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ABSTRACT

A dissertation proposal involved a study to observe spontaneous behavior of children in interaction with materials in order to gain understanding of the factors that influence classificatory and imaginative behavior in free play. Children at two levels of ability in terms of classification skills were observed in interaction with materials at two levels of complexity during four play sessions. Materials were two related sets of specially designed blocks defined as simple or complex on the basis of the variations and the possible combinations among individual members of the set. The 3- to 6-year-olds were to play in pairs to simulate the social play typical of children in natural situations. Observation focused on free classification, creative or design behavior, imaginative behavior or variety of themes. A final measure was used to determine the effect of interaction with the materials on classification ability. Results consisted of observational data from the experimental sessions and posttest scores. Non-definitive results indicated replicating the experiment with modifications. It was not feasible to use pairs as the experimental unit, so one child at a time was observed. Interaction between ability and complexity of blocks was found in testing, but not in observed behavior. No interaction effects with age or ability were observed. A revised study is proposed involving age as the independent variable and redesigned materials. (KM)

THE INFLUENCE OF ABILITY LEVEL AND MATERIALS ON CLASSIFICATORY AND IMAGINATIVE BEHAVIOR IN FREE PLAY

by

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I. INTRODUCTION

The play of young children, loosely defined to include spontaneous, child-initiated activity that serves no immediate extrinsic purpose, has traditionally been thought by educators to be basic to development. That young children learn through play is a common theme of both early (Froebel, 1912) and contemporary (Omwake, 1963; Stant, 1972) writers about the nursery school. Most frequently, play is assumed to contribute to the physical, social, and emotional development of the child (Lowenfeld, 1967; Erikson, 1963; Murphy, 1956). The notion of play as therapy is related to this position (Axline, 1969). However, a position articulated by Montessori (1964) and recently receiving increasing attention (Almy, 1966; Lunzer, 1959; Sutton-Smith, 1967) emphasizes the importance of play for intellectual development. In addition, research from a variety of areas (e.g., early stimulation, perceptual development, deprivation, Piaget studies, and disadvantaged children) is converging in an increased emphasis on cognitive development in early childhood, when play is the child's dominant activity. A few variables related to early cognitive development, such as the quantity and quality of verbal interaction with adults, have been identified (Hess & Shipman, 1968). Experimental studies of learning have examined the effect of factors such as stimulus variables, instructions, and reinforcement, in a controlled situation (Stevenson, 1970). However, there has been little investigation of the variables that affect a child's cognitive encounters with the environment in spontaneous play.

This proposal is aimed at studying the ways in which the cognitive content and cognitive outcomes of the preschool child's spontaneous play are affected by his level of development and by the complexity of the materials he uses. The following questions are asked: In a free play situation, constrained only by the materials provided: Do children's cognitive behavior patterns vary systematically as a function of their developmental level? For children at the same developmental level, do their activities vary systematically as a function of the complexity of the materials? Do children learn more from interacting with materials matched to their ability level than from materials either below or above their ability?

To investigate these questions, children 3 to 6 years old at two levels of ability will be observed playing in pairs with either simple or complex materials. The materials consist of two related sets of specially designed blocks defined as simple or complex on the basis of the variations and the possible combinations among individual members of the set. Children will play in pairs to simulate the social play typical of children of this age in natural situations. Observation will focus on three types of behavior: (1) a particular cognitive behavior, free classification; (2) creative or design behavior; (3) imaginative behavior or variety of themes. A final measure will be used to determine the effect of interaction with the materials on classification ability.

The results of this study will have implications for both the choice of materials for preschool education and the levels at which materials 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 <u>specific</u> 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 levels of development interact with specific materials and what outcomes can be expected from such interactions.

II. REVIEW OF LITERATURE

Theoretical background

It would perhaps make sense to begin a review with a definition of play. However, much has been written on this subject and in most cases the writer arrives at a definition to suit his own purpose. Often, play 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, since the word is rich in shared associations among most people, it will be retained and defined to suit the present purpose. Play is considered to be activity that the child engages in freely, in the absence of externally imposed directions or pressure, that serves no immediate or apparent adaptive purpose. In this study, it will mean behavior of pairs of children in an experimental situation with material provided, but no specific instructions given.

