scattered; up to one half inch apart if in a group clearly separated from all others; or aligned, if in rows. The total number of flowers so grouped, up to 18, was the classification score.

Pattern, as defined above, did not occur with the flowers; no discernible regularity occurred other than classification.

Organization was scored on a five-point scale similar to that used for houses:

1. Flowers scattered randomly, not upright;
2. Flowers mostly upright, but scattered;
3. Flowers mostly upright, in partial rows;
4. Flowers nearly all upright; approximate rows;
5. All flowers upright; neat rows.

Both the house and flower arrangements for each subject were scored independently on two separate occasions; in case of any discrepancies, the arrangements were independently scored on a third occasion to resolve the discrepancy.

Figures 3-1 and 3-2 give examples of each level of organization for houses and flowers and illustrated scores on the other measures. Figures 3-1a and 3-1b show organization levels 1 and 2, respectively, for houses, with no score for pattern or classification. Figure 3-1c shows organization level 3 and a classification score of 3, for the three identical buildings in the lower right-hand corner. Figure 3-1d represents an organization score of 4 and a pattern score of 12, the latter for the four groups of three houses each, in the upper left, where a tall house is in each case flanked by two low ones. Figures 3-1e and 3-1f both show organization level 5; the former also shows a pattern score of 18, for the groupings of three houses made up of one of each type; the latter shows a classification score of 18.

