CONCEPT LEARNING IN FOUR-, FIVE-, SIX-, AND EIGHT-YEAR-OLDS USING THE CONCEPT OF ALIVE

by

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Abstract

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by

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The development of children's concept of alive was first examined in a systematic manner by Piaget. As a result of his work with children's concepts of reality and causality, Piaget proposed five major forms of precausal thought which pervade all of the child's notions of reality. One of these, animism, is concerned with the child's concept of what is alive. Piaget defines animistic thinking as a belief that inanimate objects in one's environment are alive or endowed with will. Piaget's study of the development of animistic thinking in children led to the description of four distinctive stages of animistic thought based on the criteria used to classify objects as alive. Children at the first stage attribute life to anything which is useful or in good condition. At the second stage, life is attributed only to things which move, but no distinction is made between spontaneous and imparted movement. During the third stage, only things which move spontaneously are said to be alive. Finally, at the fourth or adult stage, the concept of alive is limited to things which are alive in the biological sense of the

term--animals and plants.

The majority of work done following the publication of Piaget's findings supported his stages at least to the extent of showing that they could be used to classify most of the data. A major methodological difficulty with this body of research, however, as well as with Piaget's original work in the area, is that it relied entirely on an interview method to study animistic thinking in children. Young children's ability to understand and use language varies greatly and this makes questionable the validity of their verbal reports in such studies.

In hopes of avoiding the limitations associated with children's verbal reports, the present study explored children's concept of alive using a verbal concept discrimination task which has been used successfully in the study of simple concepts. This task requires only that a child indicate a choice between two stimuli. A standardized animism questionnaire was also used for purposes of comparison to existing studies.

Three verbal discrimination tasks based on the last three stages of animistic thinking proposed by Piaget and three control tasks, one corresponding to each experimental task, were presented to 24 children in each of four age groups, four-, five-, six-, and eight-year-olds. Half of the subjects were given the animism questionnaire before the discrimination tasks and half had it following the tasks.

Age, condition (experimental or control), position of the animism questionnaire and concept task level were highly significant

factors in determining performance on the discrimination tasks. Ability to correctly explain what had been learned on the tasks was age-related. Many eight-year-olds could do this but only two subjects from the three younger groups could correctly describe the basis of their responding.

Subjects' responses on the animism questionnaire showed a lack of internal consistency. Responses reflecting several stages of animism were found within most individual protocols. Stage assignment based on mean and modal responses led to a classification of Stage IV, the adult stage, for the majority of subjects at each age. Age trends related to the use of scientific criteria and the categories of animistic responses were found on the animism questionnaire. The present data demonstrated no relationship between performance on the discrimination tasks and performance on the animism questionnaire at any of the four age levels.

The data from the verbal discrimination tasks support the stages of animism proposed by Piaget. The children did use the levels of the concept which Piaget described and this differed systematically with age. Eight-year-olds did best on the task representing Piaget's Stage IV, the adult level. Six-year-olds were transitional and did equally well on the two tasks which represented Stages III and IV. Five-year-olds' best performance was on the task representing Stage III, and four-year-olds' performance showed that they were transitional between Stages II and III. Only half of the subjects in each of the four- and five-year-old groups reached criterion for concept

learning on the task representing the adult level stage. The discrimination task data also included some evidence of internal structuring within the three concept levels studied. The three categories of stimuli within each concept level task were differentially learned.

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CHAPTER I

INTRODUCTION

The development of children's ability to use concepts has been the subject of psychological research for some time. Concept formation and concept identification, the two general paradigms for the study of concepts, require subjects to learn to make the same response to each member of a particular class of stimuli and not to stimuli which are not members of that class. Concept formation describes the process involved in the initial learning of a new concept. Concept identification is the recognition of a concept already known.

Much of the research reported in the psychological literature has been designed to answer very basic questions relating to concept acquisition and use (Bourne, 1967; Klinger & Palermo, 1967; Mandler, 1967; Shep & Zeaman, 1966; Trabasso & Bower, 1968). The concepts employed have been simple, often artificial ones, whose attributes are operationally discrete, and are thus easy to specify and control; for example, form, color, and number. While such concepts may be the best vehicles for studying some processes, an investigation of complex concepts, with greater relevance to molar levels of cognitive functioning in the real world, is important for a complete understanding of concept development and use.

Research dealing with complex concepts has been on going in a number of areas. Developmentalists have been interested in the for-

mation and use of complex concepts particularly as they relate to changes which occur in general cognitive structure with age. Piaget and the many others who have followed in his tradition have done extensive work in this area.

In other fields, anthropologists and ethnographers have dealt with conceptual behavior as it occurs in the daily interactions of people representing a variety of different cultures (Berlin et al., 1966; Frake, 1964, 1969; Herskovitz, 1962; Horton, 1967). As Tyler (1969) pointed out, an understanding of the cognitive organization of a people is an integral part of the study of a culture; a culture is not usefully described by mere lists of arbitrarily chosen anatomical traits and institutions, but must also include a description of the cognitive organization of material phenomena.

The present study investigated a fairly complex concept, the concept of alive, in children four, five, six, and eight years of age. A number of researchers have studied the development of this concept but because of methodological difficulties, primarily related to the use of verbal questionnaire techniques with young children, the results have been somewhat ambiguous. The present study employed a verbal-concept discrimination task of the type used by Cole, Gay, Glick, and Sharp (1971), and examined the concept of alive as it is used by young children. In addition, a modified version of the standardized animism questionnaire developed by Russell and Dennis (1939) was administered.

Past Research on the Child's Concept of Alive

The child's concept of alive has been a subject of interest for many years. The early baby biographies contained frequent references to what has come to be called animistic thinking or animistic responding. Piaget (1929) defines animistic thinking as "the belief that inanimate objects in one's environment are alive or endowed with will." Animistic thinking, and thus animistic responding, in children is believed by many investigators to result from their attempts to understand the unknown. In his observations on animism, Tiedemann (1787) pointed out that one usually comprehends an unknown thing through one that is known, and for a child, his own characteristics and reactions are the most familiar to him. These motives and behaviors are therefore the ones which he initially imputes to things around him.

Piaget (1929, 1933) was the first to study the child's concept of alive in a systematic manner. As a result of his analysis of the child's concepts of reality and causality, Piaget (1930) proposed five major forms of precausal thinking which tend to pervade all of the child's notions of reality. One of these, animism, is concerned with the child's concept of what is alive. Piaget suggested that the child's concept of alive is initially quite diffuse and that at early ages, he attributes life to most of the objects around him.

Piaget (1929) indicated that animism results from the child's inability to differentiate between conscious action and mechanical movement. The child tends to assimilate the activity of things into

his own activity (Piaget, 1967). Piaget suggested that the child initially conceives of life as a continuum on which everything possesses some degree of activity and awareness. In time, the child picks out what Piaget (1929) calls "centers of force" within this continuum the activity of which is more spontaneous than the rest. The bases upon which the child selects these centers, in the order of their occurrence in development, are: activity in general, movement in general, and spontaneous movement as opposed to imparted movement.

As a result of Piaget's work on animism, he proposed that children's conceptions of alive be grouped into four distinctive stages based on the criteria used to classify objects as alive. Children at the first stage attribute life to anything which is useful or in good condition. At the second stage, life is attributed only to things which move, but no distinction is made between spontaneous and imparted movement. During the third stage, only things which move spontaneously are said to be alive. Finally, at the fourth stage, the concept of alive is limited to things which are alive in the biological sense of the term--plants and animals.

These stages have been used by a number of other investigators including Russell (1940), Bruce (1941), Havighurst and Neugarten (1955), and Laurendeau and Pinard (1962), and have been found to be useful in classifying the majority of their subjects' responses. The age range suggested for the stages by Piaget (Stage I, 4-6 years; Stage II, 6-7 years; Stage III, 8-10 years; and Stage IV, 11 years

and older), however, have not been reliably replicated. Rather, the age ranges associated with the four stages varied according to the sample used, and in most instances, a few children from each age sampled could be classified into each of the stages. However, the order in which Piaget theorized that individuals pass through the stages does seem to hold in most cases. Not surprisingly, studies of animistic responding by children have shown a decrease in the number of animistic responses given with an increase in age.

This trend is somewhat contradicted by the results of studies which use adult subjects. In work with college students, Dennis (1953) and others (Bell, 1954; Crannell, 1954; Simmons & Goss, 1957) have found that adults give a relatively large number of animistic responses. The rationale for their responses is, on the whole, more sophisticated than that given by younger subjects, but nevertheless according to a strict biological definition, the responses are incorrect. There is a question, however, as to whether animistic responding in adults and children can be interpreted in the same ways. Adults invoke subtle distinctions in their use of the word alive. It is often equated with real or existing. And their language is filled with anthropomorphic terms that are not accompanied by a belief in anthropomorphism. Adult literature contains animistic references which are not interpreted literally by readers. An important factor to be considered in evaluating animistic responding in adults is the influence of the experimental situation. Questionnaires containing only examples of inanimate objects, or rather tricky items such as

a seed or an atom, or which are presented as part of an academic examination probably lead subjects to give animistic responses which do not represent true animistic thinking.

The first serious challenge to Piaget's findings regarding children's concepts of alive came from the work of Huang and Lee (1943, 1945). In their sample of Chinese children, only a small number of animistic responses were given, and these did not conform to Piaget's stages. Huang and Lee pointed out that most of the children gave naturalistic, though often rather naive, responses to their animism questionnaire. They argued against the notion of precausal thought in general, suggesting that none of the forms of precausal thought proposed by Piaget, including animism, is typical of the thinking of young children. Huang and Lee concluded that the few animistic responses which did occur in their data were most likely an artifact of the questioning technique and not indicative of precausal thinking. They argued, as others have, that the validity of using a questionnaire method with young children is suspect. Under close questioning, the child often becomes confused and is very easily led.

Huang and Lee offered a different explanation for what Piaget and others have termed animistic thinking. They suggested that ideas develop by a process of differentiation. At first the child is in a neutral state which is characterized by a lack of any knowledge of the concept of alive. The animate-inanimate dichotomy then gradually develops and becomes clearer with experience. The child, of course, makes errors in the process of learning this dichotomy. The more

characteristics which an object has in common with those of living things, the more likely the child is to confuse it with them. Huang and Lee hold that this represents an error in judgment rather than animistic thinking. They compare it to the behavior of a bird fleeing from a scarecrow. The responses in both cases depend on the characteristics which the inanimate object has in common with living things. Assuming that older children and adults have more precise knowledge about the characteristics of living things, this theory predicts that they will give fewer animistic responses than will younger children. The theory thus represents the differences between adult thought and child thought as primarily quantitative rather than qualitative in nature and resulting from lack of experience on the part of the child.

Huang and Lee's theory of animism is in many ways similar to Clark's (1973) more recently proposed semantic feature theory. She presents data showing that in the learning of the adult meanings of words, children initially overextend the meanings of words based on perceptual information. The word apple, for example, may also be applied a ball, an orange or a paperweight. As language acquisition progresses, complexes of features are used to narrow word meanings to the adult domain.

The simplicity of the Huang-Lee theory of animism has a certain appeal but the data currently available, even that gathered by Huang and Lee, give it only partial support. Huang and Lee asked their subjects the question, "Is _____ alive?" This form of the question was

also used by Piaget (1930) and a number of other investigators (Bruce, 1941; Klingensmith, 1953; Laurendeau & Pinard, 1962; Russell & Dennis, 1939; Safier, 1964). In addition to this question, Huang and Lee asked, "Does _____ have life?" In a re-examination of the Huang and Lee data, Strauss (1951) found that their data from the question, "Is _____ alive?" showed that about 50 percent of the subjects gave animistic responses. This percentage is comparable to that found by most other investigators. There were considerably fewer (9.3%) animistic responses to the other question ("Does _____ have life?") and Huang and Lee chose to base their conclusions on the data from that question. Perhaps they felt that the responses to that question more adequately reflected subjects' thinking processes, but since they did not discuss the point, it is impossible to know.

Blank's (1975) work on the effect which the form of the question has on young children's responses emphasized the importance of this issue. She found that "how" and "why" questions were interpreted differently by children and adults. While adults in an experimental setting typically respond to these questions as requests for lists of characteristics, children take "how" questions as queries about capacities and "why" questions as requests for motives. These are the usual meanings of the words as children encounter them, and unlike adults, children do not seem to perceive the different interpretation intended by the experimenter. Blank presented data showing that children could produce the lists of characteristics so frequently sought in experimental tasks if the questions were phrased

in terms of "what" and "which."

Huang and Lee's data may also reflect a language problem. The questions were presented in Chinese, and it could be that the two versions of the question have different connotations in Chinese than in English or French. Klingberg (1957) used these two questions with Swedish children and got results similar to those of Huang and Lee (1945). He concluded that living may be associated with other more concrete concepts such as moving, while life is a more abstract notion and that this might account for the differences in the number of animistic responses to the two questions.

Huang and Lee (1945) also claim that even when their subjects gave animistic responses, 69 percent did not assign anthropomorphic characteristics to the objects. But, as Strauss (1951) noted, this datum resulted from combining the results from the younger and the older subjects. Ninety percent of the older subjects (6-8½ years) did not attribute anthropomorphic traits to objects which they said were alive, while only 59 percent of the younger subjects (3-5½ years) failed to do so.

Methodological Problems of Past Research

The traditional method of studying animistic thinking has been to ask a direct question as to whether an item from a selected list is alive or not, and then to explore with further questions the rationale for each of the categorizations. This is certainly true of Piaget's "clinical method" and the more standardized method developed by Russell and Dennis (1939).

Piaget (1929) asked each child a different series of questions depending upon what he felt was appropriate in the particular situation. Many critics have objected to this lack of standardization in his procedure, and have noted that some of Piaget's questions may have suggested answers to children. He asked, for example, "Who put the snow there?", which implies a personal agent, rather than, "How did the snow get there?" (Looft & Bartz, 1969).

Russell and Dennis (1939) sought to improve upon this procedure by developing a series of questions to be presented in a standardized manner under controlled conditions. They questioned subjects about 20 objects using the same initial instructions and a set of three questions. Responses were classified using standardized directions based on Piaget's stages of animistic thinking.

While much interesting and useful data have been gathered using the interview method, its total reliance on the child's verbal reports results in a number of limitations. Children, especially young children, are often unable to find words to express themselves clearly. Verbal responses are often different as the form of the question is changed in minor ways. The variability introduced as a result of the child's inability to understand the questions put to him is probably not comparable to that of an adult. And children may be especially prone to answer in terms of what they believe the experimenter expects.

In a review of the animism literature, Looft and Bartz (1969) noted the ambiguities which have resulted from heavy dependence on

the questionnaire and interview methods and mentioned a number of alternative approaches which might be fruitfully used in future research on animism. One of their suggestions was that the methods which have traditionally been used to study lower level concepts be employed in the study of children's concept of alive. The most recent work in the area has, in fact, done this and with promising results.

Looft (1973, 1974) used sorting tasks to study animism. He examined first graders' understanding of the attributes of alive and found that even children who made no sorting errors indicating animism did not show evidence of fully understanding the implications of the concept (i.e., respiration, need for nutriment, reproduction) when questioned. Faw and Wingard (1977) employed sorting tasks with three, four and eight year olds and found that only the three year olds failed to sort on the basis of the concept of alive. Turgeon and Hill (1977) used sorting with a wider age range and found spontaneous use of the concept of alive only by eighteen year olds.

A probability model for assessing animism was proposed by Smeets (1973). He stressed the importance of taking into account the inanimate responses given to animate stimuli as well as the animistic responses. Berzonsky (1973) also examined responses to animate and inanimate stimuli in his factor analysis of the concept. He reported an inverse relationship between six year old's ability to identify inanimate and animate objects correctly. He saw this as consistent with Piaget's criteria for children functioning at Stages II or III

(general or spontaneous movement, respectively, as criteria).

Looft and Charles (1969) and Berzonsky, Ondrako and Williams (1977) used instructional films in attempts to modify the life concepts of children ages seven to nine years. Both studies concluded that the films had been effective in changing the children's concept levels. Berzonsky et al. further reported that the degree of change produced by the film was related to children's temperaments, reflective or impulsive.

Margand (1977) utilized three tasks, sentence completion, oddity, and sorting tasks, to investigate the role of perceptual and semantic features in children's use of the concept of alive. Her data showed that children spontaneously use the scientific criteria for life when contextual cues are evident but when they are not, concrete, perceptual features are more likely to be used. She also found that when the concept was provided (in a directed sort) most of the six and seven year olds and 75 percent of the four and five year olds used the concept correctly.

The present study employed three verbal discrimination tasks and a modified form of the standardized animism questionnaire to study the concept of alive as it is used by children four to eight years of age. In each discrimination task, the child was told that the examiner would name a series of pairs of things and that for each pair, he/she was to guess which one of the two "the examiner was thinking of." The examiner then told the child if he/she was right or wrong. Sets of eight pairs of stimuli were each repeated until

the subject was correct on all eight pairs consecutively. The sets in the three tasks contained conceptually orderable material related to three of the levels of the concept of alive proposed by Piaget. Correct responding within a set could be based on the designated concept, or on rote learning. The criterion for concept learning was responding correctly to all eight pairs in a new set the first time it was presented. As a control, the subjects were expected to learn four sets of eight pairs in which the correct item was randomly determined.

On the Animism Questionnaire, subjects were presented with the names of 24 objects and questioned as to whether he/she believed each one was alive or not, and why. Further "clinical" pursuit of reasons did not occur. By comparing and contrasting subjects' performances on the concept discrimination tasks and on the animism questionnaire, a number of questions relating to the child's concept of alive were examined.

Experimental Questions

The first question considered was whether the concepts postulated by Piaget as stages in the development of an adult concept of alive were relevant ones for young children. Are they a part of the interpretive framework children use spontaneously to deal with ordered segments of the world? This question was approached experimentally by looking at subjects' performance on three concept discrimination tasks. One task presented sets of stimulus pairs in which the correct choice was the living thing as opposed to the nonliving

thing, as defined by the adult level of the concept. In two other tasks, the correct choices were objects defined as alive by children functioning at Piaget's Stage II (i.e., general movement) and Stage III (i.e., spontaneous movement).

The questions asked in examining the data from the above tasks were these. With reference to the first task, how quickly did the children in each of the age groups sampled use the adult level of the concept of alive to organize the stimuli when they were asked to learn this classification scheme in which the concept was relevant? Pilot data (Masters, 1970) suggest that children of these ages do use the concept in this situation.

The role of those concepts of alive postulated by Piaget as characteristic of younger children in children's cognitive functioning was examined by comparing the data from the adult level task with that from the tasks representing earlier levels. How did the learning rates for the three tasks compare for the four age groups? Were children unable to make use of the adult level of the concept but able to use one of the child-level concepts? At which of these two child-levels did children in these age groups perform best? If children were able to use both an adult level and a child level of the concept, was one more readily used than the other? Were children able to correctly verbalize the concepts they used in the three discrimination tasks?

A second general question dealt with the relationship between the two kinds of measures used. How did children's performance on

the questionnaire compare to their performance on the discrimination tasks? Since the stimuli for the discrimination tasks were selected on the basis of Piaget's stages of animistic thinking, a relationship between task performance and questionnaire performance was expected. For example, a child who was classified as functioning at Stage III on the basis of his/her questionnaire responses would be expected to perform best on the task in which the discrimination is based on a Stage III concept of alive.

Summary and Hypotheses

This study examined the concept of alive as it is used by children aged four, five, six, and eight years. Three verbal discrimination tasks were used, in addition to the traditional animism questionnaire. Two main questions were considered. The first was the relevance of the concept of alive for children in this age range. Did children use the adult level of the concept? Was there a relationship between their use of the child-levels of the concept, as originally described by Piaget (1929), and their use of the adult level of the concept?