The role of play in cognition derives much of its theoretical support from the writings of Piaget, as well as from recent work on curiosity, exploration, and intrinsic motivation. For Piaget, cognitive development in preoperational children is dependent on active manipulation of materials. As Flavell (1963) summarizes, "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 activities 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 intestigatory 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 developm..nt. 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 sype 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 activities, 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 achieved partial success initially and thus may be presumed to have been in a stansitional 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 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 patterns.

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 (spe i. ', 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 great 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 speci ic exploratory behavior, but soon loses appeal if it provides little possibility f ·v .sive behavicr. 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, ·ility, 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 and 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, 1964). 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 coördinate 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 recent 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 items. 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. 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 dimensions 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.

Recently 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 abilites.

III. PROBLEM AND HYPOTHESES

The theoretical positions discussed above strongly suggest that children learn from spontaneous interaction with objects in the environment. A child's activity may be expected to result in learning particularly if the materials used elicit responses related to that learning. Furthermore, Piaget's theory suggests that occurrence of particular responses in play may depend largely on the match between the materials and the child's level of development. However, there is little empirical evidence to support these ideas.

The purpose of the present study is to observe spontaneous behavior of children in interaction with materials, in order to gain understanding of the factors that influence classificatory and imaginative behavior in free play. Children at two levels of ability in terms of classification skills will be observed in interaction with materials at two levels of complexity during four play sessions. The materials consist of two sets of wooden blocks specifically designed to provide novel and interesting manipulative possibilities for young children. The blocks vary in shape, color, texture, and thickness, with three values of each dimension. In the simple materials, the dimensions all vary dependently, so that all the blocks of a given shape are the same color, texture, and thickness. Thus there is only one possible way in which the blocks may be classified. Moreover, since the dimensional cues are redundant, there are no irrelevant cues to be ignored in sorting the blocks. In the complex materials, the dimensions vary independently, so that no two blocks are exactly alike. The blocks can thus be sorted in four different ways; to make any one sort, the three irrelevant cues must be ignored.

The children will be exposed to the materials in an experimental room separate from the classroom. However, every attempt will be made to create a relaxed, natural atmosphere, in which the children feel free to interact spontaneously with the materials. In order to simulate the social play typical of children of this age in natural situations, children will be observed in pairs. While this increases the number of subjects and the complexity of the data analysis, it is justified on the basis of the more natural situation and the more interesting and varied behavior that results. Three aspects of behavior during the free play will be observed and recorded: classification behavior, creative or design behavior, and fantasy behavior. In addition, a posttest will be given to measure the effect of interaction with the materials on classification behavior.

On the basis of the theories discussed, classification behavior 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 might be assumed to 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 sorting behavior would not be practiced. The child who can already sort consistently on one dimension and is becoming aware of multiple class membership presumably needs materials of sufficient complexity to allow practice in ignoring irrelevant dimensions. Materials which vary independently on a number of dimensions should provide him with an opportunity to explore various ways of grouping and classifying objects. Moreover the more advanced child has nothing to learn from the simpler materials and thus is unlikely to practice classification behavior with them. Evidence suggests that there are no sex differences in classification behavior (Denney, 1972).

The more complex materials, furthermore, provide a greater variety of possible combinations and novel patterns and may thus be assumed to be more stimulating. It is likely that the more complex materials will lead to more creative combinations and greater variety of themes.

The following hypotheses will be tested, using pairs of children as the experimental unit. High and low ability is defined on the basis of a pretest of classification ability.