Figures 3-2a and 3-2b show organization levels 1 and 2 for

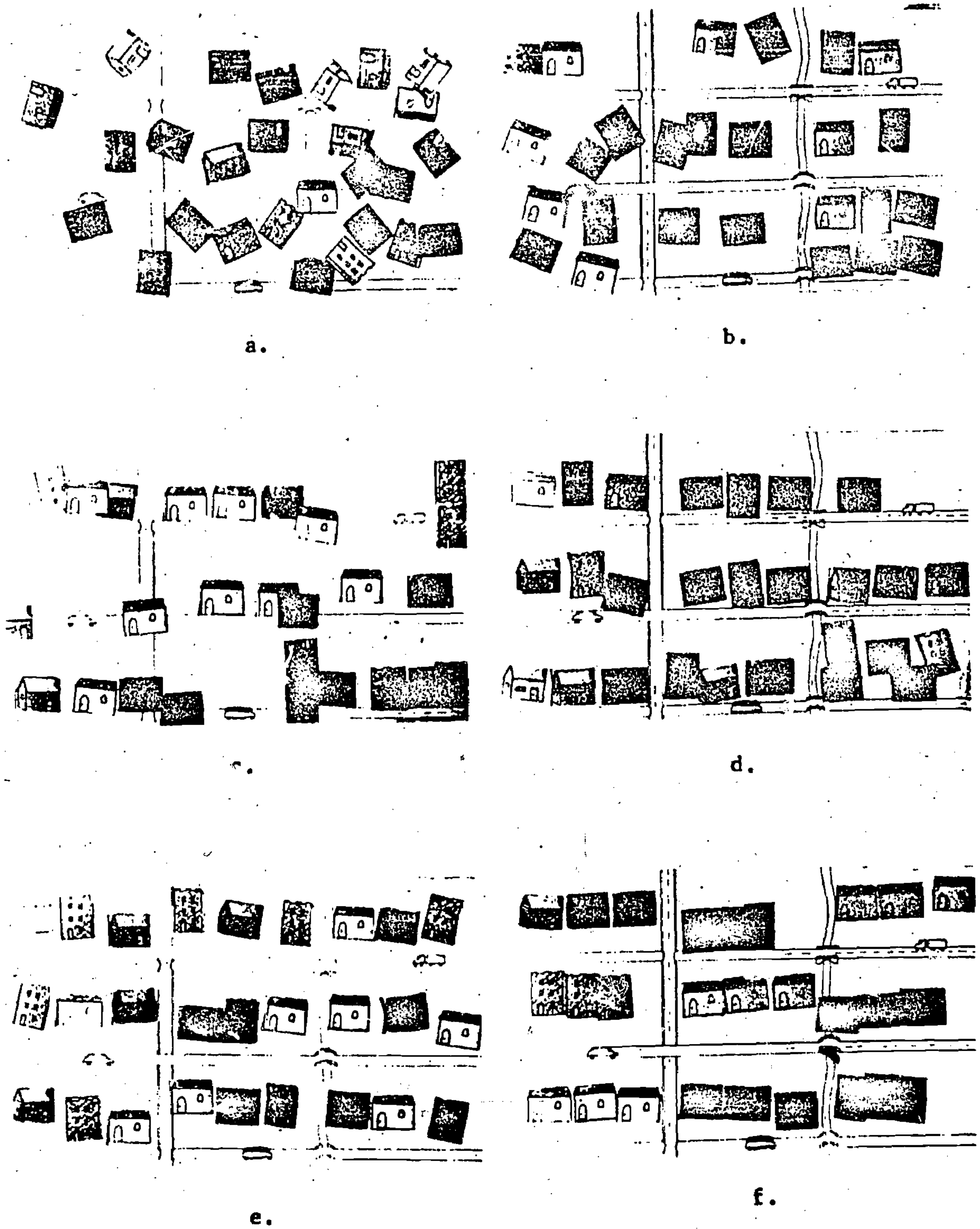


Figure 3-1. Examples of house arrangements, showing different levels of organization.

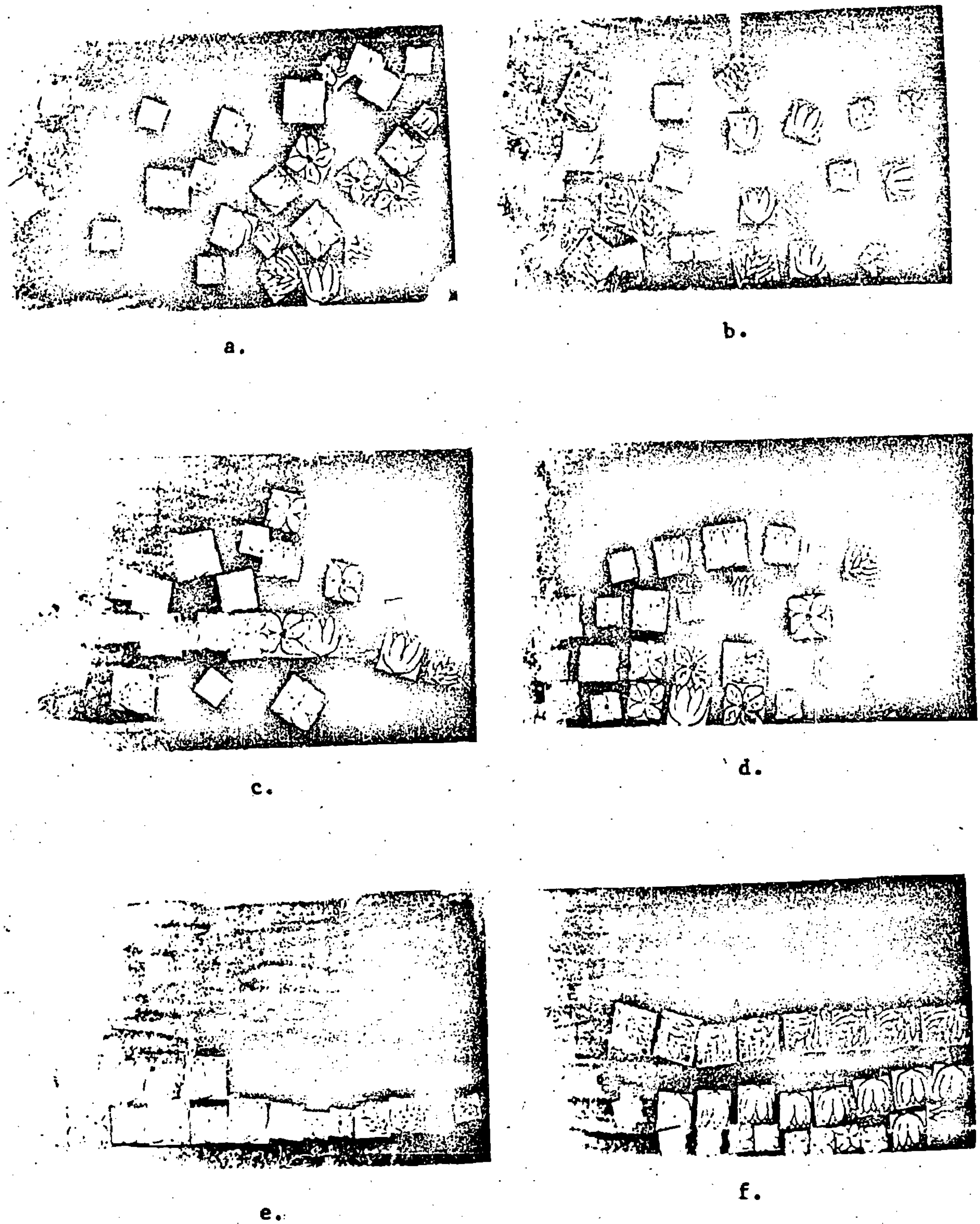


Figure 3-2. Examples of flower arrangements, showing different levels of organization.