The second question was a methodological one dealing with the relationship between the children's performance on the animism questionnaire and their performance on the concept discrimination tasks. At issue was whether the verbal interview method of the questionnaire and the concept discrimination procedure produced comparable data. Did the children's performance on the concept discrimination task reflect his level of responding on the questionnaire?

The following predictions were made:

1. All children will be able to use the adult level of the concept to solve the verbal discrimination task. The four and five year olds may not be able to verbalize their solutions, but it is expected that the older children will be able to explain the basis of their choices.
2. The verbal discrimination task which corresponds to the stage at which a child is functioning as reflected in his performance on the questionnaire will be learned faster than the other discrimination tasks.

CHAPTER II

METHOD

Design

Twenty-four subjects representing each of four age groups, four-, five-, six-, and eight-year-olds, were presented with three experimental tasks and three related control tasks. These were verbal discrimination tasks with the concept identification paradigm. The three experimental tasks represented three different concepts, appropriate to three of Piaget's stages of animistic thinking. The Adult Level Task represented Piaget's Stage IV in which the concept of alive is confined to animals and plants. This is referred to as the adult level of the concept. The Intermediate Level Task represented Stage III of the concept in which only things which move spontaneously are said to be alive. The Preschool Level Task represented Stage II of the concept in which life is attributed only to things which move, but no distinction is made between spontaneous and imparted movement. The control tasks contained the same stimulus pairs with the correct member of a pair randomly determined so that there was no underlying concepts which might be used to organize the learning.

Eash subject was also given the Animism Questionnaire (AQ). The stage of animistic thinking at which each subject was functioning, as indicated by the AQ, was compared to his/her performance (learning rates and number of errors) on the three experimental tasks representing the three stages. A comparison of subjects' performance on

each experimental task versus its control task served as a measure of concept use. Performance on the experimental tasks was also compared for subjects grouped by age.

Subjects

Four groups of subjects were used in this study: 24 nursery school children, 24 kindergarteners, 24 first graders, and 24 third graders. One-half of the subjects in each group were girls and one-half were boys. The children in the three older groups were enrolled in two catholic schools in White Plains, New York. The children in the youngest group were enrolled in a nursery school associated with one of the schools. The mean CA's of the groups were as follows: Nursery, four years three months; Kindergarten, five years six months; First Grade, six years six months; and Third Grade, eight years eight months.

The subjects were randomly selected by the examiner from class lists. Two nursery school children who were chosen refused to participate. Fourteen subjects were eliminated because illness, vacations, or academic requirements prevented completion of the three sessions within the 30 day time limit.

Experimental Tasks and Materials

Each of the concept identification tasks contained ten sets of eight pairs of words. Two forms (Forms A & B) of each task were constructed, each containing six sets. Four sets were peculiar to each form and the last two sets were shared by both forms. Because of the

learning set criterion, many subjects did not learn the last two sets. Items in the first four sets were used to construct the control task sets for each concept.

The stimulus words used in all of the tasks are common ones which the children recognized easily. Examples of the sets contained in the three tasks are shown in Table 1. A complete set of the tasks are shown in Appendix A.

Table 1

Sample Item Pairs for the Three Experimental Tasks

Adult Task		Intermediate Task		Preschool Task	
+	-	+	-	+	-
People		People		People	
Farmer	Shoe	Fireman	Sail Boat	Mailman	Swimming Pool
Child	Bell	Teacher	Bottle	Kid	Wall
Animals		Animals		Animals	
Pig	Comb	Alligator	Feather	Hen	Cookie
Bird	Movie	Germ	Brush	Tiger	Lamp
Snake	Jar	Cattle	Typewriter	Imparted Movement	
Plants		Spontaneous Movement		Train	Barn
Rose Bush	Pencil	Rain	Wagon	Moving Van	Sand
Grass	Car	Ocean	Eye Glasses	Balloon	Card
Cherry Tree	Seesaw	Clock	Flag	Tugboat	Umbrella

The Adult Level Task contained pairs of words made up of an animate item and an inanimate item as defined by Piaget's Stage IV, the adult level of the concept. Ten sets of eight pairs each were devised. The animate stimuli for every set were chosen to include three plants (hereafter, Plant Stimuli). In addition, in half of the sets, there were words designating two animals and three people (hereafter, Animal Stimuli & People Stimuli). In the other half of the sets, there were three Animal Stimuli and two People Stimuli. The stimuli were chosen to avoid very similar words within each set. The inanimate stimuli for each of the Adult Level Task sets included one spontaneous movement stimulus according to Piaget's definition of the term (hereafter, Spontaneous Movement Stimuli). In half of the sets, three of the inanimate stimuli were names of items that do not move (hereafter, No Movement Stimuli) and four were items which represent imparted movement (hereafter, Imparted Movement Stimuli). In the other half of the sets, there were four No Movement Stimuli and three Imparted Movement Stimuli.

For the Intermediate Level Task, the pairs of words consisted of items defined as alive by a child functioning at Piaget's Stage III (i.e., things which move spontaneously versus those which have no spontaneous movement), and items defined as not alive by a child at that stage. In the Intermediate Level Task, the Stage III animate stimuli for each of the ten sets included three Spontaneous Movement Stimuli. In addition, in half of the sets there were two People Stimuli and three Animal Stimuli. In the other half of the sets,

there were three People Stimuli and two Animal Stimuli. Plant Stimuli were not included. Although they are animate according to the adult level, they do not conform to the Stage III movement criterion. For each set, the Stage III inanimate stimuli for each set were four No Movement Stimuli and four Imparted Movement Stimuli.

In the Preschool Level Task, each pair consisted of an item defined as alive by a child functioning at Piaget's Stage II (i.e., a thing which moves either spontaneously or because of the action of another agent), and one defined as not alive by a child at Stage II (i.e., a thing which has no movement). The inanimate domain is much more restricted in the Preschool Task than either the Adult or the Intermediate Tasks. Items which move spontaneously but are not alive in the biological sense (i.e., a clock) and items which move only because of the action of another agent (i.e., a seesaw) can be included in the inanimate domain of the Adult Task. The latter items are in the inanimate domain of the Intermediate Task. In the Preschool Task, these items are in the animate domain, leaving only items with no movement at all in the inanimate domain. For each of the ten sets in the Preschool Task, the Stage II animate stimuli were chosen to represent two dissimilar instances of animals and people, and four instances of imparted movement. The Stage II inanimate stimuli for each set were eight No Movement Stimuli.

The pairs of animate and inanimate stimuli for each set in the three experimental tasks were randomly produced. The animate stimuli for the stage represented by the task were always the correct ones.

The position of the correct stimulus, first or second as the pair was presented, was randomly determined using the tables of randomized trial series constructed by Gellerman (1933). The order of the pairs within each set was randomized for each subject and was re-randomized for each trial within a set.

The three control tasks each contained the same eight sets of eight pairs of words as the corresponding experimental tasks (i.e., a control task set contained precisely the same stimulus pairs as its corresponding experimental task set). Reinforcement for the control task sets was randomly determined for one subject and the contingency was reversed for the next subject. The order of the pairs within each set was randomized for each subject and for each trial within a set.

Two forms of each of the control tasks containing four sets each were available for each task (Forms A & B). Each subject was presented with all four sets in a control task. This number was adopted because it is the mean number of sets required for concept learning in the pilot study (Masters, 1970).

Form A of a control task contained sets based on four of the six sets in Form A of the corresponding experimental task. The four sets in Form B of a control task were based on four of the six sets in Form B of the corresponding experimental task. The half of the subjects who received Form A of each experimental task were given Form B of each control task and vice versa.

In addition to the experimental and control task sets, six more sets of eight pairs of words each were used in this study. These

sets each contained four pairs of stimuli in which both members of a pair were positive stimuli as defined by the appropriate stage represented by the experimental tasks. In the other four pairs in each set, both members of each pair were negative stimuli as defined by one of the three stages represented by the experimental tasks. There were two sets for each experimental task. The items in one set were chosen from items in Form A of the experimental task; the items in the other set from Form B. Subjects were presented with the set constructed of items from the opposite form of the experimental task from which they learned. The six sets are shown in Appendix A.

The stimulus pairs in these sets were constructed so that one member of the pair was "more alive" than the other as defined by Piaget's stages of animistic thinking. In the pair, doctor-tiger, for example, doctor represents more living traits than tiger in that he talks and has other human characteristics, in addition to general animal characteristics. In the pair, bus-spoon, bus represents more living traits because it has movement. Since the Preschool Level Task's negative pairs were made up only of stimuli with no movement, they could not be constructed with one "more alive" member.

The pairs in each of these sets were presented in random order for each subject. The subject was not told if his responses were correct or incorrect for these sets. The pairs in these sets were presented only once.

The stimulus pairs in each of the sets for the experimental and control tasks and the six additional unreinforced sets were presented

verbally to the subject by the examiner. There was a two second pause between the stimuli in a pair. Responses were written down by the examiner on a record sheet.

The 24 items for the AQ were listed individually on 3x5 index cards and were presented verbally to the subject. The items are shown in Table 2. The order of presentation was randomized for each subject. Responses were recorded on tape as they occurred and later transcribed.

Table 2

Items for the Animism Questionnaire

People	Animals	Plants
1. Woman	*5. Dog	*9. Tree
2. Boy	*6. Bird	*10. Flower
3. Girl	*7. Bug	*11. Grass
4. Man	8. Butterfly	12. Bush
No Movement	**Imparted Movement**	**Spontaneous Movement**
13. Rock	17. Tricycle	*21. Clouds
*14. Chair	18. Scissors	*22. Wind
*15. Dish	19. Ball	23. Ocean
16. Blocks	20. Wagon	*24. Lightening

*Stimulus used by Russell and Dennis (1939).

Procedure

Twelve orders of presentation were used to counterbalance the

presentation of the three experimental tasks, and to partially counterbalance the presentation of the AQ and the three control tasks. Two subjects at each C A had each order. These are shown in Tables 3a and 3b. Testing required three sessions of approximately 40 minutes each. Successive sessions were separated by at least a week. A maximum of 30 days was allowed to complete all three sessions. This precaution insured that two successive stages of development in any child would not be tapped.

Half of the subjects were given the AQ at the beginning of the first session; for the other half of the subjects it occurred at the end of the third session.

For the AQ, the 24 items on the list were presented verbally to the subject with the following instructions adapted from Russell and Dennis (1939).

> We are going to play a game. I am going to ask you some questions to see what you think about some things. I will turn this tape recorder on and it will record what we say. (The tape recorder was turned on at this point.) Do you know what it means to be alive? You are alive, right? Now, I am going to name some things and you tell me whether you think they are alive or not alive.

The subject was then asked whether each item on the list was alive or not alive. When the subject had responded to each item on the list, the same items were presented a second time in the same order. The subject was asked again whether he thought the item was alive or not alive and then why he thought the item was alive or not alive. The tape recorder was turned off when the AQ was completed.

An experimental task and its corresponding control task were

Table 3a

Task Orders 1 through 6 for Sessions 1, 2, and 3

(replicated for each age)

Task Order	Session 1	Session 2	Session 3
1 (N=2)	AQ (½ Ss) Task A* Unreinforced Set Control Task A	Task P*** Unreinforced Set Control Task P	Task I** Unreinforced Set Control Task I AQ (½ Ss)
2 (N=2)	AQ (½ Ss) Control Task A Task A Unreinforced Set	Control Task P Task P Unreinforced Set	Control Task I Task I Unreinforced Set AQ (½ Ss)
3 (N=2)	AQ (½ Ss) Task A Unreinforced Set Control Task A	Task I Unreinforced Set Control Task I	Task P Unreinforced Set Control Task P AQ (½ Ss)
4 (N=2)	AQ (½ Ss) Control Task A Task A Unreinforced Set	Control Task I Task I Unreinforced Set	Control Task P Task P Unreinforced Set AQ (½ Ss)
5 (N=2)	AQ (½ Ss) Task P Unreinforced Set Control Task P	Task I Unreinforced Set Control Task I	Task A Unreinforced Set Control Task A AQ (½ Ss)
6 (N=2)	AQ (½ Ss) Control Task P Task P Unreinforced Set	Control Task I Task I Unreinforced Set	Control Task A Task A Unreinforced Set AQ (½ Ss)

*Task A: Adult Task
**Task I: Intermediate Task
***Task P: Preschool Task

Table 3b

Task Orders 7 through 12 for Sessions 1, 2, and 3

(replicated for each age)

Task Order	Session 1	Session 2	Session 3
7 (N=2)	AQ (½ Ss) Task P*** Unreinforced Set Control Task P	Task A* Unreinforced Set Control Task A	Task I** Unreinforced Set Control Task I AQ (½ Ss)
8 (N=2)	AQ (½ Ss) Control Task P Task P Unreinforced Set	Control Task A Task A Unreinforced Set	Control Task I Task I Unreinforced Set AQ (½ Ss)
9 (N=2)	AQ (½ Ss) Task I Unreinforced Set Control Task I	Task A Unreinforced Set Control Task A	Task P Unreinforced Set Control Task P AQ (½ Ss)
10 (N=2)	AQ (½ Ss) Control Task I Task I Unreinforced Set	Control Task A Task A Unreinforced Set	Control Task P Task P Unreinforced Set AQ (½ Ss)
11 (N=2)	AQ (½ Ss) Task I Unreinforced Set Control Task I	Task P Unreinforced Set Control Task P	Task A Unreinforced Set Control Task A AQ (½ Ss)
12 (N=2)	AQ (½ Ss) Control Task I Task I Unreinforced Set	Control Task P Task P Unreinforced Set	Control Task A Task A Unreinforced Set AQ (½ Ss)

*Task A: Adult Task
**Task I: Intermediate Task
***Task P: Preschool Task

presented in the same session. For each task, half of the subjects had the experimental task before the control task, and half had the control task before the experimental task.

The experimental and control tasks were preceded by the following instructions:

> I have a guessing game here for us to play. I will look at these cards and tell you the names of two things. Your job is to guess which of the two things I am thinking of. After you guess, I will tell you if you are right or not. We will do all eight of the cards one time and then we will do them again, and the same ones will still be right. We will see how many you can remember. If you do a good job, you will win a prize.

For the experimental tasks and the control tasks, the pairs of stimuli in a set were verbally presented to the subject by the examiner. After each response, the subject was told whether or not he was correct. For all tasks, a set was continued until the subject was correct on all eight pairs in one trial list presentation. At the end of each task, the subject was questioned about how he knew which stimuli were correct.

The six sets in each experimental task were presented to the subject in a modified random order. The first four sets in a task were presented in a random order first, and then if necessary, the last two sets were presented. The order of these two sets was also randomly determined. This was done so that unless concept learning occurred unusually early (in fewer than four sets) we would obtain from the subjects responses to the four experimental sets used to form control sets.

For each experimental task, the sets in that task were presented to the subject until he reached criterion for concept learning or until all six sets in the task had been presented. Criterion for concept learning was defined as responding correctly to the eight pairs in a set the first time the set was presented. Pilot data (Masters, 1970) had indicated that subjects from the age range sampled in the present study should reach criterion for concept learning within six sets.

The four sets in each control task were presented in random order. All four of the sets were learned by each subject.

Following the presentation of the experimental task, the subject was given one presentation of the additional, unreinforced set associated with that experimental task. At the end of each session, the subject was thanked for his/her participation and allowed to choose a small toy from a display box.

CHAPTER III

RESULTS: I. ANIMISM QUESTIONNAIRE

Scoring

The AQ protocols were each scored by three raters; a clinical psychologist, a psychiatric social worker, and this investigator. The two outside raters were unacquainted with the specific purposes of the study. Instructions given to the raters for scoring the test protocols are contained in Appendix B. The protocols were scored in a random order. No information identifying subjects accompanied the protocols.

The percentage of agreement between the psychologist and the investigator was 93 percent; between the social worker and the investigator, 94 percent; and between the psychologist and the social worker, 87 percent. For 87 percent of the responses, there was unanimous agreement on scoring by all three raters. In cases of disagreement among raters, a response was given a score if two of the three raters agreed on a category. If there was no agreement, a response was scored "not scorable." There was at least two out of three agreement on the assignment of categories for 99.6 percent of the responses.

Stage Assignment

On the basis of the scored responses, subjects were assigned to one of five Stages of Animistic Thinking or to Stage X, which indicated no stage assignment was possible. The stages assigned included Stage III (spontaneous movement as the criterion for living), Stage

IVa (only animal characteristics as the criterion for living), Stage IVb (a combination of animal and scientific characteristics as the criteria for living), and two transitional stages. Stage II-III (general movement and spontaneous movement as criteria for living) and Stage III-IV (spontaneous movement and animal or scientific characteristics as criteria for living) were assigned to subjects whose responses suggested that they were operating at a transitional level between two of the stages. Piaget's Stage I (usefulness as a criterion for living) and Stage II (general movement as a criterion for living) were not used since no subjects in the present sample were classifiable at either of these stages.

The two levels of Stage IV were included because a large number of subjects (25%) gave responses which cited animal characteristics as criteria for living but never used the higher level scientific criteria for living in any response. Piaget did not discuss this response difference among Stage IV children. Laurendeau and Pinard (1962) do note that many Stage IV children define life exclusively in terms of animal characteristics, however, they do not separate the stage. Since in the present study, an unusually large number of subjects (76%) for this age range were functioning at Stage IV, it seemed useful to examine the criteria used by this group in as much detail as possible.

For 41 of the 96 subjects, assignment to a stage was a straightforward procedure. Seventy percent or more of their responses (at least 17 out of the 24 responses) fell into one category and the

corresponding stage was assigned to them.

For most subjects, however, the use of criteria to define living was not as systematic as Piaget's reports would suggest. A single subject often used criteria representing several different levels of animistic thinking. Laurendeau and Pinard (1962) also found this lack of systematization in their data. For these 55 subjects, assignment to a stage was made on the basis of their median and mode scores. In the case of 42 of these subjects, the median and mode fell at the same score and the stage corresponding to it was assigned. For another 11 subjects, the median and mode fell at adjacent scores and a transitional stage between the two scores was assigned. For two subjects, both nursery schoolers, no clear pattern of responses was evident and they were not assigned stages. Two other subjects, one from the Nursery Group, and one from the Kindergarten Group were also not assigned stages because 70 percent or more of their responses were not scorable. Table 4 shows the stages assigned to subjects grouped by age and sex.

The number of subjects using only animal characteristics as a criterion for living for the majority of their responses (Stage IVa) was about the same for the Nursery, Kindergarten, and First Grade Groups, however, for the Third Grade Group, the number was much smaller. Since most subjects were in Stage IV, this pattern reverses itself for Stage IVb which included scientific criteria as well as animal characteristics. Many more Third Grade subjects than Nursery, Kindergarten, or First Grade subjects were in this higher level of

Table 4

Number of Subjects Grouped by Age and Sex

Assigned to Stages of Animistic Thinking

Group	Stage					
	X (no stage)	II-III	III	III-IV	IVa	IVb
Nursery	3 (1)**	1	2	2	7 (5)*	9 (2)*
Male	1	1	0	2	2 (2)*	6 (1)*
Female	2 (1)**	0	2	0	5 (3)*	3 (1)*
Kindergarten	1 (1)**	0	1	3	5 (2)*	14 (7)*
Male	0	0	0	2	4 (1)*	6 (3)*
Female	1 (1)**	0	1	1	1 (1)*	8 (4)*
First Grade	0	0	4 (1)*	4	6 (3)*	10 (9)*
Male	0	0	2 (1)*	3	1	6 (5)*
Female	0	0	2	1	5 (3)*	4 (4)*
Third Grade	0	1	1	1	2 (2)*	19 (7)*
Male	0	1	0	0	0	11 (4)*
Female	0	0	1	1	2 (2)*	8 (3)*

*Number of Ss with 70% or more responses in the category
**Number of Ss with 70% or more responses not scorable

the stage. The mean number of responses employing scientific criteria for living given by subjects at the four age levels were as follows: Third Grade, 5.8; First Grade, 2.4; Kindergarten, 2.9; and Nursery, 2.0. Thus, even though the majority of subjects in each of the age groups sampled were functioning at what Piaget described as a Stage IV adult level, subjects from the oldest group made a much greater use of the scientific criteria which define living.