1. Among low ability children, more classification behavior will occur during experimental sessions with simple materials than with complex materials; among high ability children, more classification behavior will occur during sessions with complex materials.
2. For low ability children, greater improvement in classification ability on a posttest will result from sessions with simple materials than with complex; for high ability children, greater improvement will result from sessions with complex materials.
3. Within ability groups, the amount of classification behavior during the observation period will be related to posttest performance in classification ability.
4. For both ability levels, the complex materials will result in more creative combinations and greater variety of themes during the observation period.

In addition to the above hypotheses, the following questions will be investigated. Are there systematic trends in classification behavior over the four sessions? Are there differences between ability groups in the dimensions used as a basis for classification? Do high ability groups make larger groupings? Is verbalization of dimensions and attributes related to amount of classification behavior? Are there differences between the sexes in the themes used in free play?

IV. METHOD

Subjects

The subjects will be three- to six-year-old children drawn from a Los Angeles Day Care Center. They will be selected for the study on the basis of a pretest and matched into pairs on the basis of sex and ability.

Pretest

A pretest of classification ability will be given to select two groups of children with distinct differences in classification ability. The test will involve, first, a brief training session to give the child a clear understanding of the classification task. In the training, the child will be given a demonstration of sorting on the basis of a given dimension and an opportunity to practice sorting with simple stimuli. He will then be shown how to sort the same materials on a different dimension, with appropriate verbal and manipulative assistance.

For the test itself, the child will be given a series of free classification problems with stimuli of increasing difficulty in terms of the number of stimuli, the number of dimensions, and the number of values of each dimension.

Table 1 shows the dimension, values, and number of objects used in each task.

Table 1

Task	1	2	3	4	5
Dimensions*	C,S	C,S	C,S,Si	C,S,Si	C,S,Si
Values of each	2	2	2	2	3
Total no. of objects#	4	8	8	16	18

*C - color; S - shape; Si - size

#The number will be manipulated by doubling items in tasks 2 and 4, and making a selection from all possibilities in task 5.

For each task, the child will be scored separately on his ability (1) to make a correct initial sort and (2) to shift criterion and make a second correct sort. Any child who fails to make an initial sort on two consecutive tasks will not be given additional problems. Each child's final score will be in two parts: number of correct initial sort, and number of correct second sorts. (See attached sample score sheet from pilot studies.)

The test data will be examined to select two groups: (1) those with rudimentary classification ability, who cannot consistently make an initial sort; and those (2) who can consistently make an initial sort and can under some, but not all, conditions shift criteria and reclassify on a new dimension. Pilot data suggests that the first group will comprise children between 3 and 4, and the second group, children between 4-1/2 and 6, although this varies with the particular population used. Children who cannot be classified in either group, that is, who are too low in ability, or who fall between the two groups, or are too high, will not participate. Exact scoring and selection procedures may be modified on the basis of pretest data.

Materials

The materials consist of two sets of wooden blocks specifically designed to provide novel and interesting manipulative possibilities for young children. The blocks vary in shape, color, texture, and thickness, with three values of each. The shapes are three abstract shapes with three, four, and five edges, respectively. The edges are curved, some concave and some convex, so that they can be fitted together in various combinations. The colors are red, yellow, and green. The textures are plain, grooved, and pitted. The thicknesses represented are 1/2 inch, 13/16 inch, and 1-1/16 inch. In Set A, the dimensions all vary dependently, so that all the blocks of a given shape are the same color, texture, and thickness. There are 18 blocks of each value, for a total of 54. In Set B, the dimensions vary independently, so that no two blocks are exactly alike. Of the 81 possible combinations, a selection of 54 is used to give a manageable number and still provide a large number of possibilities for manipulative play.

Procedure

In order to maintain a situation as close as possible to natural play in the classroom, children will be exposed to the experimental materials in pairs. Children will be matched on ability (on the basis of the pretest), on sex, and on compatibility, that is, on the classroom teacher's opinion that the two children do play together. The pairs will then be randomly assigned to either Set A materials or Set B materials.