flowers. Figure 3-2c shows organization level 3, a score of 4 for classification by color, and a score of 3 for classification by form. Organization level 4 is shown in Figure 3-2d, which also shows a score of 6 for classification by form (three tulips in a row, center top, and three five-petaled flowers in a row near the bottom left). Figures 3-2e and 3-2f both show organization level 5; 3-2e shows a classification score of 3 (3 tulips, center bottom): 3-2f receives a classification score of 18 (the maximum possible).

RESULTS AND DISCUSSION

The mean manipulation scores for all subjects and for each subgroup are given in Table 3-1. Scores are shown for manipulations with each of the three types of materials (blocks, houses, and flowers); scores for houses and flowers combined ("picture") are given for classification and organization. (Pattern did not occur at all with flowers.) An analysis of variance showed no significant interaction of age with materials on classification during play. Thus no support was obtained for the major hypothesis, that the younger children would engage in more classification with the simple materials, while the older children would engage in more with the complex materials.

However, the results provide interesting descriptive data on the question of how children use manipulative materials in a playful situation. The results show significant age differences in manipulation scores and provide information on the consistency of responses across different materials and the relationships between different types of

Table 3-1. Mean Manipulation Scores by Age, by Materials, and by Experimental Group.

		Age		Materials		Experimental Group			
	Total	Young	Old	Simple	Complex	Young Simple	Young Complex	Old Simple	Old Complex
Blocks									
Classification*	3.1	1.0	4.6	3.0	3.1	1.0	1.0	4.3	4.8
Pattern	1.0	.5	1.4	1.8	.3	1.0	0.0	2.3	.6
Complementarity+	3.4	2.2	4.2	1.5	5.2	0.0	4.1	2.6	6.0
Houses									
Classification	3.3	2.2	4.0	2.9	3.6	1.0	3.3	4.1	3.9
Pattern	1.9	0.0	3.2	2.3	1.5	0.0	0.0	3.8	2.7
Organization *	3.4	2.9	3.7	3.4	3.4	2.8	3.0	3.8	3.7
Flowers									
Classification	4.6	2.8	5.9	5.6	3.7	1.2	4.1	8.6	3.3
Organization	2.9	2.3	3.3	2.6	3.2	1.7	2.9	3.2	3.4
Picture (Houses + Flowers)									
Classification	7.9	5.0	9.9	8.5	7.3	2.2	7.4	12.7	7.2
Organization**	6.3	5.2	7.1	6.0	6.6	4.5	5.9	7.0	7.1

* Age difference significant $p < .05$; ** Age difference significant $p < .01$; + Materials difference significant $p < .05$.

responses to the same materials.

Looking first at age differences, Table 3-1 shows that in every category of manipulation, older children scored higher than younger. That is, older children made more orderly, scorable responses, as opposed to haphazard responses. The age differences are significant for classification of blocks ($p < .05$), organization of houses ($p < .05$), and picture organization ($p < .01$). Correlations of age with each type of manipulation for each of the three types of materials are shown in Table 3-2 (except for organization of blocks, which was not scored, and pattern of flowers, which did not occur). Not surprisingly, all the correlations are positive, and four out of the seven are significant. The strongest relationship is that between age and organization, showing a significant correlation for both houses ($p < .01$) and flowers ($p < .05$). Classification shows a significant correlation with age only with the blocks ($p < .01$), not with houses and flowers. Pattern did not occur with the flowers; but pattern with the houses correlates positively with age ($p < .05$).

These results support the developmental changes found in Study I. The significant correlation of age with pattern scores give further support to the idea that with increasing age, children increasingly attend to the properties of stimuli and utilize them in their spontaneous manipulations. The results for organization scores amplify the previous results by providing evidence in a slightly different area. These scores, it will be recalled, measure the general sense of order in the placement of elements, without regard to descriptive properties such as shape and color. The results suggest, then, that

Table 3-2. Correlations of Age with Category of Manipulation for Each Type of Material.