Categories of Animistic Responses

An examination of the animistic responses given on the AQ on stimuli from different categories showed differences associated with age, category of stimulus, and with position of the AQ. Figure 1 and Table 5 show the mean number of animistic responses given by subjects in four age groups on stimuli in the six categories represented on the AQ. With the exception of three Third Grade subjects who were able to categorize all of the items according to the adult definition of the concept of alive, all subjects gave some animistic responses. The Plant Stimuli and the Spontaneous Movement Stimuli accounted for most animistic responses. Third Grade subjects gave far fewer animistic responses on Plant Stimuli (a total of 14) than did subjects in the younger groups. No animistic responses were given by any subjects to People Stimuli. Only Nursery subjects gave animistic responses to Animal Stimuli or No Movement Stimuli. They also gave many more animistic responses to Imparted Movement Stimuli than older subjects. For some categories of stimuli for some age groups (i.e., First Grade, Plant Stimuli; Nursery, Imparted Movement and Spontane-

Figure 1. Mean number of animistic responses in six stimulus categories on the Animism Questionnaire for subjects in four age groups.

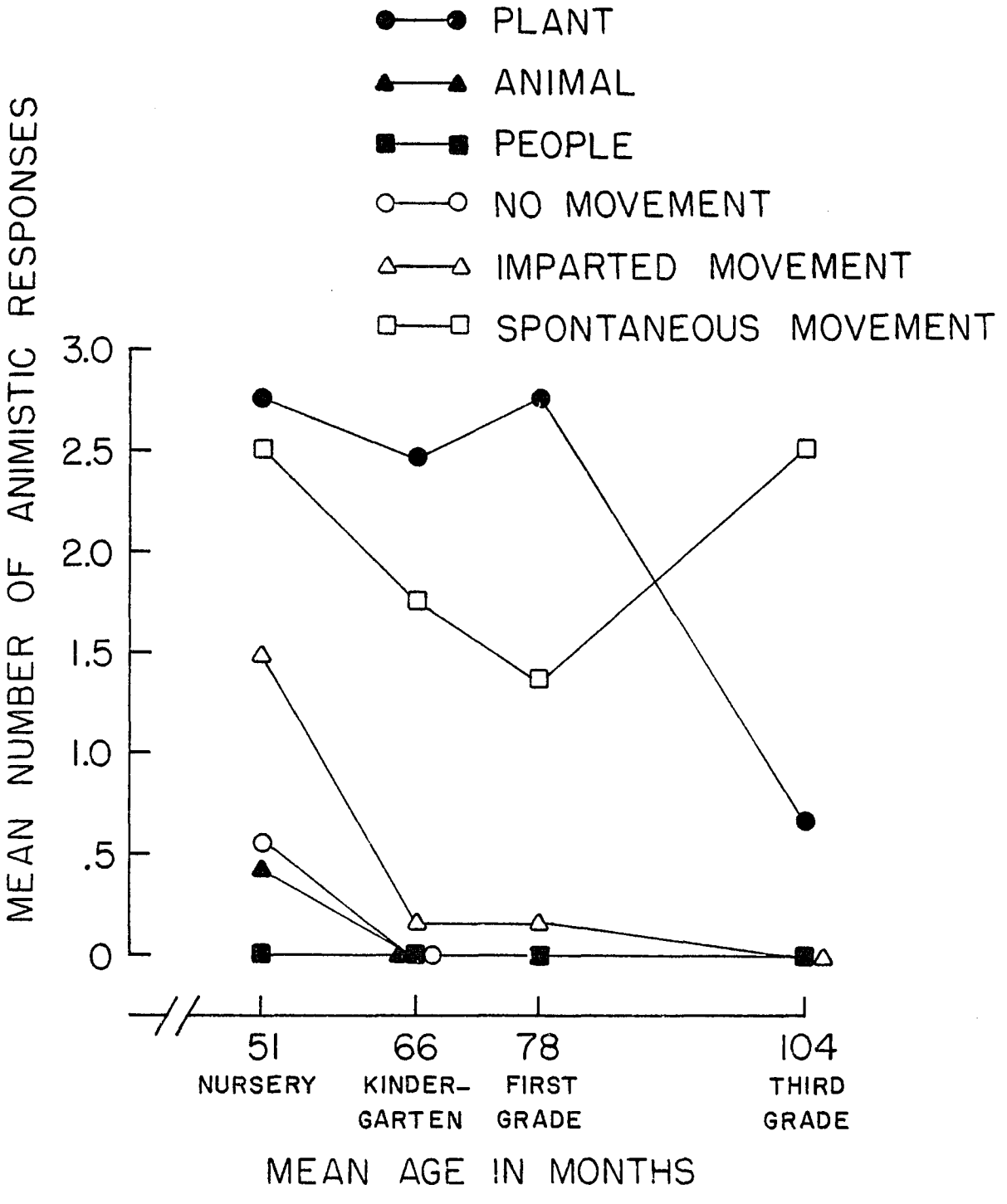

PLANT
ANIMAL
PEOPLE
NO MOVEMENT
IMPARTED MOVEMENT
SPONTANEOUS MOVEMENT
MEAN NUMBER OF ANIMISTIC RESPONSES
3.0
2.5
2.0
1.5
1.0
.5
0
51
NURSERY
66
KINDER-GARTEN
78
FIRST GRADE
104
THIRD GRADE
MEAN AGE IN MONTHS

Table 5

Mean Number of Animistic Responses in Six Stimulus Categories for Subjects in Four Age Groups Who Had the Animism Questionnaire (AQ) Before and After the Discrimination Tasks

Group	Stimulus Category						
	Plant	Animal	People	Imparted Movement	Spontaneous Movement	No Movement	Total
Nursery	2.75	.42	0	1.50	2.25	.54	7.46
AQ Before	3.00	.58	0	1.92	2.92	.50	8.92
AQ After	2.50	.25	0	1.08	1.58	.58	6.00
Kindergarten	2.46	0	0	.17	1.75	0	4.38
AQ Before	2.58	0	0	.17	1.58	0	4.33
AQ After	2.33	0	0	.17	1.92	0	4.42
First Grade	2.79	0	0	.17	1.38	0	4.33
AQ Before	3.08	0	0	0	1.08	0	4.17
AQ After	2.50	0	0	.33	1.67	0	4.50
Third Grade	.67	0	0	0	2.04	0	2.71
AQ Before	1.00	0	0	0	1.92	0	2.92
AQ After	.33	0	0	0	2.17	0	2.50
Total	2.17	.10	0	.46	1.85	.14	4.72

ous Movement Stimuli), the position of the AQ after the discrimination tasks was associated with fewer animistic responses.

The reverse of this relationship held for other ages and categories (i.e., Kindergarten and First Grade, Spontaneous Movement Stimuli). The total number of animistic responses tended to decrease with age. The two intermediate age groups gave about the same number of animistic responses, while the youngest group gave more animistic responses and the oldest group gave fewer.

The majority of animistic responses given by subjects to Plant Stimuli fell into two categories; movement and human/animal characteristics. Plant Stimuli were said to be not alive because they did not have these characteristics. The human/animal characteristics referred to included talking, eating, jumping, having a face, legs, eyes, etc. The lack of these human/animal characteristics are used to explain the animistic responses to Plant Stimuli of 47 percent of the Nursery subjects, 36 percent of the Kindergarten subjects, 32 percent of the First Grade subjects, and 86 percent of the Third Grade subjects. Twenty-four percent of the Nursery Group's animistic responses to Plant Stimuli, 54 percent of the Kindergarten Group's, 68 percent of the First Grade Group's, but none of the Third Grade Group's animistic responses are explained in terms of a lack of movement characteristics. For all four age groups, the majority of animistic responses given to Spontaneous Movement Stimuli are explained by the possession of movement characteristics. The percentages are: Nursery, 70 percent; Kindergarten, 91 percent; First Grade, 76 percent; and Third

Grade, 81 percent.

An analysis of the categories of animistic responses given by subjects functioning overall at the two levels of Stage IV revealed a trend toward fewer animistic responses by the subjects in the higher level (IVb) for the Plant category and for total number of animistic responses. This trend was reversed for the Spontaneous Movement category. Subjects relying on animal characteristics to define life (Stage IVa) gave more animistic responses to Plant Stimuli which do not possess superficial animal characteristics such as legs or faces. Probably for the same reason, they were also less likely to attribute life to Spontaneous Movement Stimuli. The Stage IVb subjects experienced some difficulty in applying scientific criteria to the Spontaneous Movement Stimuli. Table 6 shows the mean number of animistic responses given by subjects in Stages IVa and IVb on the six stimulus categories represented in the AQ.

Use of the Adult Category

At all four ages, the Adult category (Stage IVb) was used significantly more often for inclusion than for exclusion (Wilcoxon Sign Test: Third Grade, $T = 5.5$, $n = 22$, $p < .005$; First Grade, $T = 0$, $n = 17$, $p < .005$; Kindergarten, $T = 2.5$, $n = 17$, $p < .005$; Nursery, $T = 0$, $n = 13$, $p < .005$). That is, subjects gave responses which fell into the Adult category more often in order to explain why an item on the AQ was alive than to explain why an item was not alive. The mean number of Adult Level responses used for inclusion and exclusion are shown in Table 7. The Third Graders used the Adult Level

Table 6

Mean Number of Animistic Responses in Six Stimulus Categories on the Animism Questionnaire for Subjects in Stages IVa and IVb in Four Age Groups

Group	Stimulus Category						
	Plant	Animal	People	Imparted Movement	Spontaneous Movement	No Movement	Total
Nursery (n = 16)	2.69	.38	0	.75	1.94	.44	6.19
Stage IVa (n = 7)	3.57	.43	0	.43	1.86	.14	6.43
Stage IVb (n = 9)	2.00	.33	0	1.00	2.00	.67	6.00
Kindergarten (n = 19)	2.32	0	0	0	1.58	0	3.89
Stage IVa (n = 5)	4.00	0	0	0	.20	0	4.20
Stage IVb (n = 14)	1.71	0	0	0	2.07	0	3.78
First Grade (n = 16)	3.12	0	0	0	.81	0	3.94
Stage IVa (n = 6)	3.33	0	0	0	.17	0	3.50
Stage IVb (n = 10)	3.00	0	0	0	1.20	0	4.20
Third Grade (n = 21)	.57	0	0	0	1.81	0	2.38
Stage IVa (n = 2)	4.00	0	0	0	0	0	4.00
Stage IVb (n = 19)	.21	0	0	0	2.00	0	2.21
Total	2.07	.08	0	.17	1.56	.10	3.97

category more often for both inclusion and exclusion than did younger subjects.

Table 7

Mean Number of Adult Level Responses Used for Inclusion and Exclusion on the Animism Questionnaire

Group	Inclusion	Exclusion
Nursery	1.7	.3
Kindergarten	2.6	.3
First Grade	2.1	.4
Third Grade	4.5	2.7

Response Changes Between the Initial Presentation of the Animism Questionnaire and the Inquiry

It will be remembered that each item was presented for classification twice with an explanation requested on the second occasion. Table 8 shows the number and stimulus categories of the response changes between the initial presentation of the AQ items and the inquiry for the four age groups. The Nursery Group made many more response changes than the older groups and more of their changes were from adult level responses to animistic responses than vice versa. For each of the four groups, the most changes to an adult level response were on Plant Stimuli. The most changes to an animistic response were on Spontaneous Movement Stimuli. The Nursery Group made

Table 8

Number and Stimulus Categories of Response Changes Between the Initial Presentation of the Animism Questionnaire and the Inquiry for Four Age Groups

Group	Change to Adult Level Response		Change to Animistic Response		Total
Nursery N = 18	33:	2 People 10 Animals 17 Plants 1 Spontaneous Movement 1 Imparted Movement 2 No Movement	42:	2 Animals 18 Spontaneous Movement 16 Imparted Movement 6 No Movement	75
Kindergarten N = 11	7:	1 People 4 Plants 1 Imparted Movement 1 No Movement	9:	1 Plant 7 Spontaneous Movement 1 Imparted Movement	16
First Grade N = 13	10:	5 Animals 5 Plants	10:	5 Plants 4 Spontaneous Movement 1 Imparted Movement	20
Third Grade N = 5	4:	4 Plants	5:	5 Spontaneous Movement	9
Total	54:	30 Plants 15 Animals 1 Spontaneous Movement 2 Imparted Movement 3 No Movement	66:	6 Plants 2 Animals 34 Spontaneous Movement 18 Imparted Movement 6 No Movement	120

almost as many changes to animistic responses on Imparted Movement Stimuli as on Spontaneous Movement Stimuli. The majority of the changed responses (Third Grade, 77%; First Grade, 85%; Kindergarten, 75%; and Nursery, 75%) were explained with reasons which had been used to explain the item immediately previous to the changed item.

CHAPTER IV

RESULTS: II. DISCRIMINATION TASKS

Since there was not sufficient variability in the Animism Questionnaire data to allow for analyses of the discrimination tasks with subjects grouped by stage of functioning on the Animism Questionnaire, these analyses were done only by age.

Control Variables

Three measures of learning, number of errors, number of trials, and number of sets to concept learning, were examined. Before the analyses of the main experimental variables were performed, the effects on each age group of the four counterbalanced or partially counterbalanced variables were studied for each of these three measures. These variables included: position of the task (analyzed only in terms of score when a task was presented first); sex of the subject; relative position of experimental and control tasks, first or last; and position of the AQ, before or after the learning tasks. Only the last variable proved to be significant, consequently further analyses used scores collapsed over the first three variables.

For number of errors, mixed design analyses of variance with repeated measures on experimental condition and task were done for each of four age groups for each of the control variables. The analyses revealed no significant effects for position of task, sex of subject, or position of experimental and control tasks for any of the four age groups. The position of the AQ was not a significant

factor for the Nursery Group ($F = .36$; $df = 1, 22$; $p > .50$), or the Kindergarten Group ($F = .08$; $df = 1, 22$; $p > .50$). It was significant, however, for the First Grade Group ($F = 7.22$; $df = 1, 22$; $p = .014$) and the Third Grade Group ($F = 4.53$; $df = 1, 22$; $p = .045$). This variable was therefore included in later analyses.

Using the number of trials measure, mixed design analyses of variance with repeated measures on experimental condition and task were performed on the four control variables for each age group. Again, no significant effects were found for position of task, sex of subject, or relative position of experimental and control tasks for any of the four age groups.

As was the case with the error measure, the position of the AQ had no significant effect for the Nursery Group ($F = 1.40$; $df = 1, 22$; $p = .25$), or the Kindergarten Group ($F = .089$; $df = 1, 22$; $p > .50$). For the present measure, it was also not significant for the First Grade Group ($F = 2.74$; $df = 1, 22$; $p = .113$). It was significant, however, for the Third Grade Group ($F = 4.35$; $df = 1, 22$; $p = .049$). It was thus included in later analyses.

Similar analyses of variance based on number of sets to concept learning for each age group were done. These analyses revealed no significant effects for position of task, sex of subject, or position of experimental and control tasks for any age group.

As was the case for the number of errors and number of trials, the analyses of number of sets for concept learning revealed no significant effects related to position of the AQ for the Nursery Group

($F = 2.85$; $df = 1, 22$; $p = .106$), or the Kindergarten Group ($F = .689$; $df = 1, 22$; $p = .416$). The effects were significant for the First Grade Group ($F = 14.47$; $df = 1, 22$; $p < .001$) and the Third Grade Group ($F = 17.99$; $df = 1, 22$; $p < .001$). The position of the AQ factor was therefore included in later analyses using this measure.

Experimental Variables

Three main analyses of variance using number of sets to concept learning, number of errors, and number of trials were performed. Since concept learning was possible only on experimental sets, the analysis of variance for number of sets to concept learning compared only the data for the three experimental tasks over four age groups.

The analyses of variance for number of errors and number of trials compared data for three experimental and three control tasks over four age groups. Each control task contained only four sets based on the first four sets in the corresponding experimental task. Consequently, only the data from the first four sets of each experimental task were included in these analyses. Number of errors and number of trials are related measures in that a set was repeated until no error was made. It was therefore expected that these two analyses would be similar. Two additional mixed design analyses of variance with repeated measures on task using the data from all of the experimental task sets were also done for the number of errors and number of trials measures. This was to include the data omitted in the main analyses because of the structure of the control tasks.

Following all of these analyses, a posteriori comparisons were

made using the Tukey (a) procedure as recommended by Winer (1962). The results of all of the Tukey procedures are shown in Appendix C.

Concept attainment: Speed. A mixed design analysis of variance with repeated measures on task was used to compare the number of sets required to reach criterion for concept learning (excluding the criterion set) on the three experimental tasks by subjects in the four age groups. Those subjects who did not reach criterion for concept learning were given a score of six, the maximum number of sets presented, for the purposes of this analysis. The means for the four groups for three experimental tasks are shown in Figure 2 and Table 9. The analysis of variance is given in Table 10.

The age factor was significant at the .001 level. The means for groups in order of decreasing age were 8.92, 11.04, 12.46, and 11.50. A Tukey procedure indicated that the Third Grade Group required significantly fewer sets for concept learning than any of the three younger groups. Comparison among the three younger groups showed no significant differences.

Administering the AQ at the beginning or at the end of the series of learning tasks resulted in a significant difference in the number of sets to criterion for concept learning ($p < .001$). Fewer sets were required when the AQ preceded the tasks (mean, 9.62) than when it followed the tasks (mean, 12.33).

The interaction of age and position of the AQ combined over tasks was also significant ($p < .003$). An examination of this interaction using the Tukey procedure showed that the AQ preceding the

Figure 2. Mean number of sets to criterion for concept learning on three experimental tasks for four age groups.