The children will be invited to come in pairs into an unused room adjoining the classroom and told simply that they will have a chance to play with some new toys. The two children will be seated on opposite sides of a small table with a two-inch high divider across the table between them. A subset of either A or B materials will be randomly arranged on the table in front of each child. For this purpose, each set of materials will be divided in half. Set A materials will be divided into two identical subsets of 27 blocks each; Set B materials will be divided into two matched subsets of 27 blocks, each having the same number of blocks of each attribute. Children will be told that they can do anything they want with the toys and asked to let the experimenter know if they wish to return to the classroom. Each session will last a maximum of 10 minutes, but children can leave sooner if they express the wish to do so. In pilot studies, children have generally played for 15 to 25 minutes, and rarely less than 10 minutes.

Children will be invited to participate a second time each day if they decline a first invitation, but they will not be urged. In pilot studies, children have generally been eager to come with the experimenter. Children who are initially reluctant typically want a turn after they see other children participating. Pairs of children will be invited to participate on successive days until they have had four sessions.

Observation and recording of behavior

An observer will be seated unobtrusively in one corner of the room, behind a one-way screen if possible. Some, if not all, of the sessions will be videotaped, to allow for observer reliability checks.

Pilot studies indicate that young children respond to the experimental materials readily and engage spontaneously in a variety of manipulative activities, including constructions, design and fantasy play. Within the context of their play, children to varying degrees utilize and verbalize about the various dimensions and attributes.

Behavior will be recorded separately for each member of the pair, using a check sheet. Both manipulative and verbal behavior will be recorded. Manipulative behavior will be recorded in terms of groupings of blocks, considering both the type and size of the grouping. From pilot studies, it seems feasible to consider all groupings as classification, design, or random. Classificatory groupings will be defined as sets of four or more blocks in physical proximity that share one attribute, with no intervening, contrasting blocks. For Set B materials only, notation will be made of the dimension used as a basis of classification. Design or creative groupings will be defined as sets of four or more blocks that contrast or alternate two or more attributes (e.g., a row of alternating colors; a regular pattern using two different shapes). Random groupings will be sets of blocks with no discernible regularity. Some groupings may fall in two categories; for example, a design using alternating colors but all of one shape would be checked both as a design and as classification by shape. Each category will be further broken down in terms of the size of the groupings, for example, 4-8 blocks, 9-18, or all 27. Videotapes of pilot sessions will be used to define more precisely the behavioral categories and decide on the most appropriate size categories.

Two types of verbal behavior will be recorded: verbalization of dimensions and attributes and nouns used to describe objects made with the blocks. Verbal behavior will be recorded on the check sheet during observation, but videotapes or tape recordings will be made to allow for reliability tests. Verbalization of a dimension will be recorded by means of a check in the appropriate column; verbalization of an attribute will be recorded with a key symbol (e.g. r for red) in the appropriate dimension column (e.g. color). Nouns used to describe objects made with the blocks will be recorded verbatim on first occurrence by either member of the pair. Subsequently, these will be grouped into themes (such as animals, vehicles, domestic articles) and a frequency count made of the items in each group.

Behavior will be observed continuously and recorded in separate one minute blocks. Any of the defined behaviors that occur within a one minute interval will be given one check as they occur, but only one in any one interval. If a child begins with a four-element group and then adds five more blocks of the same type, he will be given checks for both the smaller and the larger groupings. If a grouping is made and then left aside for more than a minute, it will not be given a check in the second time interval; however, if a child continues to work on a grouping over more than a minute without changing its category, he will be given a check in the second time interval.

Posttest

All subjects will be given a posttest, a transfer test, and a test of classification ability similar to the pretest. The posttest will consist of classification tasks using Set A and Set B materials. The low ability children will be given both sets; the high ability children, who have already demonstrated the ability to classify on one dimension, will be given only set B. For Set A materials, the child will be shown 27 blocks (one subset) and asked to put together the blocks that are alike. For Set B materials, he will be given a similar task. He will then be asked to put together the blocks in a different way. If successful, he will be asked for a third sort. Again, if successful, he will be asked for a fourth sort.