Category of Manipulation	Materials		
	Blocks	Houses	Flowers
Classification	.48**	.14	.23
Pattern	.23	.41*	NA
Organization	NA	.46**	.34*

*p <.05; ** p <.01; NA: not applicable

with increasing age, children are more systematic and orderly in their playful manipulations.

Since classification is an activity of particular interest in this study, different types of classification for each of the materials were examined separately for differences between younger and older children, as shown in Table 3-3. The only significant difference is the greater classification of simple flowers by older children. However, classification activity generally does not appear to be a variable of great interest, in terms of differentiating among groups, a finding similar to that of the first study.

In this study, as in the first, differences between simple and complex materials did not generally produce systematic differences in manipulations (see Table 3-1). An analysis shows only one significant difference, namely, more complementarity with complex blocks. This difference is difficult to interpret, since there is no theoretical reason for complementarity, which involved simple fitting together matching shapes, to be related to complexity of materials.

The small and inconsistent differences in classification and pattern with the blocks is interesting in view of the fact that the blocks in the second study were redesigned in an effort to emphasize differences between simple and complex sets. It will be recalled that in the redesigned blocks, texture was emphasized and shape de-emphasized. The effect of the simpler, less distinctive shapes seems to have been to make the blocks less interesting generally, perhaps because they were less novel in appearance. Even though the sessions with the blocks were shorter in the second study, many more children

Table 3-3. Mean Classification Scores, by Types of Materials and Age.

Materials	Total	Young	Old
Simple Blocks	3.0	1.0	4.3
Complex Blocks			
Shape	1.7	.4	2.7
Color	.8	.3	1.2
Texture	.1	.3	0.0
Combination	.5	0.0	.9
Simple Houses	2.9	1.0	4.1
Complex Houses			
Form	2.5	1.3	3.6
Color	.9	2.0	0.0
Combination	.2	0.0	.3
Simple Flowers*	5.6	1.2	8.6
Complex Flowers			
Form	2.3	2.3	2.3
Color	1.4	1.9	1.0

*Age difference significant, $p < .05$.

than in the first study indicated that they were through with the blocks before the time was up. It was the observer's impression that there was also less spontaneous interest in the blocks in the second study. The more salient textures were hardly attended to at all (see Table 3-3). As was suggested in the first study, shape may be inherently the most important attribute when children handle blocks, since any manipulation, other than laying them out randomly, requires attention to shape, but not to color or texture. In making the shapes less unusual and distinctive, the blocks themselves apparently became less interesting. These results suggest that future studies should emphasize interesting and distinctive shapes, and attempt to make the other dimensions, such as color and texture, equally distinctive.

As with the blocks, the differences between simple and complex sets of houses and flowers were entirely too subtle to elicit any discernible differences in manipulative responses. The development of simple and complex materials sufficiently different to elicit different responses remains a problem for further study.

The use of three different types of materials allowed for the examination of responses to different materials, that is, the consistency of similar responses across materials. Correlations were computed for each category of manipulation between scores for different materials. Table 3-4 gives these correlations for the total population and for younger and older subjects. (Since no significant differences between materials were found, groups using simple and complex materials were combined for further analysis.) The results show generally low

Table 3-4. Correlations between Similar Manipulations with Different Materials by Age.

	Total	Young	Old
Classification			
Blocks with Houses	-.06	.11	-.17
Blocks with Flowers	-.02	-.36	-.16
Houses with Flowers	-.08	.36	-.21
Pattern			
Blocks with Houses	-.10	-	-.19
Organization			
Houses with Flowers	.21	.59*	-.30

*p <.05

Table 3-5. Correlation between Different Manipulations with the Same Materials by Age.

	Total	Young	Old
Blocks			
Classification with Pattern	.14	.26	.06
Houses			
Classification with Pattern	-.26	-	-.37
Classification with Organization	.24	.44	.20
Organization with Pattern	.41*	-	.46*
Flowers			
Classification with Organization	.51*	.20	.54*

*p <.05

or negative correlations, as might be expected. Categories of manipulations used with one type of materials do not predict manipulations with a different type.

However an exception to this generalization is organization scores. For the young subjects, organization scores for houses and flowers correlated .59 ($p < .05$). This is in accord with the data in Table 3-2, showing higher correlations of age with organization than with classification or pattern. Thus organization, unlike other manipulations, shows some degree of consistency across different materials and may represent general maturity of approach rather than a specific type of response. The negative correlation of the two organization scores for the older children may reflect a realistic response to the materials: houses are generally neatly aligned in rows while flowers are usually scattered about.