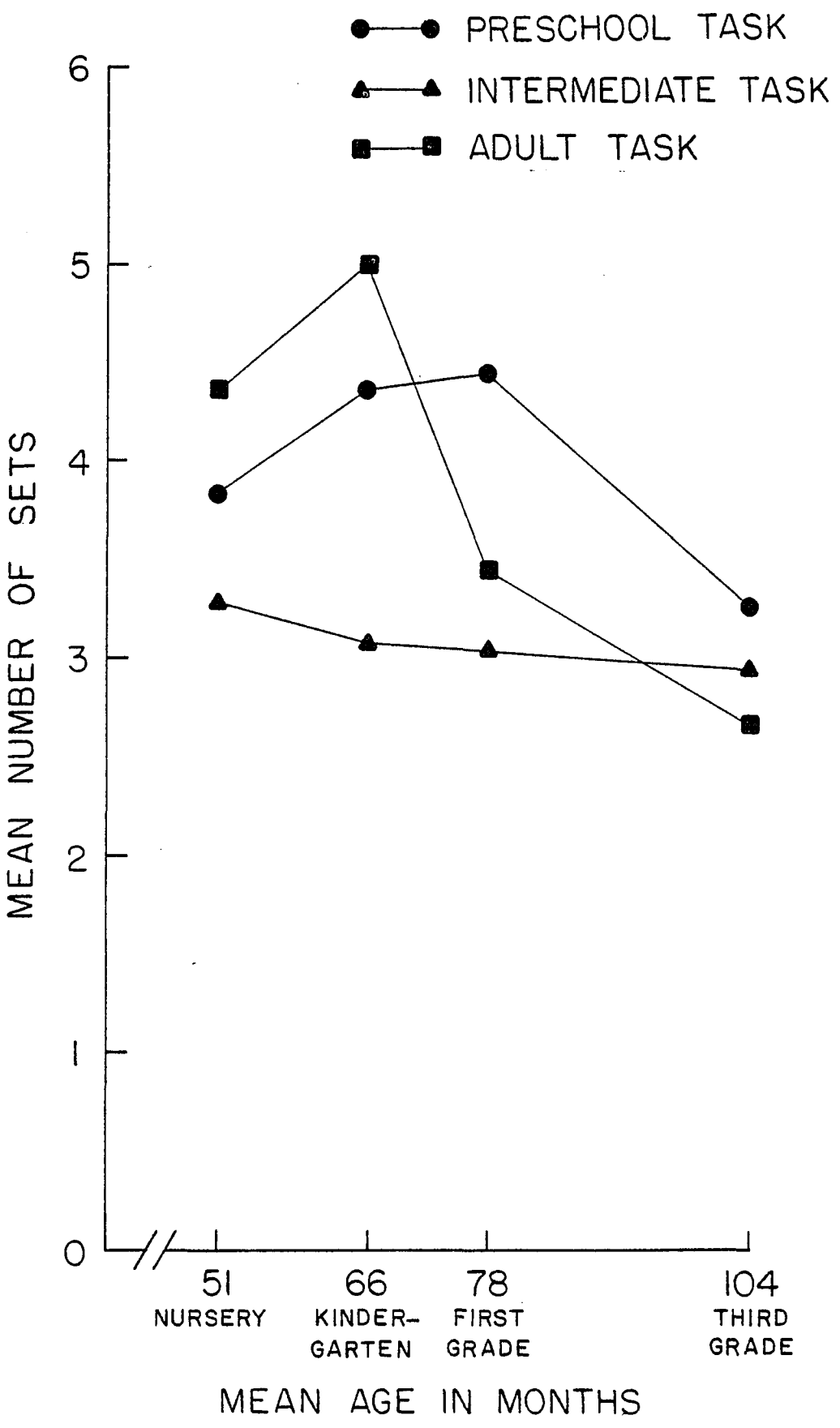

PRESCHOOL TASK
INTERMEDIATE TASK
ADULT TASK
MEAN NUMBER OF SETS
6
5
4
3
2
1
0
51
NURSERY
66
KINDER-
GARTEN
78
FIRST
GRADE
104
THIRD
GRADE
MEAN AGE IN MONTHS

Table 9

Mean Number of Sets to Concept Learning for Four Age Groups

Group	Position of AQ	Preschool Task M	Preschool Task SD	Intermediate Task M	Intermediate Task SD	Adult Task M	Adult Task SD
Nursery	AQ First	3.17	1.69	3.08	1.63	4.17	1.89
	AQ Last	4.50	1.24	3.50	1.68	4.48	1.39
	Total	3.83	1.61	3.29	1.63	4.38	1.62
Kindergarten	AQ First	4.58	1.69	3.08	1.51	5.25	1.21
	AQ Last	4.17	1.52	3.08	1.17	4.75	1.14
	Total	4.38	1.57	3.08	1.32	5.00	1.18
First Grade	AQ First	3.92	1.07	2.17	.71	2.75	1.60
	AQ Last	5.17	1.01	3.92	1.37	4.17	1.69
	Total	4.54	1.22	3.04	1.40	3.46	1.76
Third Grade	AQ First	2.58	1.32	1.92	.89	1.83	1.53
	AQ Last	4.00	1.45	4.00	1.35	3.50	1.73
	Total	3.29	1.54	2.96	1.54	2.67	1.80

Table 10

Summary of Analysis of Variance for

Number of Sets to Concept Learning

Source	df	MS	F
Between Ss:			
Age (A)	3	18.374	6.500**
Position of AQ (AQ)	1	57.781	20.441**
A X AQ	3	14.661	5.187*
Between Ss	95		
Within Ss:			
Task (T)	2	23.156	13.776**
T X A	6	7.749	4.610**
T X AQ	2	.594	.353
T X A X AQ	6	.918	.546
Within Ss	192		

*$p < .003$
**$p < .001$

tasks resulted in significantly fewer sets to concept learning for First Grade (AQ first, mean 8.33; AQ last, mean 13.25) and Third Grade (AQ first, mean 6.33; AQ last, mean 11.5) subjects, but not for Nursery (AQ first, mean 10.42; AQ last, mean 12.58) and Kindergarten (AQ first, mean 12.92; AQ last, mean 12.0) subjects. The AQ seemed to serve as a cue to the concept in the following tasks for the two older groups but not for the two younger ones.

A comparison of the number of sets for concept learning required on the three experimental tasks combined over age was significant at the .001 level. A Tukey procedure showed significant differences in the number of sets required for concept learning on the Intermediate Level Task (mean, 3.09) as compared with the Adult Level Task (mean, 3.88) and the Preschool Level Task (mean, 4.01). The Intermediate Level Task required significantly fewer sets than either of the other tasks. The difference in the number of sets required between the Adult and Preschool Level Tasks was not significant.

The interaction between the age and task factors was significant ($p < .001$). A Tukey procedure showed no differences among the three tasks in number of sets for concept learning for the Third Grade. Although this group learned the three tasks at approximately the same rate, it is interesting to note that the order of the means for the tasks indicated that the order of difficulty was the Adult Level Task (mean, 2.67), the Intermediate Level Task (mean, 2.96) and then the Preschool Level Task (mean, 3.29).

For the First Grade subjects, the difference in learning rate

between the Adult (mean, 3.46) and Intermediate (mean, 3.04) Level Tasks was not significant nor was that between the Adult and Preschool (mean, 4.54) Level Tasks. The difference between the Intermediate and Preschool Level Tasks, however, was significant. The means for this group showed that the order of difficulty of the tasks was Intermediate Level, Adult Level, and Preschool Level. For both the Third Grade and the First Grade Groups, the Preschool Level Task required the greatest number of sets for learning.

For the Kindergarten Group, the Intermediate Level Task (mean, 3.08) was learned with significantly fewer sets than either the Preschool (mean, 4.38) or the Adult (mean, 5.0) Level Tasks, which did not differ significantly. This group appears to function best at the Intermediate Level with slower learning on tasks representing higher or lower levels of the concept.

The Nursery Group, like the Third Grade Group, showed no significant differences in number of sets required for concept learning among the three tasks. The means for this group showed the Intermediate Level Task (mean, 3.29) being learned most rapidly, followed by the Preschool Level Task (mean, 3.83), and the Adult Level Task (mean, 4.38).

The analysis of number of sets to concept learning thus revealed age, condition, position of the AQ, and task to be significant variables. Having the AQ before the tasks led to faster learning on the experimental tasks for the First Grade and Third Grade Groups but not for the Nursery and Kindergarten Groups. Third Graders showed no

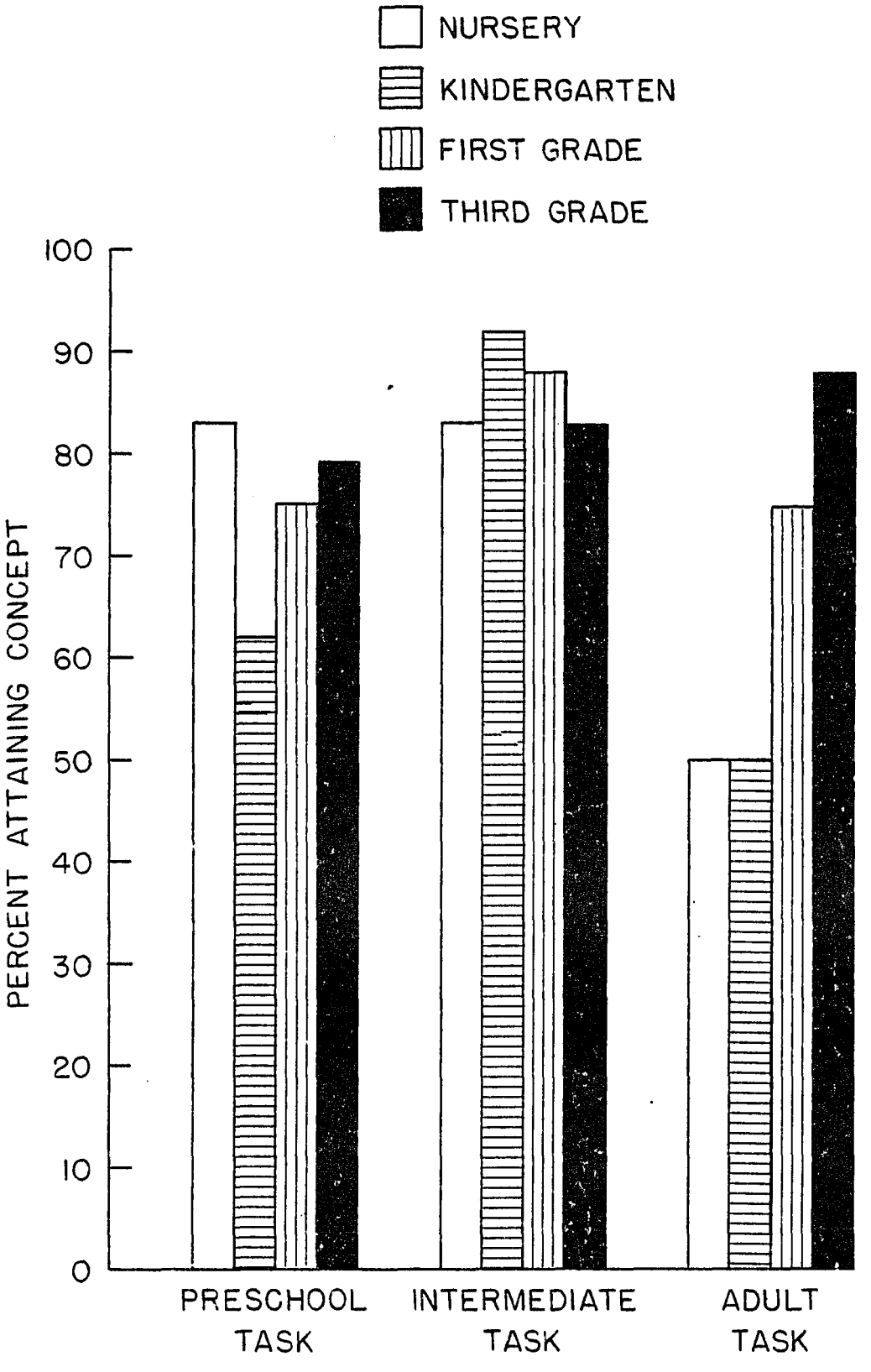
significant differences in number of sets to learning among the three experimental tasks. First Grade subjects learned the Intermediate Level Task fastest and the Preschool Level Task slowest. Kindergarten subjects also learned the Intermediate Level Task fastest but they took the most sets to learn the Adult Level Task. Nursery subjects showed no significant differences in number of sets to learn the three experimental tasks.

Concept attainment: Frequencies. Two sets of chi-square analyses evaluated the differences in number of subjects in each age group who reached criterion for concept learning (i.e., perfect performance on a new set the first time it was presented) on each of the three experimental tasks. The percent of subjects at each age who attained concept learning on the three tasks is shown in Figure 3.

For the Adult Level Task a significant difference was found in the number of subjects from the four age groups who reached the criterion for concept learning ($X^2 = 11.19$; $df = 3$; $p < .02$). For each of the Nursery and Kindergarten Groups, exactly half (12) of the subjects reached criterion. For the First Grade and Third Grade Groups, 75 percent (18) and 88 percent (21) of the subjects, respectively, reached criterion. Significantly more subjects in the two older groups used the adult level of the concept than in the two younger groups.

For the Intermediate Level Task, there was no reliable difference in the number of subjects from the four age groups who reached criterion for concept learning ($X^2 = .98$; $df = 3$, $.50 < p < .70$).

Figure 3. Percent of subjects from four age groups who attained concept learning on three experimental tasks.


NURSERY
KINDERGARTEN
FIRST GRADE
THIRD GRADE
PERCENT ATTAINING CONCEPT
100
90
80
70
60
50
40
30
20
10
0
PRESCHOOL TASK
INTERMEDIATE TASK
ADULT TASK

Eighty-three percent or more of the subjects in each of the groups were able to use this level of the concept. Similarly, for the Preschool Level Task, no significant difference was found in the number of subjects from the four age groups who reached criterion ($X^2 = 3.12$; $df = 3$, $.40 < p < .50$).

A second set of chi-square analyses was done to examine performance within age groups. A comparison of the number of subjects in the Nursery Group who reached criterion for concept learning on all three experimental tasks yielded a reliable difference ($X^2 = 8.86$; $df = 2$; $p < .02$). Only half of the subjects reached criterion on the Adult Level Task. On the Intermediate and Preschool Level Tasks, 20 subjects each reached criterion while only four subjects failed to reach criterion. The Stage IV or adult level of the concept was less utilized by these subjects than the earlier Stage II (general movement as a criterion for living) and Stage III (spontaneous movement as a criterion for living) levels of the concept.

For the Kindergarten Group, a reliable difference was also found in the number of subjects who reached criterion for concept learning on the three tasks ($X^2 = 10.10$; $df = 2$; $p < .01$). Only half of the subjects were able to reach criterion on the Adult Level Task, while 15 out of 24 reached criterion on the Preschool Level Task, and 22 out of 24 reached criterion on the Intermediate Level Task. These subjects used the Stage III level of the concept most often, followed by the Stage II level and the Stage IV level, in that order.

For the First Grade Group, there was no significant difference

in the number of subjects who reached criterion for concept learning on the three tasks ($X^2 = 1.51$; $df = 2$, $.30 < p < .50$). Out of 24 subjects, 18 reached criterion on each the Adult and Preschool Level Tasks. On the Intermediate Level Task, 21 subjects reached criterion.

There was also no significant difference in the number of Third Grade subjects who reached criterion for concept learning on the three tasks ($X^2 = .60$; $df = 2$, $.70 < p < .80$). Of the 24 subjects tested, 21 reached criterion on the Adult Level Task, 20 on the Intermediate Level Task, and 19 on the Preschool Level Task.

Thus, while most First Grade and Third Grade subjects reached criterion on each of the three experimental tasks, only half of the Nursery and Kindergarten subjects learned the Adult Task and only slightly more than half of the Kindergarten subjects learned the Preschool Task. Most of the Nursery subjects learned the Preschool and the Intermediate Tasks and most of the Kindergarten subjects learned the Intermediate Task.

Errors to learning criterion. The number of errors made by subjects in the four age groups in learning the three experimental tasks and the three control tasks was examined using a mixed design analysis of variance with repeated measures on condition (experimental or control) and task. The means of the four age groups for two conditions and three tasks are presented in Figure 4 and in Table 11. The results of the analysis of variance are presented in Table 12.

The age factor was significant at the .001 level. The mean

Figure 4. Mean number of errors for set learning on three experimental tasks and three control tasks for four age groups.

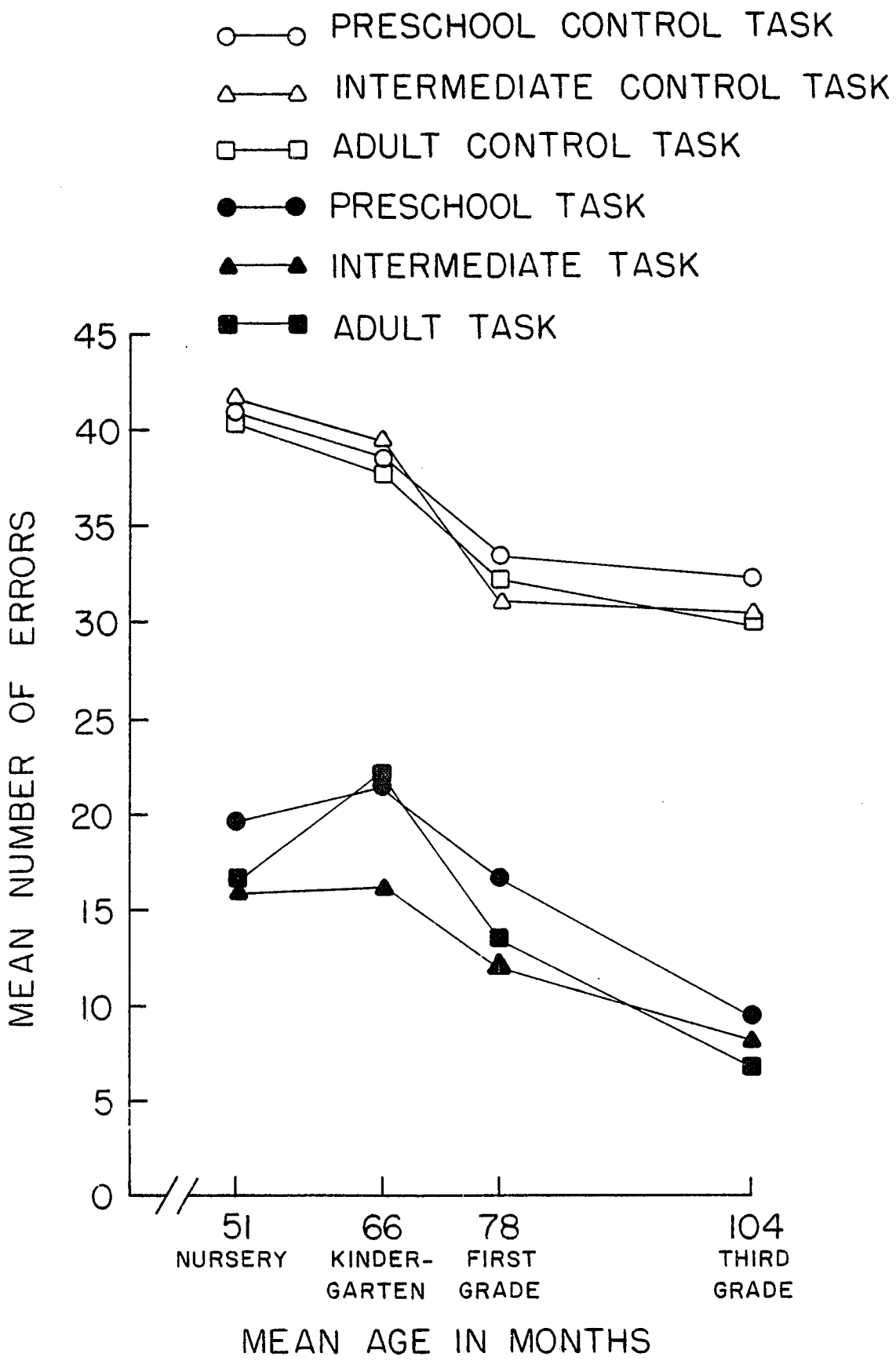

PRESCHOOL CONTROL TASK
INTERMEDIATE CONTROL TASK
ADULT CONTROL TASK
PRESCHOOL TASK
INTERMEDIATE TASK
ADULT TASK
MEAN NUMBER OF ERRORS
45
40
35
30
25
20
15
10
5
0
51
NURSERY
66
KINDER-
GARTEN
78
FIRST
GRADE
104
THIRD
GRADE
MEAN AGE IN MONTHS

Table 11 (Part 1)

Mean Total Number of Errors to Learning on Four or Fewer Sets for Four Age Groups on Three Experimental Tasks

Group	Position of AQ	Preschool Task M	Preschool Task SD	Intermediate Task M	Intermediate Task SD	Adult Task M	Adult Task SD
Nursery	AQ First	12.00	8.93	15.08	10.00	20.58	14.87
	AQ Last	21.58	9.22	17.92	8.46	18.92	9.42
	Total	16.79	10.14	16.50	9.17	19.75	12.20
Kindergarten	AQ First	23.58	10.19	17.33	10.14	21.08	8.03
	AQ Last	20.92	7.59	16.00	7.56	22.33	4.14
	Total	22.25	8.89	16.67	8.76	21.70	6.30
First Grade	AQ First	13.58	10.09	6.42	4.69	7.67	5.98
	AQ Last	19.75	11.11	17.58	7.32	18.63	13.58
	Total	16.67	10.84	12.00	8.29	13.25	11.57
Third Grade	AQ First	6.33	5.35	5.42	5.41	3.75	3.79
	AQ Last	12.67	6.53	11.58	7.30	9.50	5.93
	Total	9.50	6.68	8.50	7.60	6.63	5.68

Table 11 (Part II)

Mean Total Number of Errors to Learning on Four Sets for Four Age Groups on Three Control Tasks

Group	Position of AQ	Preschool Task M	Preschool Task SD	Intermediate Task M	Intermediate Task SD	Adult Task M	Adult Task SD
Nursery	AQ First	39.83	9.28	42.58	6.14	42.08	12.17
	AQ Last	41.08	9.91	41.67	8.20	38.75	8.58
	Total	40.46	9.39	41.67	9.49	40.42	10.42
Kindergarten	AQ First	39.17	7.26	37.83	9.56	36.58	4.92
	AQ Last	38.25	7.05	41.83	14.83	39.42	9.58
	Total	38.71	7.01	39.83	12.37	38.00	7.56
First Grade	AQ First	34.25	5.49	29.33	9.37	30.42	9.63
	AQ Last	32.67	7.93	32.75	6.52	33.58	9.60
	Total	33.46	6.72	31.04	8.08	32.00	9.54
Third Grade	AQ First	32.58	11.32	31.00	5.48	29.75	8.25
	AQ Last	32.33	9.53	30.25	4.18	31.17	8.61
	Total	32.46	10.22	30.62	4.81	30.46	7.94

Table 12

Summary of Analysis of Variance for Number of Errors

Source	df	MS	F
Between Ss:			
Age (A)	3	3334.608	22.239***
Position of AQ (AQ)	1	1048.133	6.990**
A X AQ	3	173.751	1.159
Between Ss	95		
Within Ss:			
Condition-experimental or control (C)	1	61772.871	849.964***
A X C	3	254.060	3.496*
AQ X C	1	500.641	6.889*
A X AQ X C	3	196.919	2.710*
Task (T)	2	144.882	1.807
A X T	6	59.007	.736
AQ X T	2	13.583	.169
A X AQ X T	6	108.235	1.350
C X T	2	88.757	2.033
A X C X T	6	59.039	1.353
AQ X C X T	2	20.437	.468
A X AQ X C X T	6	13.618	.312
Within Ss	480		

*p < .05
**p < .01
***p < .001

number of errors for successive age groups were 176.04, 177.16, 138.42 and 119.00 for tasks and conditions (experimental or control) combined. The results of a Tukey procedure comparing the age groups revealed significant differences among all groups with the exception of the Nursery and Kindergarten Groups. The numbers of errors made by the two younger groups were not significantly different.