Each child will also be given a transfer test, consisting a a new set of 27 blocks which vary on the same four dimensions as the experimental materials, but with different values of each. The child will be asked to classify them and then reclassify them in a different way, up to four different sorts.

Finally, the child will be given a test of classification ability similar to the pretest, but with different values of each dimension.

Analysis of results

Results will consist of (1) observational data from the experimental sessions, and (2) posttest scores.

1. Total scores will be obtained for each pair of children across all four sessions by totaling all occurrences of behavior in each of the following categories:

a. classification groupings (combining size and dimension subcategories);

b. design groupings (combining size subcategories);

c. random groupings (combining size subcategories);

d. verbalization of dimensions and attributes.

In addition, all the themes mentioned will be grouped into broad categories.

A frequency count will be made of themes in each category mentioned by each pair of children, and the variety of themes, that is, the number of different categories used, will be noted. Occurrence of unusual themes, defined in terms of low frequency among all children, will also be recorded.

2. Posttest data will consist of scores on the three final measures of classification ability described above.

Data will be analyzed as follows in terms of the hypotheses:

Hypothesis 1: Using total classification behavior, a 2 x 2 x 2 analysis of variance, using materials, ability level, and sex as the three factors, will be computed. This analysis will be used to look at the effects of materials and ability on classification behavior.

Hypothesis 2: Using posttest data, a 2 x 2 x 2 analysis of variance, as above, will be computed to examine the effects of initial ability and materials on posttest measures of classification ability.

Hypothesis 3: Correlations will be computed between total classification scores and posttest scores within each ability group.

Hypothesis 4: Separate analyses will be made using the total design behavior and a measure of unusualness and variety of themes.

In order to investigate the additional questions posed, the following analyses may be carried out: multivariate analysis for trends in classification behavior over the four sessions; analysis of variance for each of the four dimensions used as a basis of classification with Set B materials; analysis of variance using total scores for size of groupings across all categories of behavior; correlation ot amount of verbalization with total classification behavior; and *t* test for differences in frequency of various themes between boys and girls.

Sample Scoring Sheet: Pretest

Name	Age	Sort	Task 1 2x2 C&S 4 items	Task 2 2x2 P&S 8 items	Task 3 3x2 C,S,P 8 items	Task 4 3x3 S,Si,C 9 items	Total Sorts 1st	Total Sorts 2&3	Total Sorts ( )	Group Assign- ment
Michele	3	1	S	(S)	-		1			
		2	(C)						(1)	Lo
		3								
Sally	3-3/4	1	C	(S)	(C)	-	1		(2)	
		2	(S)	-	-	-			(1)	Lo
		3			-					
Gail	4	1	C	S	Si	(Si)	3		(1)	
		2	(S)	(P)	(C)	S		1	(3)	Reject
		3			(P)	(C)			(2)	
Jarrid	4	1	C	P	C	S	4			
		2	-	(S)	(P)	(C)			(3)	Lo
		3			-	-				
Guy	4	1	C	S	-	-	2			
		2	-	(P)	-	-			(1)	Lo
		3								
Lina	4	1	C	S	-	-	2			
		2	-	(P)	-	-			(1)	Lo
		3								
Leslie	4-3/4	1	S	S	S	(C)	3		(1)	
		2	(C)	-	-	-			(1)	Lo
		3				-				
Lisa	5-1/2	1	C	P	Si	S	4			
		2	S	S	C	C(1 error)		4		Reject
		3			P	Si		2		
Nancy	6	1	C	P	P	S	3			
		2	(S)	(S)	(C)	(C)			(4)	Hi
		3			(Si)	-			(1)	
Sherry	6-1/2	1	C	P	P	C	4			
		2	S	(Variation)	C	S		3		Reject
		3			(Variation)	(Si)			(1)	
Elliot	5	1	C	P	C	S	4			
		2	S	S	(P)	(C)		2	(2)	Hi
		3			(Si)	(Si,			(2)	

<u>Key</u>: C: Color; S: Shape; P: Pattern; Si: Size; ( ): Prompted, e.g. "You could sort by size"

INTERIM REPORT

The work described in the dissertation proposal was completed as scheduled. However the encouraging but non-definitive results indicated the need for replicating the experiment with some modifications.