Finally, it is interesting to look at relationships among different types of responses to the same materials. Table 3-5 gives correlations among the major categories of manipulations for each of the materials. As in the first study, correlations between classification and pattern within a given set of materials are low or negative and nonsignificant; these two types of activities appear to be independent. However, the correlations of organization scores with other manipulations are consistently positive and are significant for the older children and the total sample in two cases (with pattern for houses, and with classification for flowers). Organization scores are thus the best predictor of other manipulations.

In summary, the second study provides no support for the hypothesis of an interaction between age and complexity of materials on classification activity during play. However, a number of interesting relationships are revealed by the data. Age is positively correlated with all manipulation scores and is particularly strongly related to organization. Organization scores show considerable consistency across materials and are the best predictor of other systematic manipulations. Organization of materials in free play may represent general maturity of approach.

CHAPTER 4. SUMMARY AND CONCLUSIONS

The research reported in this paper is concerned with the way in which young children use manipulative materials in a play situation and the way their use of materials in play is related to learning. In the first, more extensive, study, 24 preschool children at two levels of classification ability were observed in individual play sessions with one of two sets of wooden blocks: either simple blocks, which could be classified in only one way, or complex blocks, which allowed for multiple classification. After the play sessions, they were given a posttest of classification ability. In the second study, 32 three- and five-year-old children were observed in a single play session with either simple or complex materials of three different types; no posttest was given. In both studies, observers recorded a variety of play activities in order to study the effect of the child's ability (or age) and the complexity of materials on his activities. In addition, the first study examined how learning (as measured by the posttest) was related to the materials used and to the activities of the child during play.

It was hypothesized that children with limited classification ability would engage in more classification during play and learn more from simple than from complex materials, while children with greater classification ability would engage in more classification and learn more from the complex materials. It was further hypothesized that within ability groups, the amount of classification during play would be related to posttest performance on a classification posttest.

In addition, general descriptive information was sought on children's use of materials in play.

THE INFLUENCE OF AGE AND MATERIALS ON PLAY ACTIVITIES

The theoretical concept of "match" suggests that for maximum benefit to cognitive development, materials used by a child should be at a level of difficulty appropriate to the child's level of ability. In Study I, a pretest of free classification was initially used as an estimate of ability. However, since the pretest was found to provide too narrow an estimate of ability, age, as a broader and more general correlate of ability, was used as a basis for grouping children in subsequent analysis of results in Study I and as a basis for selecting subjects in Study II.

The data from both studies were examined for evidence of the effect of age and complexity of materials on manipulations during play. In both studies, no evidence was found that younger children classified more with simple materials or that older children classified more with complex materials; that is, there was no significant interaction of age and complexity of materials on classification activities. Similarly, none of the other manipulations recorded showed an interaction of age with complexity of materials. Thus, with these materials, no support was found for the concept of "match" as applied to play activities.

The data were further analyzed for independent effects of age and materials on play activities. Both studies showed clear evidence of developmental changes in children's spontaneous use of materials in play. With increasing age, three- to five-year-old children showed an increasing tendency to create patterns and an increasing degree of organization in their arrangements of elements. The significant correlations of age with pattern scores in both studies indicate an increasing tendency to utilize the properties of stimuli in a systematic way. The significant correlations between age and organization scores in Study II show that, independent of the properties, children tend increasingly to impose order on an array of stimuli. This greater regularity with age suggests increasing planfulness and coherence in children's thinking, as would be predicted by most theories of development. However, little systematic study has been made of such changes as revealed spontaneously in play, as opposed to under task conditions. This tendency for a child to make patterns and impose order as he plays might be worth investigating as a means of estimating mental maturity while avoiding some of the problems of a test situation, such as comprehension and motivation.

While age was found to be an important factor in play activities, the results of both studies showed no significant differences between the simple and complex materials in terms of activities during play. Apparently the differences between the two sets were not sufficiently striking to elicit different responses. It was suggested that one dimension of difference was so salient that other dimensions were not widely attended to. Thus, it did not matter whether they varied dependently or independently.

Individual patterns of play were highly consistent across three sessions with the same materials. This result suggests that play behavior is not as ephemeral as it might seem but rather reflects stable response tendencies to specific materials. Even across different types of materials, as in Study II, the amount of spontaneous organization of stimuli showed considerable consistency. Classification and pattern making, on the other hand, were more influenced by the specific materials and showed little consistency across materials. An important area for future study is the particular features of materials that elicit different types of activities during play.