Similarities in performance between the Nursery and the Kindergarten Groups appear throughout the data. Two possible explanations for this present themselves. The first is that there is no significant difference in the concept development attained by these two age groups; hence, the similar levels of responding. A second explanation is the possibility of a sampling bias such that the Nursery subjects represent a more select group than the others. Enrollment in nursery school is not compulsory and subjects in the Nursery Group may come from different socioeconomic or educational groups than the other subjects in the study. This might account for a more advanced level of conceptual development.

The difference in number of errors between the experimental and control tasks was significant at the .001 level. Fewer errors were made on experimental tasks (mean, 45.26) in which the correct responses were conceptually determined than on control tasks (mean, 107.40) in which the designation of correct responses was randomly determined. As anticipated, the conceptual relationships among the stimuli in the experimental tasks appears to have produced markedly easier learning tasks, whereas when such generalization was impos-

sible on the control tasks, learning was slower.

The interaction between age and condition (experimental or control) was significant at the .01 level. A Tukey procedure showed that within each age group subjects made significantly fewer errors on the experimental tasks (means for successive age groups are 53.04, 60.62, 41.92, and 25.46) than on the control tasks (means for successive age groups are 123, 116.54, 96.50, and 93.54). Between group comparisons showed that differences in number of errors for Nursery and Kindergarten subjects were not significant on either the experimental tasks or on the control tasks. The basic learning rate for Nursery and Kindergarten subjects as reflected by errors on control tasks was the same, as was the level of general concept use as reflected by errors on experimental tasks.

In comparisons of the First Grade and Third Grade Groups, the difference in number of errors on control tasks was not significant. On the experimental tasks, however, the Third Grade Group made significantly fewer errors than the First Grade Group. This fact coupled with the two groups' equal performance on the control tasks suggests that the Third Grade Group made more effective use of the concepts in learning the experimental tasks than did the First Grade Group.

These comparisons of the four groups, then, showed faster learning for both the Third Graders and the First Graders than for Nursery or Kindergarten subjects. With regard to concept use, Third Graders made significantly more use of the concept than either Nursery or

Kindergarten subjects, while First Graders used concepts more than Kindergarteners but not Nursery subjects.

Presenting the AQ before or after the learning tasks led to a difference in number of errors which was significant at the .01 level. Fewer errors were made when the AQ preceded the tasks (mean, 144.56) than when it followed the tasks (mean, 160.75).

The interaction between position of the AQ and condition (experimental or control) was significant at the .01 level. The Tukey procedure indicated that for the experimental tasks, significantly fewer errors were made when the AQ preceded the tasks (mean, 38.21) than when it followed them (mean, 52.29). For the control tasks, there was no relationship between number of errors and position of the AQ (means, 106.35 and 108.44 for AQ preceding and following control tasks). This suggests that learning the conceptually related material contained in the experimental tasks was facilitated by the presentation of the AQ before the tasks. The AQ, which focused on the same general concept as the tasks, seemed to have created a set for attaining the concept in the experimental tasks.

The three way interaction between age, position of AQ, and condition (experimental or control) was significant at the .01 level. A Tukey test showed an .01 level significant difference in number of errors on experimental tasks related to position of the AQ only for the First Grade Group. For this group, having the AQ before the tasks (mean, 26.83) led to significantly fewer errors than having it after the tasks (mean, 56.08). For the two younger groups, presenting

the questionnaire first did not have a consistent effect on errors to learn the concepts. For the Third Graders, performance appears to have been based on the concept regardless of when the AQ was presented. The position of the AQ had no effect on the number of errors on the control tasks for any of the age groups.

There were no significant differences in numbers of errors related to the three concepts represented by the tasks or to the interaction of the different task levels with other factors. As measured by number of errors, the three levels represented in the three experimental tasks did not differentially effect learning for any of the age groups. As noted above, when number of sets to concept learning was used as a measure of learning, significant differences were found for the task factor and the task-age interaction.

Although task was not a significant factor in the present analysis, the mean error scores suggest trends in the predicted directions. The Adult Level Task was learned slowest of the three tasks by the youngest group and fastest by the oldest group. The three older groups displayed slow learning on the Preschool Level Task. It was apparently more difficult for them to use a level of the concept which they had advanced past. The Nursery Group showed similar learning rates of the Preschool and Intermediate Level Tasks, suggesting a transitional level of functioning. The Kindergarten Group made many errors on the Adult Level Task indicating that they had not yet reached this level of functioning. The First Grade Group appeared transitional with similar scores on the Intermediate

and Adult Level Tasks.

A summary of the analysis of variance for errors using all of the experimental task sets is shown in Table 13. Total mean number of errors for subjects in four age groups on three experimental tasks with all sets included are shown in Table 14. The results of this analysis are similar to those of the main analysis with the exception that the present analysis also found task to be a significant variable. A Tukey procedure examining the significant interaction of age and task showed significant differences only for the Kindergarten Group in which the Intermediate Task was learned with fewer errors than either of the other tasks.

For the number of errors measure, then, the results indicated that age, condition (experimental or control), and position of the AQ were significant variables. An examination of the significant three way interaction between age, condition, and position of AQ showed that having the AQ first led to significantly fewer errors on the experimental tasks only for the First Grade Group. No significant differences in number of errors were found associated with any of the three levels of the experimental tasks representing Piaget's three levels of animistic thinking.

Trials to learning criterion. The number of trials required by subjects in the four age groups to learn the three experimental tasks and the three control tasks was compared using a mixed design analysis of variance with repeated measures on condition (experimental or control) and task. The means of the four age groups for the two

Table 13

Summary of Analysis of Variance for

Number of Errors Using all Experimental Task Sets

Source	df	MS	F
Between Ss:			
Age (A)	3	3212	15.25***
Position of AQ (AQ)	1	2665	12.65***
A X AQ	3	877.67	4.17*
Between Ss	95		
Within Ss:			
Task (T)	2	815.50	6.55**
T X A	6	328.67	2.64*
T X AQ	2	26.50	< 1
T X A X AQ	6	149.33	1.20
Within Ss	192		

*$p < .01$
**$p < .005$
***$p < .001$

Table 14

Mean Total Number of Errors to Learning with All Sets Included for Four Age Groups on Three Experimental Tasks

Group	Position of AQ	Preschool Task	Intermediate Task	Adult Task
Nursery	AQ First	13.42	16.33	28.66
	AQ Last	25.92	21.42	25.33
	Total	19.67	18.88	27.00
Kindergarten	AQ First	31.08	18.33	29.08
	AQ Last	25.50	16.67	25.58
	Total	28.29	17.50	28.83
First Grade	AQ First	14.83	6.42	8.33
	AQ Last	26.17	21.17	24.83
	Total	20.50	13.79	16.58
Third Grade	AQ First	6.33	6.08	4.33
	AQ Last	16.08	13.17	11.42
	Total	11.21	9.62	7.88

conditions and three tasks are presented in Figure 5 and Table 15. Table 16 shows the results of the analysis of variance. For the most part, these results parallel the findings regarding errors to criterion.

There were differences significant at the .001 level associated with age. The mean number of trials combined over tasks and conditions for successive age groups were 60.75, 59.08, 50.21, and 39.96. A Tukey procedure showed significant differences among all groups with the exception of the comparison of Nursery and Kindergarten subjects. The overall number of trials to learning required by these two younger groups are not significantly different. These results parallel those for errors.

The difference between the experimental and control conditions in number of trials was significant at the .001 level (experimental mean, 16.66; control mean, 35.48). Fewer trials were required to learn in the experimental condition. This was also the case for errors.

The interaction between age and condition was significant at the .006 level. A Tukey test revealed significantly fewer errors on the experimental tasks (means for successive age groups are 19.04, 21.50, 15.25, and 10.83) than on the control tasks (means for successive age groups are 41.21, 37.58, 34.96, and 29.12) within each age group. Comparisons between groups showed no significant differences in number of trials for Nursery and Kindergarten subjects on the experimental tasks or on the control tasks. These results are

Figure 5. Mean number of trials for set learning on three experimental tasks and three control tasks for four age groups.

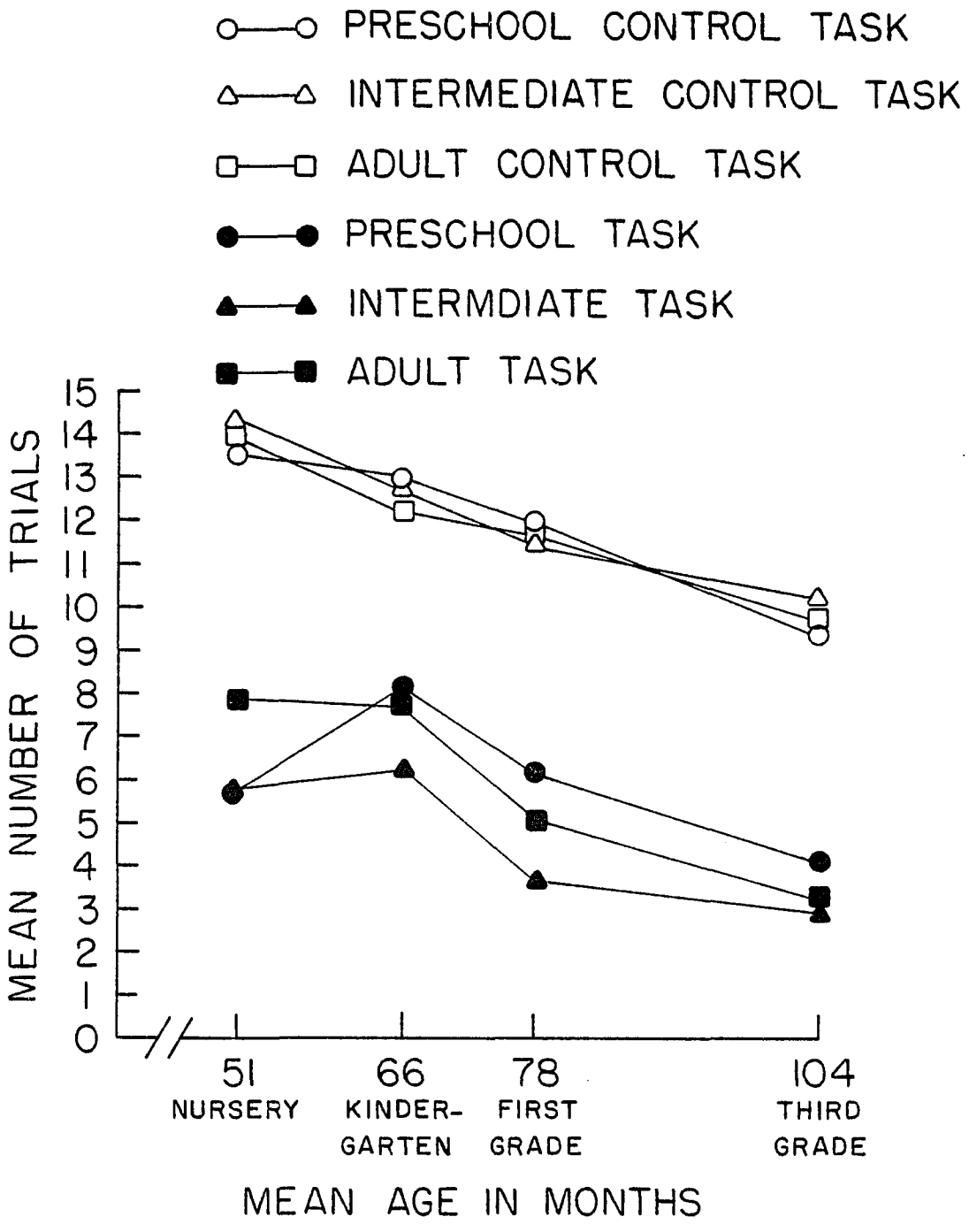

PRESCHOOL CONTROL TASK
INTERMEDIATE CONTROL TASK
ADULT CONTROL TASK
PRESCHOOL TASK
INTERMDIATE TASK
ADULT TASK
MEAN NUMBER OF TRIALS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
51
NURSERY
66
KINDER-
GARTEN
78
FIRST
GRADE
104
THIRD
GRADE
MEAN AGE IN MONTHS

Table 15 (Part I)

Mean Total Number of Trials to Learning on Four or Fewer Sets for Four Age Groups on Three Experimental Tasks

Group	Position of AQ	Preschool Task M	Preschool Task SD	Intermediate Task M	Intermediate Task SD	Adult Task M	Adult Task SD
Nursery	AQ First	4.33	2.61	4.42	2.91	7.58	5.11
	AQ Last	6.92	3.08	6.83	3.04	8.00	3.41
	Total	5.62	3.02	5.62	3.18	7.79	4.26
Kindergarten	AQ First	8.75	3.25	6.00	3.13	7.33	2.36
	AQ Last	7.50	2.61	6.50	2.15	7.92	1.71
	Total	8.12	2.97	6.25	2.64	7.62	2.06
First Grade	AQ First	5.25	1.42	3.08	1.25	4.08	2.75
	AQ Last	7.50	1.45	4.58	1.63	6.00	3.30
	Total	6.38	1.79	3.83	1.61	5.04	3.13
Third Grade	AQ First	3.50	2.43	2.17	1.52	2.50	2.07
	AQ Last	4.92	1.77	4.42	2.19	4.17	1.84
	Total	4.21	2.20	3.30	2.16	3.34	2.09

Table 15 (Part II)

Mean Total Number of Trials to Learning on Four Sets

for Four Age Groups on Three Control Tasks

Group	Position of AQ	Preschool Task M	Preschool Task SD	Intermediate Task M	Intermediate Task SD	Adult Task M	Adult Task SD
Nursery	AQ First	13.58	2.09	14.08	2.52	14.08	2.00
	AQ Last	13.83	2.15	14.00	1.59	13.83	2.06
	Total	13.71	2.11	14.04	2.06	13.96	1.95
Kindergarten	AQ First	12.58	2.13	12.08	1.90	11.75	2.05
	AQ Last	12.92	3.69	13.17	3.72	12.68	2.52
	Total	12.75	2.95	12.62	3.05	12.21	2.29
First Grade	AQ First	11.92	1.59	11.33	2.03	11.58	2.37
	AQ Last	11.67	1.70	11.83	1.92	11.58	2.08
	Total	11.80	1.58	11.58	1.95	11.58	2.18
Third Grade	AQ First	9.25	1.96	10.58	1.70	9.67	1.59
	AQ Last	9.58	1.40	9.83	1.11	9.33	1.69
	Total	9.42	1.65	10.20	1.49	9.50	1.61

Table 16

Summary of Analysis of Variance for Trials to Learning Criterion

Source	df	MS	F
Between Ss:			
Age (A)	3	365.263	27.456***
Position of AQ (AQ)	1	72.250	5.431*
A X AQ	3	4.523	.340
Between Ss	95		
Within Ss:			
Condition-experimental or control (C)	1	5890.551	865.398***
A X C	3	30.419	4.469**
AQ X C	1	45.563	6.694*
A X AQ X C	3	21.095	3.099*
Task (T)	2	21.505	5.358**
A X T	6	14.325	3.569**
AQ X T	2	.422	.105
A X AQ X T	6	3.403	.848
C X T	2	43.078	13.933***
A X C X T	6	6.796	2.198*
AQ X C X T	2	.099	.032
A X AQ X C X T	6	3.006	.972
Within Ss	480	17.158	

*p < .05
**p < .01
***p < .001

the same as those for errors.

Significant differences were revealed between the First Grade and Third Grade Groups for both the experimental and control conditions. The analysis of number of errors showed significant differences between these groups only in the experimental condition.

Both the First Grade and the Third Grade Groups required significantly fewer trials to criterion than the Kindergarten or Nursery Groups under both experimental and control conditions. Number of errors data were in line with this, except for showing no significant difference between First Grade and Nursery on the experimental task.

Differences associated with the position of the AQ were significant at the .02 level. Fewer trials were required when the AQ preceded the tasks (mean, 50.38) than when it followed the tasks (mean, 54.62).

The interaction between position of the AQ and condition was significant at the .01 level. The Tukey procedure indicated that for the experimental tasks, having the AQ first (mean, 14.75) resulted in significantly fewer trials to learning than having it last (mean, 18.56). As expected, the position of the AQ had no effect on number of trials for the control tasks (means, 35.62 and 36.06 for AQ preceding and following control tasks).

The three way interaction between age, position of AQ and condition (experimental or control) was significant at the .03 level. The Tukey procedure showed no significant differences for the control

condition for any age group related to the position of the AQ. For the experimental condition, significant differences were found for the Third Grade (AQ first, mean, 8.17; AQ last, mean, 13.5), First Grade (AQ first, mean, 12.42; AQ last, mean, 18.08), and Nursery (AQ first, mean, 16.33; AQ last, mean, 21.75) Groups related to the position of the AQ. Position of the AQ did not significantly effect performance on the experimental task for the Kindergarten Group (AQ first, mean, 22.08; AQ last, mean, 20.92). The analysis of number of errors showed a significant difference in performance related to AQ position only for the First Grade Group on the experimental tasks.

The task variable, which represented three levels of the concept of alive, was significant at the .006 level for the number of trials measure combined over age and condition (Adult Task mean, 17.76; Intermediate Task mean, 16.77; Preschool Task mean, 18.0). No significant differences were found associated with this variable or its interaction with any other variables for the number of errors measure. Task was a significant variable when number of sets to concept learning was analyzed.

The interaction between task and age (combined over condition) was significant at the .003 level. For the Preschool Level Task, the Third Grade subjects (mean, 13.62) required significantly fewer trials than any of the other three groups. First Grade subjects (mean, 18.12) learned in significantly fewer trials than either Nursery (mean, 19.33) or Kindergarten (mean, 20.88) subjects, and there was no significant difference in number of trials between Nursery

and Kindergarten subjects.