As had been suggested by committee members, it was not feasible to use pairs as the experimental unit. Problems of scoring the behaviors and interpreting the interactions between two children playing together resulted in the decision to work with just one child at a time. Because of limitations on the availability of subjects, plus attrition, the study was run with 24 subjects instead of the 32 planned. A number of interesting results were obtained:

1. The hypothesized interaction of ability (as measured by the pretest) and treatment (simple vs. complex blocks) was in the predicted direction on both posttest measures of free classification. It approached significance on one of the subtests ($p = .056$). Figure 1 shows the means for each group on each of the two subtests and on the total posttest.

2. When age was used as the independent variable instead of ability, the interaction was again consistently in the predicted direction. It was found to be significant on one subtest of the posttest ($p < .05$), and it bordered on significance ($p = .054$) on the total posttest (see Figure 2).

3. The system developed for recording and scoring the observed play behavior was found to be highly reliable. For all behaviors except those of very infrequent occurence, reliabilities between the two observers ranged from .77 to .99. There was considerable consistency of individual behavior patterns across the three play sessions.

4. In the observed play situations, the older children exhibited significantly more regular behavior (defined as use of organized patterns such as symmetry, but not including classification). The expected differences in classification behavior were not found. There were no differences on any measure of observed behavior between the simple and the complex blocks, and no interaction effects with age or ability.

Plans for revised study

The above results have been sufficiently encouraging to warrant replicating the study, with the following modifications.

1. Age will be used instead of ability as the independent variable. Subjects will be selected from two distinct age groups: 3-4 years and 5-6 years. In the first study, the pretest, while found to be reasonably reliable, apparently tapped too narrow a range of the child's ability to produce differences in play behavior. Chronological age appears to provide a broader and more general estimate of ability. When age was used to reanalyze the data from the first study, a dichotomy was made to obtain two equal groups; there was thus no age gap between the groups and only a one and a half year mean difference in age between them. The new procedure will correct these shortcomings.

2. The blocks will be redesigned in an attempt to emphasize the differences between the simple and the complex blocks. Analysis of the observed play behavior shows that with the complex blocks shape was by far the most used (apparently the most salient) dimension, while color and texture were largely ignored. Thus, although the complex blocks had three dimensions which varied independently, the dimensions other than shape were not attended to and so play with the blocks did not differ appreciably from play with the simple blocks, in which the dimensions were not independent. Blocks redesigned to make the three dimensions equally salient should emphasize the differences between the two sets and thus elicit different behaviors.

3. In addition to the blocks, two new sets of materials will be introduced to provide a greater opportunity for each child to interact with varied examples of dependent and independent dimensions. Instead of three sessions with one set of materials, as in the first study, each child will have one session with each of three sets of materials. In the first study, there were no interesting trends across the three play sessions; children typically adopted one style of interaction with the blocks and repeated this on each occasion. It seems likely that variety of materials will provide more opportunity for exploring varied types of classification than did repeated experience with one set of materials. The new materials will consist of sets of small pictures which vary dependently

or independently on three dimensions; for example, flowers of differing types, colors, and sizes. The child will be given the pictures with the suggestion that he place them on a sheet identified, in the case of flowers, as a garden. Thus he will have the opportunity to react to the various dimensions in the way he arranges them. His arrangement can be scored in the same way as play with the blocks, in terms of classification and regularity. The sessions with the new materials will be considerably shorter than the ten-minute sessions with the blocks; it is anticipated that all three sets of materials can be presented in sequence on one day.

With the changes described above, the second study can be carried out in less time than the first. No pretest will be given, and each child will be seen only twice, once for play with the three sets of materials and once for the posttest. The attempt will be made to obtain 32 children as subjects. The same hypotheses as stated in the proposal will be tested.