INFLUENCE OF MATERIALS AND PLAY ACTIVITIES ON LEARNING

The first study provided limited evidence that a match between ability and complexity of materials used in play may be a factor in the learning of classification. Specifically, the lower ability children learned more, in terms of a classification posttest, from play with simple materials than from play with complex materials; the higher ability children profited more from play with complex materials. The evidence was clearer when age, rather than ability as measured by the pretest, was used as the basis for grouping the children. The pretest, although it showed resonably high reliability. apparently tapped too narrow a range of ability to provide an appropriate basis for grouping children.

The present study leaves largely unanswered the question of how play with simple and complex materials may have mediated differential learning for older and younger children. The posttest results are difficult to interpret because of the failure to obtain differences between manipulations with simple and complex materials and the few significant trends across sessions. In addition, the correlations between play activities and posttest scores do not establish a causal relationship.

Nevertheless, the correlations between manipulations in play and posttest performance suggest some possibilities for further investigation. In general, classification manipulations were not closely related to posttest performance. In terms of the theoretical basis for the study, practicing developing classification schemes during play bore little relationship to the learning of classification, as measured by the posttest. However, for the children using the complex materials, classification of the most sophisticated type, namely, on two dimensions at once, correlated significantly with posttest scores. This result gives limited support to the hypothesized relationship between play activities and learning and suggests that a particular type of classification in play may have mediated improved posttest performance.

The other play activity that showed high correlations with the posttest was pattern making. This type of manipulation showed a significant correlation with the posttest scores for the younger children and for all groups combined. These results suggest that children may develop important abilities related to classification through activities other than classification itself. Pattern making, by requiring attention to the attributes of the materials, may contribute to the awareness of different properties required for classification tasks.

In addition to classification skills, it is likely that the varied activities during play may contribute to learning in a variety of areas. In this study, classification was selected somewhat arbitrarily as a reasonable outcome; however, the records of activities during play suggest other equally reasonable outcomes: ability to make patterns, combine and build with blocks, or make pictures from abstract shapes. In order to elucidate the relationship between what children do in play and what they learn, further research should sample a wide range of possible learning outcomes, and relate these to activities during play.

CLASSIFICATION PERFORMANCE IN TEST AND PLAY SITUATIONS

In addition to information about play activities, the study provided some interesting data on children's ability and tendency to classify under a variety of circumstances. It is clear from this study that the accuracy and consistency of children's classification performance varies greatly from one occasion to another. Children classified on some trials of the pretest but not on others; some children who did not classify on the pretest did so in play; and some competent children made patterns instead of classifying on the pretest, although they clearly knew how to classify.

A number of different factors appear to influence classification performance. In the test situation, comprehension of the task is no doubt a major factor. The orientation apparently helped children understand what was wanted, so that the children generally performed better than was expected. A single trial of practice with specific stimuli also improved performance, as shown by those children who classified accurately on the second trial after failing the first.

The actual stimuli used no doubt also play a role. It was noted that one child, who did not classify accurately on the pretest, with nine stimuli, subsequently classified the 27 complex blocks in play. Perhaps the salience of shape helped the child to ignore the irrelevant dimensions. Possibly also the absence of adult pressure in the play situation gave him the opportunity to try out new combinations.

Finally, motivation is important in determining whether or how well children classify. The fact that some older children made patterns in the pretest instead of classifying suggests that classifying may not be a very interesting activity for the competent child. For the girl who did not classify during play but stacked the blocks carefully by shape after the session, classification was clearly seen not as a playful activity but as a terminal activity, associated with putting things away.

Classification performance appears in fact not to be a clearly defined or easily measurable unitary skill. It is more likely a composite of perceptual and conceptual abilities highly influenced by the situation, the specific stimuli, and the attitude of the child. Future attempts to measure or modify free classification should take into consideration the many factors that influence its manifestation.

THE STUDY OF PLAY: CONCLUDING REMARKS

One of the outcomes of this study has been a description of children's spontaneous responses to an array of stimuli in an unstructured situation. While previous studies of play have generally focused on the thematic or affective content of play, the present study has looked primarily at cognitive factors, specifically, the way combinations of materials reveal recognition and utilization of physical attributes. From this point of view, it is less important that child makes a house, a tower, or a flat array, than that he selects all blocks of one color (for a house), alternates shapes (to make a tower), or uses symmetry (in a flat array). The categories selected for recording behavior, particularly classification, pattern making, and complementarity, seem well suited to the task of studying cognitive factors that operate during play.