For the Intermediate Level Task, there was no significant difference between Third Grade (mean, 13.50) and First Grade (mean, 15.42) Groups or between Kindergarten (mean, 18.38) and Nursery (mean, 19.67) Groups. Both Third Grade and First Grade subjects required significantly fewer trials than either Kindergarten or Nursery subjects.

For the Adult Level Task, the Third Grade Group (mean, 12.83) learned in significantly fewer trials than the three younger groups. First Grade subjects (mean, 16.62) learned significantly faster than Kindergarten (mean, 19.83) or Nursery (mean, 21.75) subjects. The difference in number of trials for Kindergarten and Nursery subjects was not significant.

The comparison within each age group showed no significant differences among the three tasks for any of the four age groups. However, examination of the means showed patterns similar to those noted for the number of errors measure. The Adult Level Task was learned slowest of the three tasks by the youngest group while the Preschool Level Task was most difficult for the three oldest groups.

The Tukey procedure following the significant interaction between task and condition (experimental or control) revealed that all three experimental tasks required fewer trials for learning than the three control tasks. There were no significant differences among the three control tasks. The means for the Adult, Intermediate, and Preschool Control Tasks combined over age were 11.81, 12.14, and

11.92, respectively. For the experimental tasks, the Intermediate Level Task (mean, 4.62) required significantly fewer trials than the Preschool (mean, 6.08) or the Adult (mean, 5.95) Level Tasks. There was no significant difference in number of trials between the Preschool Level Task and the Adult Level Task.

The three way interaction between age, task and condition (experimental or control) was significant at the .05 level. The results of the Tukey procedure showed no differences among the three control tasks for any of the four age groups, as predicted since the correct responses on all of these tasks were randomly determined. These means are shown in Table 15. This lack of difference indicates that the stimulus words were of relatively equal difficulty and suggests that differences found among the three experimental tasks can be attributed to differences resulting from the conceptual relationship among items, rather than to differences in stimulus difficulty. For each control task, there were a number of significant differences among the four age groups. These were expected and reflect age differences in learning. In all cases, for example, Third Graders learned significantly faster than Nursery subjects. No significant differences were found between Nursery and Kindergarten subjects. First Grade subjects showed a learning rate between that of the Third Graders and the two younger groups.

Comparing the subjects' scores on the three experimental tasks, Third Grade subjects showed no significant differences. For First Grade and Kindergarten subjects, the only significant difference was

between the Intermediate Level Task and the Preschool Level Task; the Intermediate Level Task required significantly fewer trials. For Nursery subjects, the Preschool Level Task and the Intermediate Level Task were not significantly different; both of these tasks required significantly fewer trials than the Adult Level Task. These means are shown in Table 16.

When the control task data were excluded and scores were examined for experimental tasks alone, it was found that for the Adult Level Task, the performance of the two older groups was statistically similar to each other and significantly better than those of the two younger groups. The difference between the two younger groups was not significant. For the Adult Level Task, the means showed that the Third Grade subjects learned most rapidly, followed by First Grade, Kindergarten, and Nursery subjects, in that order.

For the Intermediate Level Task, the same basic pattern of performance held as in the Adult Level Task with the exception that the First Grade and Nursery Groups were not significantly different. For this task, the means showed that Third Grade subjects learned fastest followed by First Grade, Nursery, and Kindergarten subjects, in that order.

For the Preschool Level Task, the performance pattern was quite different. The performances of the oldest group (Third Grade) and the youngest group (Nursery) were statistically similar. Both of these groups learned significantly faster than the Kindergarten Group, and the Third Grade Group learned significantly faster than the First

Grade Group. The order of the means was as follows: Third Grade, Nursery, First Grade, and Kindergarten.

A summary of the additional analysis of variance for trials using all of the experimental task sets is shown in Table 17. Means for this analysis are shown in Table 18. The findings are the same as those of the main analysis for trials with the exception of a significant interaction between age and AQ position in the analysis using all sets.

In summary, analysis of the number of trials measure indicated significant differences associated with age, condition (experimental or control), position of AQ, and the three levels of the task representing three of Piaget's stages of animistic thinking. For the Third Grade, First Grade and Nursery Groups, having the AQ before the tasks resulted in faster learning on the experimental tasks. The significant interaction between age, condition and task showed that the Intermediate Level Task was learned fastest by the Kindergarten and First Grade Groups, and that the Preschool and Intermediate Level Tasks were learned equally rapidly by the Nursery Group. There were no significant differences among tasks for Third Graders on this measure.

Summary. The analyses of the number of sets to concept learning, number of errors and number of trials all showed that age was a highly significant factor. In general, older subjects learned faster than younger ones. There were exceptions in the cases of some of the experimental tasks in which various conceptual levels

Table 17

Summary of Analysis of Variance for

Number of Trials Using all Experimental Task Sets

Source	df	MS	F
Between Ss:			
Age (A)	3	303.29	13.11***
Position of AQ (AQ)	1	213.55	9.23**
A X AQ	3	83.73	3.62*
Between Ss	95		
Within Ss:			
Task (T)	2	196.95	15.90***
T X A	6	58.54	4.72***
T X AQ	2	.77	<1
T X A X AQ	6	14.96	1.21
Within Ss	192		

*$p < .025$
**$p < .005$
***$p < .001$

Table 18

Mean Total Number of Trials to Learning with All Sets Included for Four Age Groups on Three Experimental Tasks

Group	Position of AQ	Preschool Task	Intermediate Task	Adult Task
Nursery	AQ First	4.58	4.75	10.50
	AQ Last	8.17	7.50	10.75
	Total	6.38	6.12	10.62
Kindergarten	AQ First	12.33	6.42	10.08
	AQ Last	8.75	5.75	10.25
	Total	10.54	6.08	10.17
First Grade	AQ First	5.92	3.08	4.25
	AQ Last	9.67	5.92	8.67
	Total	7.79	4.50	6.46
Third Grade	AQ First	3.50	2.42	2.83
	AQ Last	5.95	5.08	4.92
	Total	4.71	3.75	3.88

were represented. For example, the Nursery Group learned the Preschool Level Task in significantly fewer sets than the Kindergarten or First Grade Groups.

The presence of a concept applicable to all pairs in a task was also a highly significant factor. In all instances, experimental tasks were learned more quickly than control tasks in which the correct stimulus was randomly assigned. Within each age group, there were no significant differences in learning rate among the three control tasks. This indicates that the specific stimulus words which were used in both control tasks and experimental tasks at a given level were equivalent in difficulty across concept levels.

For all measures, presenting the AQ before the discrimination tasks resulted in faster learning on experimental tasks. As expected, this factor had no consistent effect on control task learning. Position of the AQ tended to have a greater effect on older subjects, overall, but not for specific tasks or age groups.

For two measures, number of trials and number of sets to concept learning, the task and its interaction with age were significant factors. For the Third Grade Group, there was no significant difference in learning among the three experimental tasks. The means, however, showed that the Adult Level Task was learned fastest and the Preschool Level Task was learned slowest. For the First Grade Group, the Intermediate Level Task was learned significantly faster than the Preschool Level Task; the Adult Level Task fell between these two tasks.

The Kindergarten Group showed significantly faster learning on the Intermediate Level Task than on the Adult or the Preschool Level Tasks. Both of these groups functioned best at the Intermediate Level, however, the First Grade Group seemed to be transitional in the direction of the Adult Level concept. The Nursery Group showed similar learning rates on the Preschool and the Intermediate Level Tasks and both of these tasks were learned significantly faster than the Adult Level Task. This suggests a transitional stage of functioning. Only half of the subjects in each of the Nursery and Kindergarten Groups reached criterion for concept attainment on the Adult Level Task. This, along with the data from the other two measures, points up the difficulty these younger subjects had with the task representing the most advanced level of the concept. The older groups displayed more access on the Adult Level Task. There were no significant differences in number of subjects from the four groups who reached criterion for concept attainment on the Preschool or Intermediate Level Tasks.

Other Measures

Ability to verbalize concepts. Following the presentation of an experimental task, its control, and the unreinforced task, each subject was asked to explain the basis of his/her responding. The ability to correctly verbalize what had been learned was examined using a series of chi-square analyses. Significant differences associated with age were found for each of the tasks (Adult Task: $X^2 = 36.57$, $df = 3$, $p < .001$; Intermediate Task: $X^2 = 21.73$, $df =$

3, $p < .001$; Preschool Task: $X^2 = 15.83$, $df = 3$, $p < .01$). The number of subjects in each age group who correctly verbalized their solutions to the three tasks is shown in Table 19. For all three tasks, only in the Third Grade Group did a significant number of subjects correctly describe verbally, the basis for their responding on the tasks. As Table 19 shows, only one Nursery subject and one Kindergarten subject were able to correctly verbalize their solutions and then only on one task each. No First Graders were able to correctly verbalize their solutions. Typical explanations given by subjects in the three younger groups included: "My brain tells me the right one to pick."; "I think it in my mind."; "I'm just smart."; and most often, "I don't know." Of the 12 Third Graders who gave correct explanations on the Adult Task, 11 used the words "alive" or "living" in their responses and one described the correct stimuli as being "animals or plants." On the Intermediate Task, seven of the eight scorable explanations used "alive" or "living" and one referred to "people or moving things." The five relevant responses on the Preschool Task included one reference to "living," two to "living and moving," and two to "moving." Seven of the correct Adult Task explanations were given spontaneously during the task. Four were given spontaneously during the Intermediate Task and two during the Preschool Task. The spontaneous verbalizations of subjects who did not correctly explain their responses on the tasks related to their feelings about the task (i.e., fun, hard, easy), reactions to particular stimuli (i.e., "I have a dog."), and to topics unrelated to the

tasks (i.e., vacations, friends, teachers).

Table 19

Number of Subjects in Four Age Groups Who Correctly Verbalized their Solutions on Three Experimental Tasks

Group	Adult Task	Intermediate Task	Preschool Task
Nursery	0	0	1 (AQ First)
Kindergarten	1 (AQ First)	0	0
First Grade	0	0	0
Third Grade	AQ First 7 AQ Last 5 Total 12	AQ First 4 AQ Last 1 Total 5	AQ First 6 AQ Last 2 Total 8

A further examination of the Third Grade data on ability to correctly verbalize solutions indicated a reliable difference associated with the three experimental tasks ($X^2 = 12.04$, $df = 2$, $p < .01$). As shown in Table 19, the most correct reponses were given on the Adult Level Task followed by the Intermediate and Preschool Level Tasks, in that order. These subjects thus responded correctly most often on the task which they learned fastest and least often on the task which they learned slowest. And Third Graders who had the AQ before the tasks were more likely to correctly explain their solutions than those who had the AQ after the tasks ($X^2 = 4.96$, $df = 1$, $p < .05$). The data

for each of the three measures of task learning showed a trend toward faster learning on the three experimental tasks among subjects who correctly explained their responses on those tasks. This trend, however, was not significant ($t = 1.52$, $df = 70$, $p < .05$).

Categories of errors on experimental tasks. Backward learning curves for number of trials to concept learning provided no conclusive evidence for either continuous or step-wise learning for the concept of alive. It seemed possible that subjects were separately learning the simpler concepts (i.e., people, animals, plants, movement) represented within each of the levels of the concept of alive. In order to explore this, the types of errors made on the three experimental tasks were analyzed. For each of the tasks, the number of errors made by subjects in four age groups on each of the three categories of positive stimuli represented by the task was examined using a mixed design analysis of variance with repeated measures on the three types of stimuli. Position of the AQ was included in all three analyses of categories of errors since it had been a significant factor in earlier analyses of number of errors.

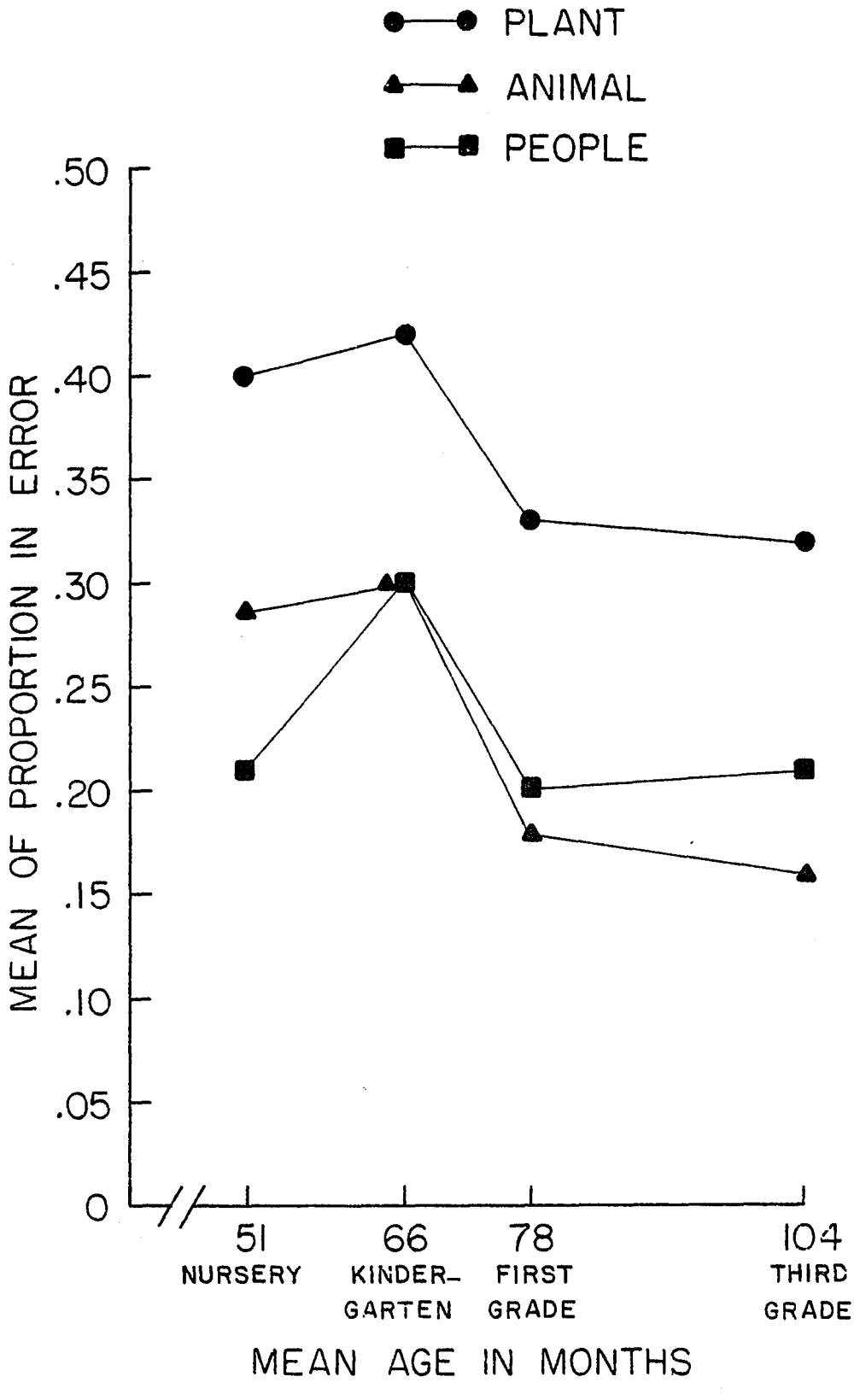
Adult Level Task. The positive stimuli for the Adult Task fell into the categories of People, Animals, and Plants. Mean scores of the proportion in error for these three types of stimuli for four age groups divided according to the order of presentation of the AQ are shown in Table 20. Figure 6 shows the means combined over position of AQ. Proportions were used because the number of pairs involving People, Animal, and Plant Stimuli in each of the Adult Level

Table 20

Mean Proportion in Error for Plant, Animal and People Stimuli on Adult Level Task for Four Age Groups and Two Positions of the Animism Questionnaire

Group	Position of AQ	Plant Stimuli	Animal Stimuli	People Stimuli	Total
Nursery	AQ First	.41	.28	.19	.30
	AQ Last	.38	.30	.23	.30
	Total	.40	.29	.21	.30
Kindergarten	AQ First	.42	.30	.30	.34
	AQ Last	.41	.29	.30	.33
	Total	.42	.30	.30	.34
First Grade	AQ First	.32	.14	.14	.20
	AQ Last	.34	.22	.26	.27
	Total	.33	.18	.20	.24
Third Grade	AQ First	.31	.12	.13	.19
	AQ Last	.32	.21	.28	.27
	Total	.32	.16	.21	.23
TOTAL		.36	.23	.23	

Figure 6. Mean proportion in error on three categories of positive stimuli on the Adult Level Task for four age groups.


PLANT
ANIMAL
PEOPLE
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
0
MEAN OF PROPORTION IN ERROR
51
NURSERY
66
KINDER-
GARTEN
78
FIRST
GRADE
104
THIRD
GRADE
MEAN AGE IN MONTHS

Task sets was not equal. Figure 6 clearly indicates that over the entire age range, Plant Stimuli were harder to learn than either People or Animal Stimuli and that People and Animal Stimuli did not differ consistently.

The results of the analysis of variance are summarized in Table 21. The age ($p < .001$) and AQ ($p < .05$) factors were significant in the present analysis. This was expected on the basis of earlier analyses of total number of errors.

The stimulus factor (People, Animal, Plant) was significant at the .001 level. This indicated that the stimuli representing the three attributes of this concept level were learned at different rates. A Tukey procedure showed that Plant Stimuli (mean, .36) were learned significantly slower than either People (mean, .23) or Animal (mean, .23) Stimuli. No significant difference in number of errors between People and Animal Stimuli was found.

None of the interactions was significant in this analysis. There was an expectation that Plant Stimuli would be relatively more difficult for younger subjects than for older subjects but this was not the case.

Intermediate Level Task. For the Intermediate Task, the positive stimulus categories were People, Animals, and Spontaneous Movement. Figure 7 and Table 22 show the mean scores of the proportion in error for the three types of stimuli for four age groups. Table 23 contains a summary of the analysis of variance. For the Intermediate Level Task, position of the AQ was not a significant variable in determining

Table 21

Analysis of Variance on the Effects of Age, Animism Questionnaire Position, and Type of Stimuli on Errors on the Adult Level Task

Source	df	MS	F
Between Ss:			
Age (A)	3	.2021	8.4208**
Position of AQ (AQ)	1	.1089	4.5375*
A X AQ	3	.0378	1.5750
Between Ss	95		
Within Ss:			
Type of Stimuli (S)	2	.5646	33.6071**
S X A	6	.0198	1.1786
S X AQ	2	.0356	2.1190
S X A X AQ	6	.0065	< 1
Within Ss	192		

*$p < .05$
**$p < .01$

Figure 7. Mean proportion in error on three categories of positive stimuli on the Intermediate Level Task for four age groups.