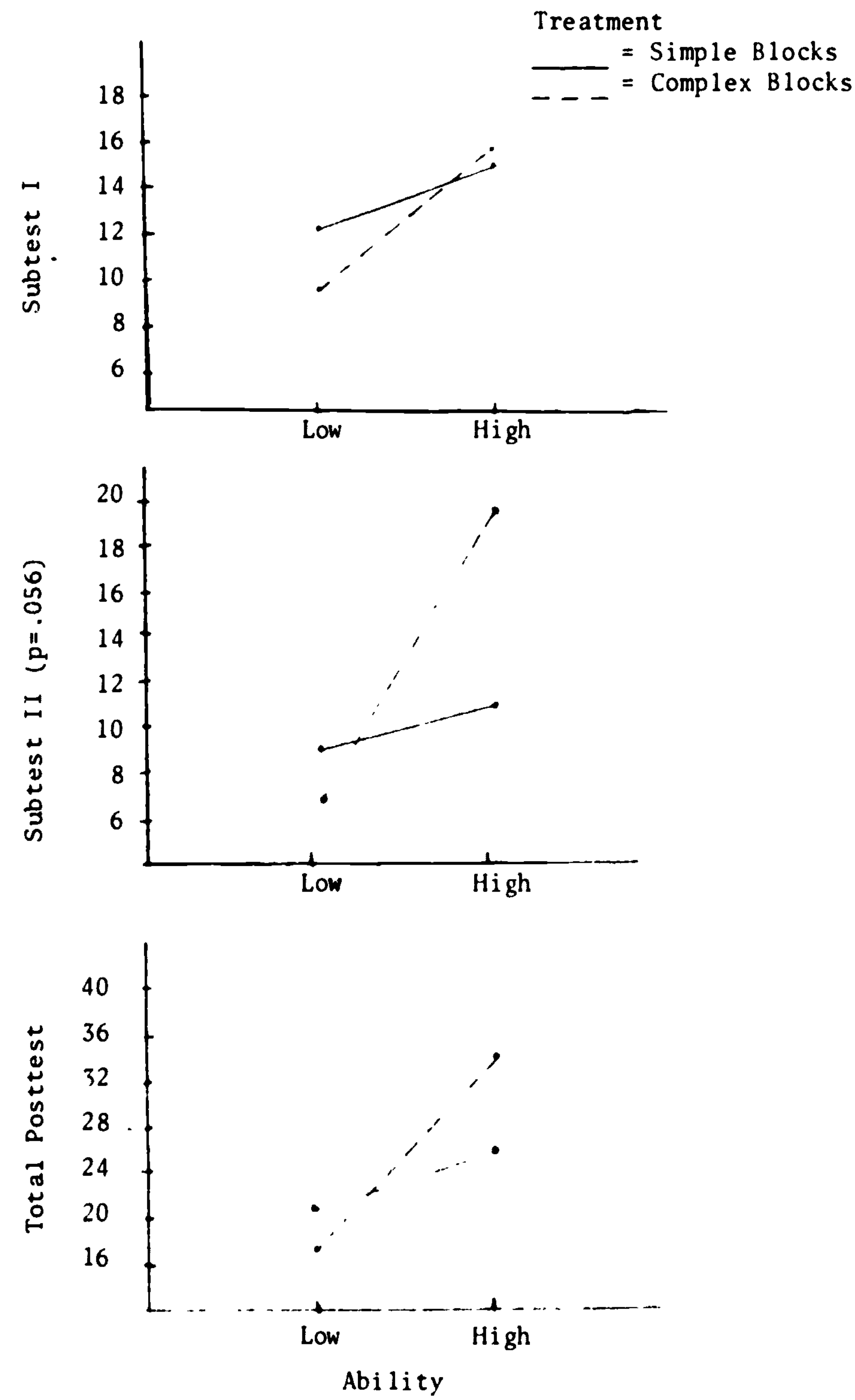

Figure 1. Interaction of Ability and Treatment on Posttest Scores