Observing young children's spontaneous responses to materials that allow for a variety of manipulative responses can give us important clues to developing thought processes and aid our understanding of how children learn from materials. In play, as opposed to a task situation, a child is not trying to understand or interpret what an adult wants him to do; he is relatively free to respond to the materials in his own way; in so doing, he reveals spontaneous tendencies to group and arrange objects. The present research shows that manipulative play reveals clear developmental changes and may contribute to developing classification abilities. The mechanisms by which play is related to learning remain to be elucidated in future research.

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APPENDIX A

ORIENTATION SEQUENCE

Part A: The child was shown three low boxes and nine cardboard stimuli (three shapes, with three colors of each). He was told:

> "We're going to play a game with these pieces of cardboard and these boxes. In this game, the pieces of cardboard that are the same in some way go together in one box. I'll start by putting one piece in each box."

The experimenter put one piece in each box, to represent each color and each shape (e.g., red square, yellow circle, and blue triangle). The child was then handed one piece (e.g., a yellow triangle).

> "Now you take this piece and put it in a box with a piece that is like it in some way."

The child had the option of matching by color or shape. If he failed to match correctly (e.g., put a yellow triangle with a red square), he was told:

> "No, this piece is not like that one; try again to put it with a piece that is like it in some way."

Once the child established color or shape as his basis for sorting, he was handed additional pieces one by one and told:

> "Now put this one with a piece that is like it in some way."
>
> Or "Now put this piece where it belongs."

If a piece was incorrectly placed, the experimenter picked it up and put it in the correct box, and said:

> "No, this piece is like that one (those), so it goes here."

Part B: After all the pieces were correctly placed, the experimenter removed all the pieces except the original three, which were left in place in the boxes.

> "You put all the pieces away in the boxes. Now we're going to take some of the pieces out of the boxes and do it a different way. This time I want you to put together in one box pieces that are alike in some way, but do it differently than you did before."

The experimenter handed the child the same piece as he was given initially in Part A (e.g., a yellow triangle).

> "Now put this one with a piece that is like it, but do it in a different way than before."

If the child used the same basis for sorting as previously, he was told:

> "No, you did it that way before. Let me show you a different way to put together pieces that are alike. This piece is like that one, so it goes there."

The child was handed additional pieces one by one and told to put them where they belonged. In the case of an error, the experimenter placed the piece correctly and said:

> "No, this piece is like that one (those), so it goes there."