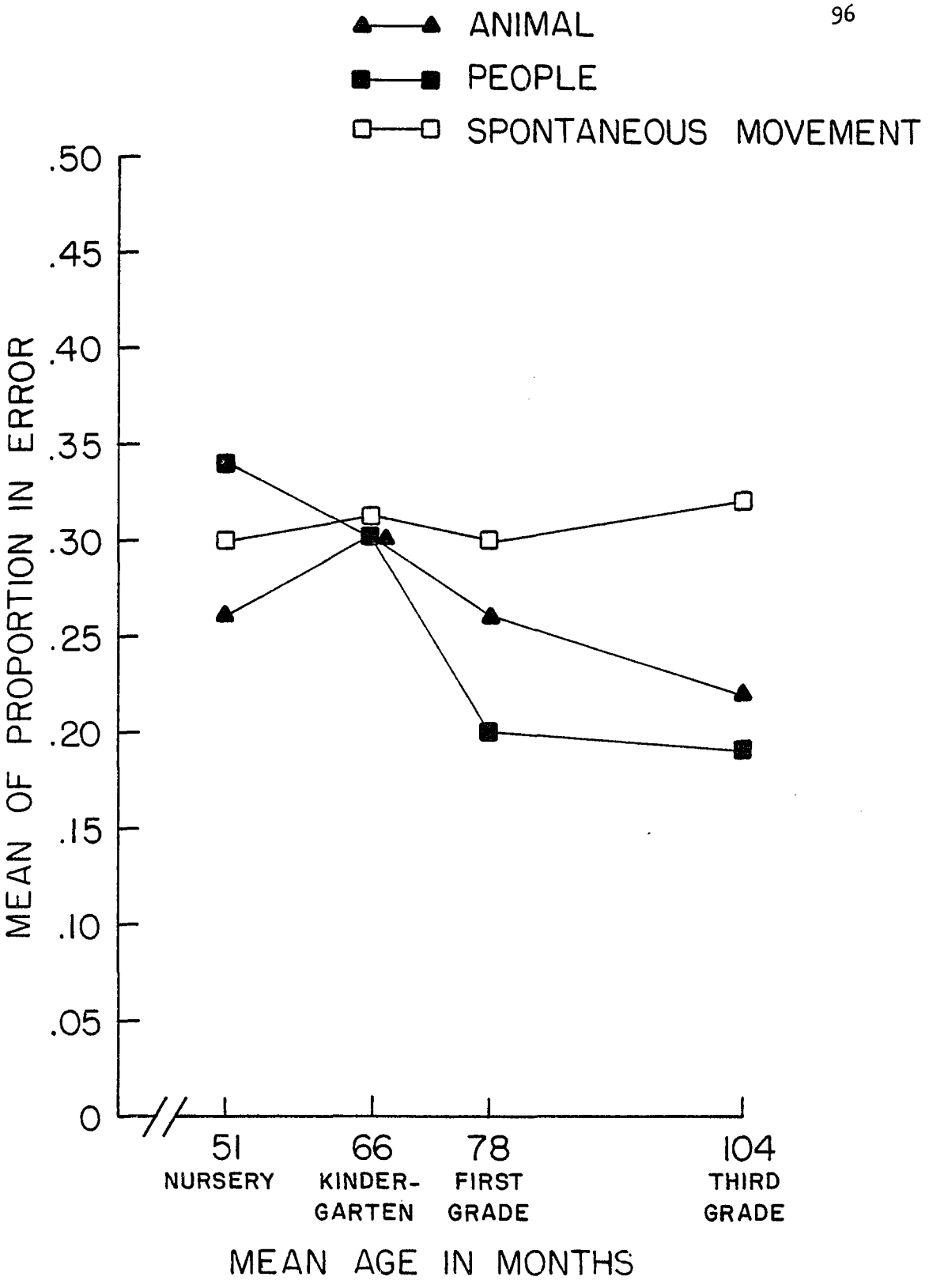

ANIMAL
PEOPLE
SPONTANEOUS MOVEMENT
MEAN OF PROPORTION IN ERROR
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
0
51
NURSERY
66
KINDER-
GARTEN
78
FIRST
GRADE
104
THIRD
GRADE
MEAN AGE IN MONTHS

Table 22

Mean Proportion in Error for People, Animal, and Spontaneous Movement Stimuli on the Intermediate Level Task for Four Age Groups and Two Positions of the Animism Questionnaire

Group	Position of AQ	People Stimuli	Animal Stimuli	Movement Stimuli	Total
Nursery	AQ First	.38	.26	.34	.33
	AQ Last	.30	.27	.27	.28
	Total	.34	.26	.30	.30
Kindergarten	AQ First	.35	.29	.33	.32
	AQ Last	.27	.33	.30	.30
	Total	.31	.31	.32	.31
First Grade	AQ First	.18	.27	.25	.23
	AQ Last	.21	.24	.34	.26
	Total	.20	.26	.30	.24
Third Grade	AQ First	.15	.19	.32	.22
	AQ Last	.23	.26	.31	.26
	Total	.19	.22	.32	.24
TOTAL		.26	.26	.31	

Table 23

Analysis of Variance of the Effects of Age, Animism Questionnaire, and Type of Stimuli on Errors on the Intermediate Level Task

Source	df	MS	F
Between Ss:			
Age (A)	3	.103	4.68**
Position of AQ (AQ)	1	.010	< 1
A X AQ	3	.033	1.50
Between Ss	95		
Within Ss:			
Type of Stimuli (S)	2	.080	3.20*
S X A	6	.042	1.60
S X AQ	2	.0005	< 1
S X A X AQ	6	.023	< 1
Within Ss	192		

*p < .05
**p < .005

number of errors for any of the four age groups. Position of the AQ was a significant factor in analyses of number of errors on the Adult and Preschool Tasks. As in the other analyses of number of errors, age was a highly significant variable in the present analysis ($p < .005$).

The analysis of variance showed that type of stimulus significantly effected the number of errors ($p < .05$). A Tukey procedure, however, indicated no significant difference in number of errors between any of the three types of stimuli. The difference between both People (mean, .26) and Animal (mean, .26) Stimuli, and Spontaneous Movement Stimuli (mean, .31) approached the .05 significance level. This discrepancy may be a function of the conservative nature of the Tukey test. As Winer (1962, p. 87) notes, it tends to result in too few significant differences. None of the interactions in the present analysis was significant.

Preschool Level Task. The positive stimulus categories for the Preschool Task were People, Animals, and General Movement. Mean scores of the proportion in error for the three types of stimuli for four age groups are shown in Figure 8 and Table 24. No consistent trend is apparent in Figure 8 and Table 24 across all ages, however, Movement Stimuli were easiest for the two younger groups and People Stimuli were easiest for the two older groups.

The results of the analysis of variance are summarized in Table 25. As was the case for earlier analyses of number of errors, age and position of the AQ were again significant factors. There was

Figure 8. Mean proportion in error on three categories of positive stimuli on the Preschool Level Task for four age groups.

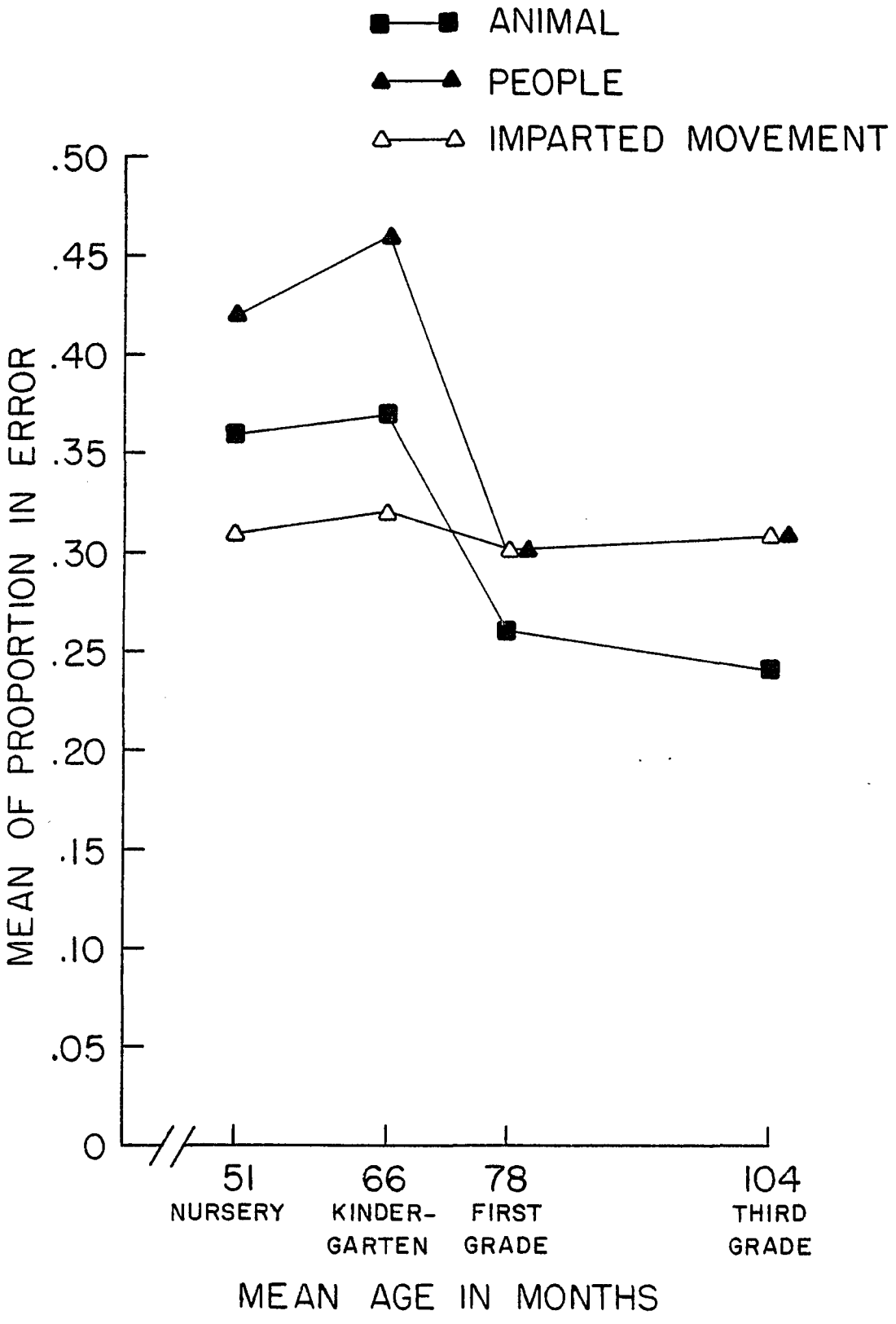

ANIMAL
PEOPLE
IMPARTED MOVEMENT
MEAN OF PROPORTION IN ERROR
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
0
51
NURSERY
66
KINDER-
GARTEN
78
FIRST
GRADE
104
THIRD
GRADE
MEAN AGE IN MONTHS

Table 24

Mean Proportion in Error for People, Animal, and General Movement Stimuli on the Preschool Level Task for Four Age Groups and Two Positions of the Animism Questionnaire

Group	Position of AQ	People Stimuli	Animal Stimuli	Movement Stimuli	Total
Nursery	AQ First	.25	.36	.23	.28
	AQ Last	.46	.48	.38	.44
	Total	.36	.42	.31	.36
Kindergarten	AQ First	.29	.46	.29	.34
	AQ Last	.44	.45	.35	.41
	Total	.37	.46	.32	.38
First Grade	AQ First	.24	.27	.27	.26
	AQ Last	.27	.33	.33	.31
	Total	.26	.30	.30	.29
Third Grade	AQ First	.15	.24	.16	.18
	AQ Last	.33	.38	.26	.32
	Total	.24	.31	.31	.25
TOTAL		.30	.37	.28	

Table 25

Analysis of Variance of the Effects of Age, Animism Questionnaire Position, and Type of Stimuli on Errors on the Preschool Level Task

Source	df	MS	F
Between Ss:			
Age (A)	3	.26	4.6*
Position of AQ (AQ)	1	.79	12.34**
A X AQ	3	.06	.94
Between Ss	95		
Within Ss:			
Type of Stimuli (S)	2	.20	13.33**
S X A	6	.03	2.00
S X AQ	2	.04	2.67
S X A X AQ	6	.03	2.00
Within Ss	192		

*$p < .05$
**$p < .001$

also a significant relationship between numbers of errors and type of stimuli ($p < .001$). The stimuli representing the three attributes were thus learned at significantly different rates. A Tukey procedure showed that Animal Stimuli (mean, .37) were learned significantly slower than either People (mean, .30) or General Movement (mean, .28) Stimuli. There was no significant difference in number of errors between People and General Movement Stimuli. No significant interactions were found.

Categories of errors on control tasks. The three control tasks contained the same stimuli as the three experimental tasks but on the control tasks, reinforcement was randomly determined rather than determined by a level of the concept of alive described by Piaget. This meant that stimuli representing the concept of alive were sometimes positive and sometimes negative on the control tasks. The control task errors made on the three stimulus categories in each control task which were positive in the experimental tasks were examined to determine whether any stimulus bias existed.

The mean number of errors for subjects at four ages when these stimulus categories were positive and negative on the three control tasks are shown in Tables 26, 27, and 28. The probabilities associated with these errors were determined by sign tests and are also indicated in the above tables. The means for Plant Stimuli in the Adult Task, Spontaneous Movement Stimuli in the Intermediate Task, and Imparted Movement Stimuli in the Preschool Task have all been prorated because these categories contained more instances than the

Table 26

Mean Number of Errors and Probability of Errors on Three Stimulus Categories when Category was Positive or Negative for Four Age Groups on the Adult Control Task

Group	Stimulus Category					
	People		Animal		Plant	
	+	-	+	-	+	-
Nursery	6.42	5.92	5.46	7.75	5.66*	6.74*
	p = .18 (N=21, X=7)		p = .30 (N=24, x=9)		p = .66 (N=23, x=10)	
Total	12.33		13.21		12.40*	
Kindergarten	5.12	7.58	6.29	5.58	4.86*	6.32*
	p = .66 (N=23, x=10)		p = .40 (N=23, x=9)		p = .26 (N=20, x=7)	
Total	12.71		11.88		11.18*	
First Grade	5.33	4.58	4.42	5.62	5.34*	4.69*
	p = .30 (N=24, x=9)		p = .38 (N=21, x-8)		p = .50 (N=20, x=8)	
Total	9.92		10.04		10.03*	
Third Grade	4.92	5.08	5.00	3.58	5.07*	4.83*
	p = .36 (N=19, x=7)		p = .50 (N=20, x=8)		p = .52 (N=22, x=9)	
Total	10.00		8.58		9.90*	

*Prorated Mean (x 10/12)

Table 27

Mean Number of Errors and Probability of Errors on Three Stimulus Categories when Category was Positive or Negative for Four Age Groups on the Intermediate Control Task

Group	Stimulus Category					
	People		Animal		Plant	
	+	-	+	-	+	-
Nursery	6.46	7.08	6.83	6.12	6.80*	6.22*
	$p = \frac{1.16}{(N=20,\ x=10)}$		$p = \frac{.20}{(N=23,\ x=8)}$		$p = \frac{.30}{(N=24,\ x=9)}$	
Total	13.54		12.96		13.02*	
Kindergarten	5.21	6.58	5.67	6.71	6.81*	6.25*
	$p = \frac{.38}{(N=21,\ x=8)}$		$p = \frac{.54}{(N=24,\ x=10)}$		$p = \frac{.52}{(N=22,\ x=8)}$	
Total	11.79		12.38		13.03*	
First Grade	4.71	4.46	5.12	5.42	5.35*	5.14*
	$p = \frac{.54}{(N=24,\ x=10)}$		$p = \frac{.28}{(N=22,\ x=8)}$		$p = \frac{.40}{(N=23,\ x=9)}$	
Total	9.17		10.54		10.48*	
Third Grade	5.54	3.71	5.17	4.54	4.17*	5.56*
	$p = \frac{.40}{(N=23,\ x=9)}$		$p = \frac{.66}{(N=21,\ x-9)}$		$p = \frac{.50}{(N=20,\ x=8)}$	
Total	9.25		9.71		9.72*	

*Prorated Mean (x 10/12)

Table 28

Mean Number of Errors and Probability of Errors on Three Stimulus Categories when Category was Positive or Negative for Four Age Groups on the Preschool Control Task

Group	Stimulus Category					
	People		Animal		Plant	
	+	-	+	-	+	-
Nursery	5.33	5.12	4.50	5.46	4.23*	5.79*
	$p = .67$ (N=23, x=10)		$p = .40$ (N=23, x=9)		$p = .82$ (N=22, x=10)	
Total	10.46		9.96		10.02*	
Kindergarten	5.88	4.25	4.12	5.00	4.23*	5.19*
	$p = .26$ (N=20, x=7)		$p = 1.0$ (N=23, x=11)		$p = .82$	
Total	10.12		9.12		9.73*	
First Grade	4.71	3.88	3.46	4.62	4.14*	8.50*
	$p = .67$ (N=23, x=10)		$p = .30$ (N=24, x=9)		$p = .38$ (N=21, x=8)	
Total	8.58		8.08		8.40*	
Third Grade	3.78	3.75	4.04	4.50	4.29*	4.08*
	$p = .54$ (N=24, x=10)		$p = .18$ (N=21, x=7)		$p = .52$ (N=22, x=9)	
Total	7.12		8.54		8.40*	

*Prorated Mean (x 8/16)

other two categories in each task. People and Animal Stimuli were equally represented within each task. In no case was a significant difference found between number of errors when a category was positive and when it was negative. It is thus assumed that there was no consistent bias within any of the categories which represented levels of the concept of alive on the experimental tasks.

Unreinforced tasks. The unreinforced tasks were scored by determining the number of responses each subject made to the "more alive" stimulus in each stimulus pair for the three tasks. Proportions were used to report the results since the scores for the Adult and Intermediate Level Tasks were based on eight pairs, while the scores for the Preschool Level Task were based on four pairs. Subjects' responses to the negative pairs in the Preschool Level Task revealed no discernible patterns. These pairs were made up of two No Movement Stimuli and thus neither stimulus was more alive than the other according to Piaget's stages. The mean proportion of responses to the more positive or more alive member of the unreinforced stimulus pairs for the three tasks for four ages are shown in Table 29.

It is noted that the pattern found here is similar to those reported earlier for the other measures of learning on these three tasks. The Nursery Group gave a greater proportion of more alive responses on the two lower level tasks, while the Kindergarten Group chose the more alive stimulus most often on the Intermediate Task. The two older group's highest score was on the Adult Task.

Table 29

Mean Proportion of Responses to the More Alive Member of the Unreinforced Stimulus Pairs on Three Tasks for Four Age Groups

Group	Preschool Task	Intermediate Task	Adult Task
Nursery	.81	.84	.55
Kindergarten	.67	.86	.59
First Grade	.75	.83	.90
Third Grade	.63	.83	.92

Relationship Between the Experimental Tasks and the Animism Questionnaire

Stage of functioning on the Animism Questionnaire compared to that on the experimental tasks. A comparison of stage of functioning on the AQ and best performance on the experimental tasks was inconclusive. Only Stage IV on the AQ had enough representation to make a meaningful comparison. Best performance on the tasks was defined as the modal task when number of errors, number of trials and number of sets to learning were compared. For the three youngest groups in Stages IVa and IVb on the AQ, the Intermediate Task was both the modal and the median task when comparisons were made for each group. For the oldest group, AQ Stage IVa contained only two subjects and no

comparisons were made. For Stage IVb, the modal and the median task for this group was the Adult Task. The best performance on experimental tasks thus seems to be related to age rather than to AQ stage for these subjects.

An examination of performance on the AQ by subjects divided above and below the median in number of sets for concept learning on the tasks also showed no relationships. The majority of all subjects functioned at either Stage IVa or IVb on the AQ. There was no pattern of concept learning associate with either of these AQ stages or with any of the other stages.

A comparison of AQ stage and task performance as reflected in number of errors to set learning showed few definitive trends. In order to increase the frequencies, subjects were grouped into a younger group (Nursery and Kindergarten) and an older group (First Grade and Third Grade). The frequencies in the four stages on the AQ which were compared ranged from three to 29. Figures 9 and 10 show these comparisons; clearly differences are remarkably small.

For both age groups, transitional Stage III-IV subjects showed slowest learning on the Preschool Task, followed by the Intermediate Task and the Adult Task, in that order. Both Stage IVa groups, on the other hand, showed slowest learning on the Adult Task and fastest learning on the Intermediate Task. The Stage IVb younger group also followed this pattern. The older Stage IVb group learned the Adult Task fastest followed by the Intermediate Task and the Preschool Task, in that order.

Figure 9. Mean number of errors on three experimental tasks for subjects in the Nursery and Kindergarten Groups at four stages of animistic thinking.