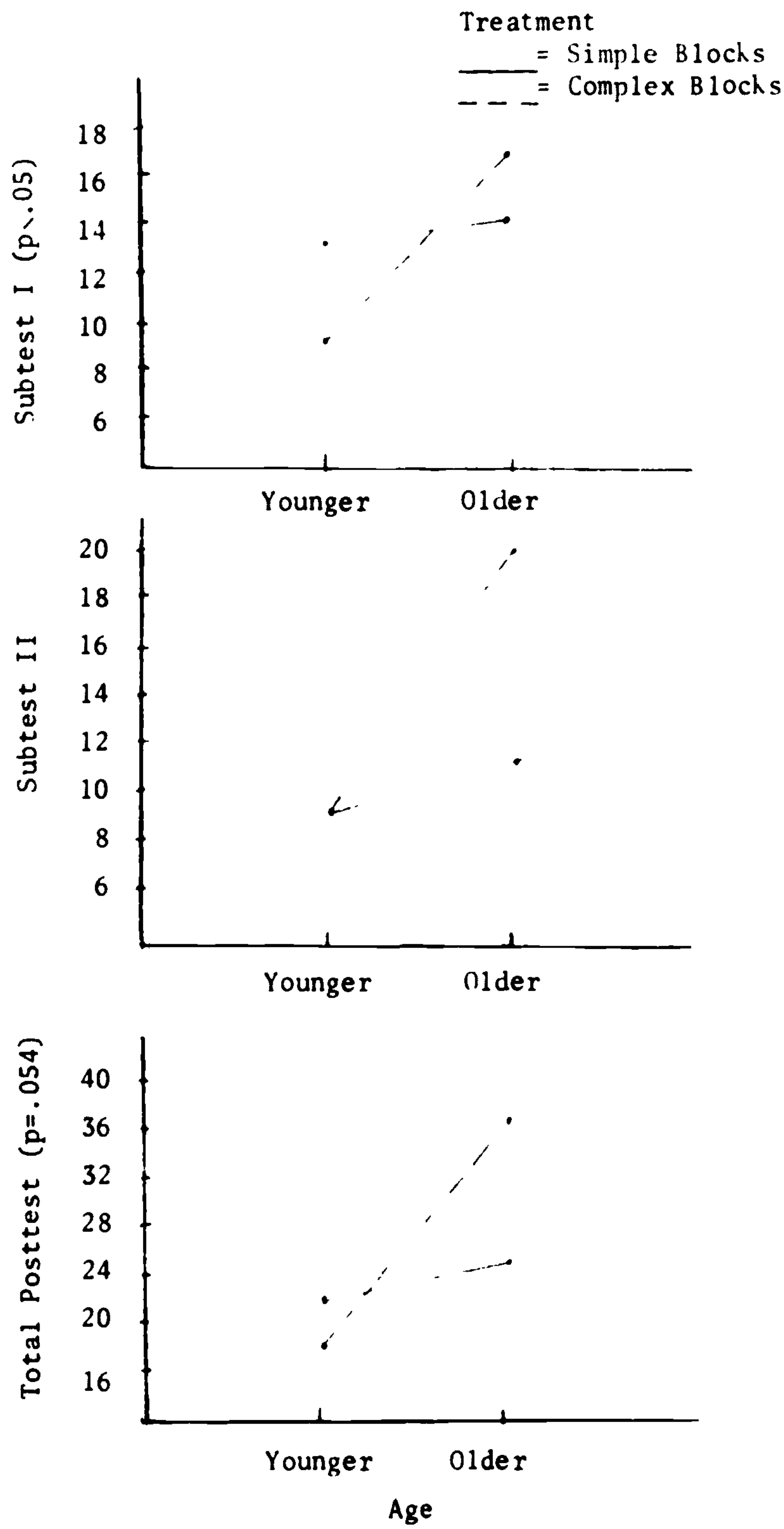

Figure 2. Interaction of Age and Treatment on Posttest Scores