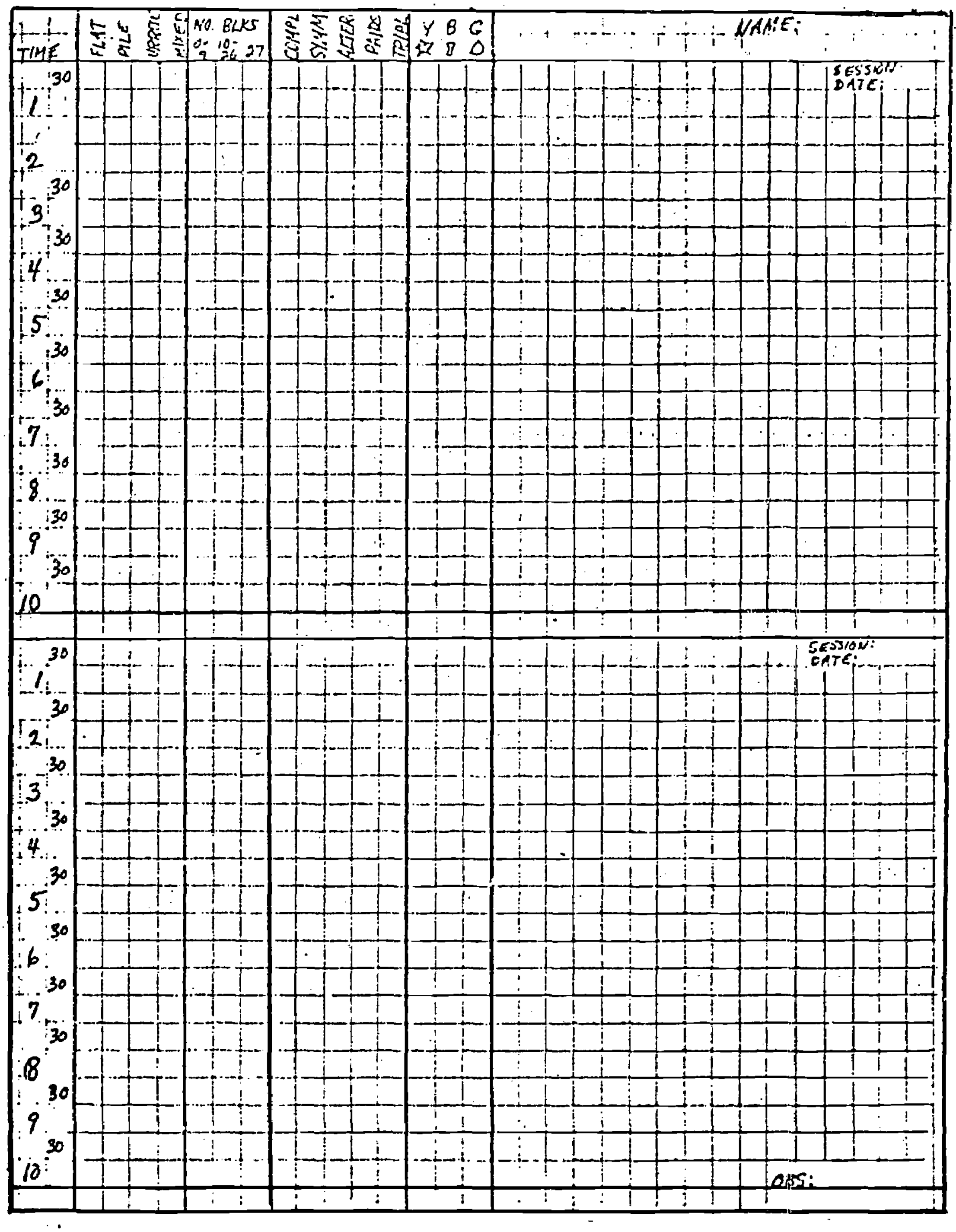
APPENDIX B

Frequency Distribution of Pretest Scores, Based on 41 Children

Score	N	
12	1	low ability group
⋮		
15	0	
16	1	
17	2	
18	7	
19	1	
20	0	
21	2	
22	0	middle ability group
23	2	
24	2	
25	0	
26	2	
27	3	
28	0	
29	4	
30	1	
31	0	
⋮		
35	0	high ability group
36	9	
37	1	
38	0	
39	0	
40	1	
41	0	
42	0	
43	0	
44	0	
45	2	perfect score; not used.

APPENDIX C

1. Form used for recording play sessions with simple materials (reduced)



2. Form used for recording play sessions with complex materials (reduced)

TIME	FLAT	PILE	UPRTG	MIXED	NO. BLKS 0-9 10-26 27	SIMPL	SYMM	ALTER	PAIRS	TRIPL	SHAPE ☆ B O	COLOR Y B R	TEXTURE	COMBO C's	NAME:	SESSION DATE:
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APPENDIX D

Patterns of Classification Performance for the 24 Experimental Subjects, by Experimental Group

Experimental Group	Subject Number	Initial Classification: Pretest: First Trial	Initial Classification: Pretest: Subsequent Trial or Subtest	Initial Classification: Play: Spontaneous Classif.	Horizontal Reclassification: Subtest 1	Horizontal Reclassification: Subtest 2
Young Simple	1	+	+	+	+	+
	2	+	+	+	+	+
	3	+	+	+	-	-
	4	-	-	+	-	-
	5	+	+	+	-	-
	6	-	-	+	-	-
	7	-	+	-	-	-
	8	+	+	+	-	-
Young Complex	9	-	+	+	-	-
	10	+	+	-	+	+
	11	+	+	+	-	-
	12	-	-	+	-	-
	13	-	-	-	-	-
	14	+	-	+	-	-
Old Simple	15	-[a]	+	-[b]	-[a]	+
	16	-[a]	+	+	-[a]	+
	17	+	+	+	-	-
	18	+	+	+	+	+
Old Complex	19	-	-	-	-	-
	20	+	+	+	+	+
	21	-[a]	+	+	-[a]	+
	22	+	+	+	+	+
	23	+	+	+	+	+
	24	+	+	+	+	+

[a]A patterned arrangement - one of each color and each shape together.

[b]No classification in play session, but all blocks stacked by shape after conclusion of session.