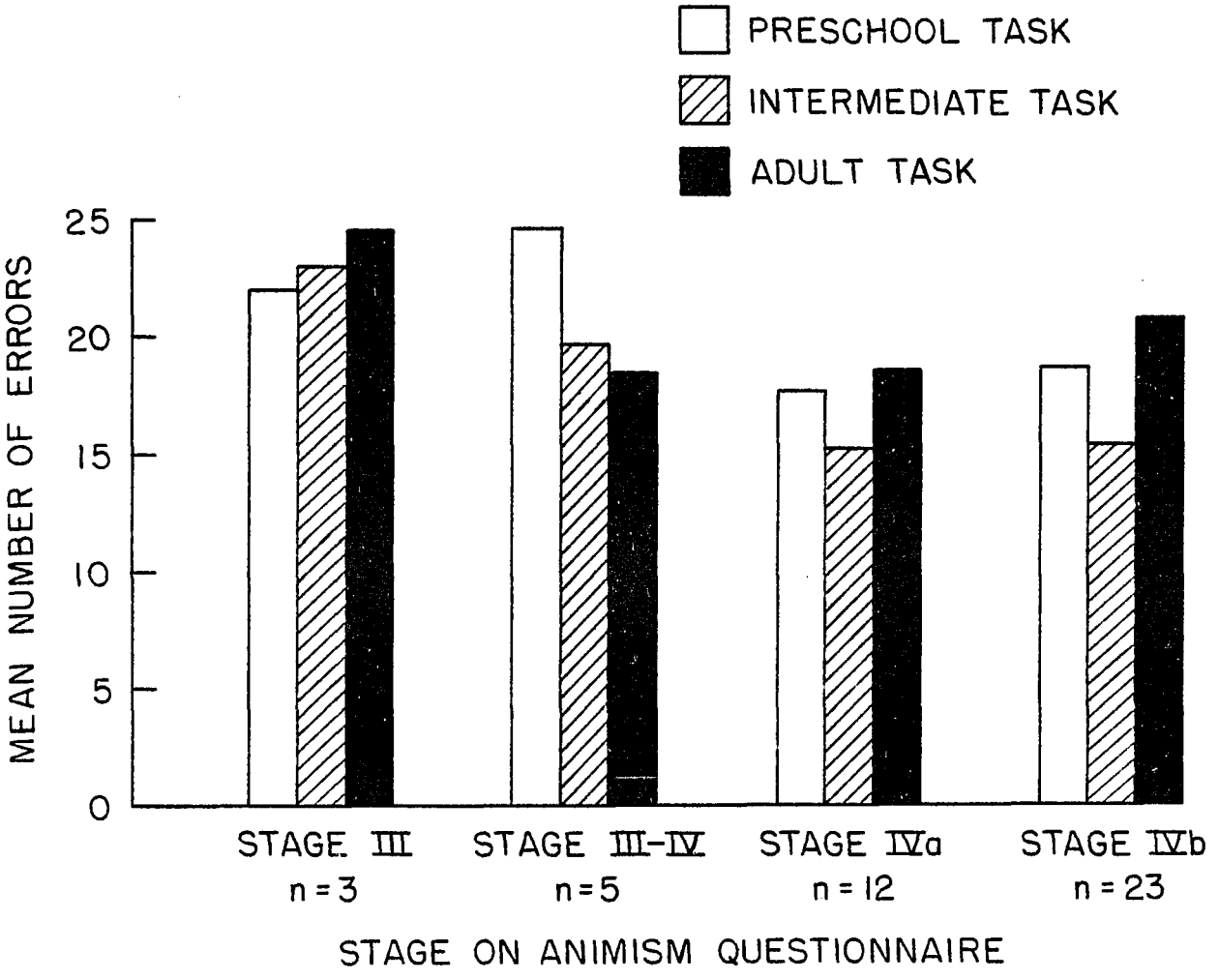
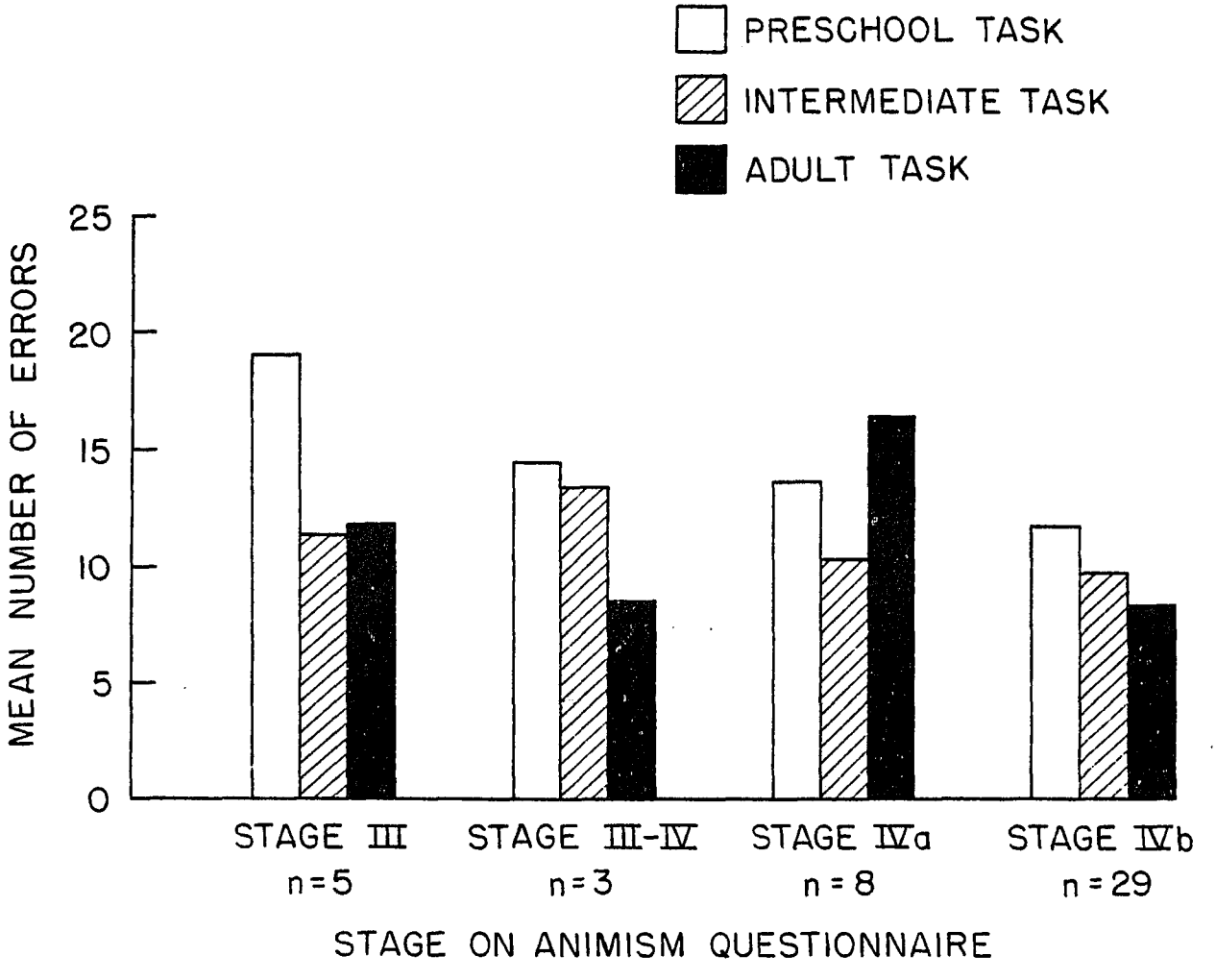

PRESCHOOL TASK
INTERMEDIATE TASK
ADULT TASK
MEAN NUMBER OF ERRORS
25
20
15
10
5
0
STAGE III
n = 3
STAGE III–IV
n = 5
STAGE IVa
n = 12
STAGE IVb
n = 23
STAGE ON ANIMISM QUESTIONNAIRE

Figure 10. Mean number of errors on three experimental tasks for subjects in the First Grade and Third Grade Groups at four stages of animistic thinking.


PRESCHOOL TASK
INTERMEDIATE TASK
ADULT TASK
MEAN NUMBER OF ERRORS
25
20
15
10
5
0
STAGE III
n=5
STAGE III-IV
n=3
STAGE IVa
n=8
STAGE IVb
n=29
STAGE ON ANIMISM QUESTIONNAIRE

Errors on Plant Stimuli on the Adult Level Task and animistic responses to Plant Stimuli on the Animism Questionnaire. A comparison of the number of errors on Plant Stimuli on the Adult Task and the number of animistic responses to Plant Stimuli on the AQ for four ages was done by means of a Pearson product-moment correlation (r). The obtained correlations were as follows: Nursery, $r = .38$; Kindergarten, $r = .006$; First Grade, $r = .03$; Third Grade, $r = .17$. These do not indicate significant relationships between Plant Stimuli errors on the two measures.

Errors on Spontaneous Movement Stimuli on the Intermediate Level Task and animistic responses to Spontaneous Movement Stimuli on the Animism Questionnaire. Errors on Spontaneous Movement Stimuli on the Intermediate Task and animistic responses to Spontaneous Movement Stimuli on the AQ were also compared. The correlations obtained were as follows: Nursery, $r = .12$; Kindergarten, $r = .20$; First Grade, $r = .05$; Third Grade, $r = .15$. Like those for the Plant Stimuli errors, these correlations are low and do not suggest a relationship between the Spontaneous Movement errors on the Intermediate Task and on the AQ.

CHAPTER V

SUMMARY OF RESULTS

Animism Questionnaire

The AQ protocols showed a striking lack of internal consistency. Responses representing several stages of animism were found within single protocols. Animism stage assignment based on mean and modal responses resulted in classification of the majority of subjects from each age group at Stage IV, the adult stage. The AQ thus did not reflect an overall differential use of the concept levels associated with age. A more detailed analysis of the AQ showed some age related trends. More scientific criteria were used by older subjects, Third Graders gave fewer animistic responses to Plant Stimuli than did younger subjects, and only Nursery subjects gave animistic responses to Animal or General Movement Stimuli. For all ages, the Adult category was used significantly more often for inclusion than for exclusion. No relationships were found between performance on the AQ and performance on the discrimination tasks at any age.

Discrimination Tasks

The results showed that age was a highly significant factor in determining performance on the three discrimination tasks. Older subjects learned faster than younger ones on most measures for these tasks. The exceptions were related to the conceptual levels represented by the tasks. For each age group on each task, the experimental task was learned faster than its control indicating that the

concept represented in the experimental task was used to speed learning. There were no significant differences in learning among the three control tasks for any of the four age groups.

A relationship was demonstrated between age and learning on the three tasks representing three of Piaget's stages of animism. Third Graders did best on the Adult Task. First Graders were transitional and did equally well on the Adult and Intermediate Tasks. Kindergarten subjects' best performance was on the Intermediate Task, and Nursery subjects were transitional between the Preschool and Intermediate Levels. Only half of the subjects in each of the Nursery and Kindergarten groups reached criterion for concept attainment on the Adult Level Task.

An examination of the errors on the experimental tasks indicated that the categories of stimuli contained within each concept level were differentially learned. On the Adult Task, Plant Stimuli accounted for the most errors at each age level. No significant relationship among categories was found for the Intermediate Task, however, means showed more errors on Spontaneous Movement Stimuli for the two older groups. Animal Stimuli were learned significantly slower than either People or General Movement Stimuli on the Preschool Task.

Presenting the AQ before the tasks resulted in significantly faster learning on the experimental tasks for all measures. The position of the AQ had no consistent effect on the control tasks. In general, this factor had a greater effect on older subjects.

The ability to correctly explain what had been learned in the experimental tasks was clearly age related. Only two subjects in the younger groups could correctly explain their basis of responding on any of the tasks. Many Third Graders could do this. Among the Third Graders, significantly more correct explanations were given on the Adult Level Task.

CHAPTER VI

DISCUSSION

Children in four age groups, four, five, six, and eight year olds, were presented with a standardized Animism Questionnaire, three verbal-concept discrimination learning tasks based on three stages of animistic thinking as described by Piaget, and three control tasks, one based on each of the three discrimination tasks. Stimulus sets for each task included positive stimuli from categories representing three aspects noted by Piaget as characteristic of that particular stage of functioning. Half of the subjects in each group had the Animism Questionnaire before the discrimination tasks; half had it following the tasks. The order of the discrimination tasks and their controls was counterbalanced.

Age, condition (experimental or control), position of the Animism Questionnaire, and task level were highly significant factors in determining performance on the discrimination tasks. The three categories of stimuli within each concept level were differentially learned. Ability to correctly explain what had been learned on the tasks was age-related, with about half of the correct explanations being given spontaneously during the tasks. Other spontaneous verbalizations during the tasks were unrelated to the concept.

Subjects' responses on the Animism Questionnaire showed a lack of internal consistency. Responses reflecting several stages of animism were found within most individual protocols. Stage assignment based

on mean and modal responses led to a classification of Stage IV, the adult stage, for the majority of subjects at each age. Age trends related to the use of scientific criteria and the categories of animistic responses were found on the Animism Questionnaire. With the present data, no relationship was demonstrated between performance on the discrimination tasks and performance on the Animism Questionnaire at any of the four age levels.

The primary experimental questions which this study was designed to answer were first, whether children in this age range would use the various levels of the concept of alive defined by Piaget on the discrimination tasks and on the Animism Questionnaire; and second, the comparative usefulness of the two measures of children's use of the concept of alive, the verbal-concept discrimination task and the Animism Questionnaire.

To begin with the methodological question, the interview technique as represented in this study by the Animism Questionnaire was found to be of limited usefulness as a measure of children's understanding of the concept of alive. This is in contrast to the rich data produced by Piaget with his clinical method. His entire theory of animistic thinking in children grew out of studies using the interview method. It would seem to be the case that the power of the interview technique is seriously diminished when it is rigidly standardized.

The Animism Questionnaire in the standardized form first developed by Russell and Dennis (1939) as well as in forms incorporating

various refinements added by later investigators restricts the interviewer to standardized questions and so reduces opportunities to suggest responses to the children and also precludes asking relevant follow-up questions indicated by the child's responses. This kind of standardization has resulted in a technique which is far more controlled than Piaget's method but which does not yield the level of detailed data obtained by his clinical method.

It might be possible to construct a clinical interview method which is more objective than Piaget's and at the same time is effective in differentiating stages in children's use of the concept of alive but some compromise in the degree of standardization would be necessary. In such a questionnaire, the same items should be presented to each child as is the case in the Russell-Dennis questionnaire. Items defined as alive and not alive by children at each stage should be equally represented, as was done in the questionnaire used in the present study but not in the Russell-Dennis questionnaire.

The most important change required if the questionnaire is to produce significant data would be to allow some degree of flexibility in the inquiry. This change of course brings up the very questions of objectivity and reliability which are at the heart of the criticisms leveled at Piaget's method. If a questionnaire is to be really useful, however, some trade-off seems unavoidable. The line of questioning could be less suggestive than that used by Piaget and still be flexible enough to allow the examiner to pursue relevant themes in the child's responses until the level of functioning was clearly

indicated. The usefulness of such a compromise questionnaire is still to be determined, however, and the demonstrated effects of such factors as the forms of questions, the role of the examiner, and the particular items included must be dealt with.

In contrast to the limitations found to be associated with the Animism Questionnaire in the present study, the concept discrimination learning tasks produced data which are rich in detail while retaining the experimental control associated with laboratory studies. The data from the three discrimination tasks show that children in each of the four age groups make use of the concept of alive at one or more of the three higher levels postulated by Piaget. The three levels of the concept represented by the three tasks in the present study were used differently by subjects at different ages. As expected, the best performance by Third Graders, as a group, was on the Adult Task and the poorest on the Preschool Task. The First Graders did equally well on the Intermediate and Adult Tasks, and therefore appeared to be best described according to Piaget's classification as in a transitional stage. Kindergarten subjects clearly did best on the Intermediate Task. The Nursery group did equally well on the Preschool and Intermediate Tasks and consequently was also considered to be at a transitional stage. Both of the younger groups performed very poorly on the Adult Task.

The data from the discrimination tasks thus give clear support to the sequence of stages in the development of the concept of alive theorized by Piaget. The majority of past studies in the area of

children's concept of alive has also been interpreted as being in general agreement with Piaget's formulations. The bulk of this research employed some type of questionnaire method and because of this has been subjected to some of the same criticisms and questions as Piaget's work. It is thus important to note that in the present study, the data from the concept discrimination task which is a more objective technique than either the standardized animism questionnaire or Piaget's clinical method, basically confirm the stages in the development of the concept of alive described by Piaget and the sequence in which they occur.

An examination of the errors made by subjects on the three discrimination tasks further clarifies their use of the concept of alive. On the Adult Task, the Plant Stimuli are the most difficult for all four ages. Correct responding on these stimuli probably implies some understanding of the scientific criteria which define alive since these stimuli possess neither the animal nor movement features characteristic of earlier stages. First Grade and Third Grade subjects, who are presumably more knowledgeable about scientific criteria and are thus functioning at or near an adult level with respect to the concept of alive, make fewer errors on Plant Stimuli than either Nursery or Kindergarten subjects.

Animal and People Stimuli are about equally difficult for all but the Nursery Group. For these youngest subjects, People Stimuli are learned faster than Animal Stimuli on this task. Since Nursery-aged children are presumably at an earlier stage in the building of this

concept and also without the formal rules that scientific criteria will later supply, it is not surprising for people to be their best exemplar of this concept.

The most striking error finding on the Intermediate Task is the comparative difficulty which the Third Grade children have in learning the Spontaneous Movement Stimuli. First Graders have somewhat more difficulty with this category than with the other two. Nursery and Kindergarten subjects learn the Spontaneous Movement Stimuli no more slowly than the other categories. They seem to be applying a concept which includes all three of these categories of stimuli, as would be expected of children functioning at Piaget's Stage III. The older subjects, particularly the Third Graders, do not have as ready access to such a concept.

No obvious pattern of errors is seen in the data for Preschool Task. Although a Tukey procedure shows that overall, Animal Stimuli are learned significantly more slowly than either People or General Movement Stimuli, a careful examination of the data shows that this is a function of averaging over the four ages.

Rosch's (1973; Rosch & Mervis, 1975; Rosch et al., 1976) work on the internal structure of categories offers an interesting interpretation of the discrimination task error data and the animistic responses on the questionnaire. Rosch argues that psychological categories, including semantic categories, have internal structure which affects the way in which they are processed. By structure, she means that categories possess a core meaning and that instances of a cate-

gory differ in the extent to which they represent this meaning--there are more typical and less typical examples within categories. Rosch's (1973) data on semantic categories show that children (aged 9 to 11 years) learn more typical members of categories faster than less typical members.

Rosch proposes that the existence of an internal structure implies that defining a category in terms of its necessary attributes does not fully correspond to the category as a psychological unit. She suggests that attributes which formally define inclusion and exclusion in a category may not be the ones which define a more or less typical member. In considering the concept of alive, for example, it may be that spontaneous movement is an important attribute in defining a more typical member of the category even though it is not an attribute which is necessary for category membership at the adult level. Rosch theorizes that at first children probably define a category on the basis of its typical or clear cut cases rather than in terms of abstract criterial attributes.

Applying Rosch's theory of internal structure to the Adult Task error data suggests that Plant Stimuli, which are learned most slowly by all age groups, are less typical members of the category of alive than Animal or People Stimuli. When subjects are asked about the Plant Stimuli on the Animism Questionnaire, they are more likely to say that plants are not alive than that animals or people are not alive. The three youngest groups made many more errors on the Animism Questionnaire Plant Stimuli than the Third Grade Group did.

If children form their concept of alive in part by generalizing the characteristics which they perceive in themselves as Piaget and others have suggested, it is clear that plants would not be seen as very typical examples of the concept. In fact, the lack of either spontaneous movement or superficial human and animal characteristics are the reasons cited most frequently by subjects on the Animism Questionnaire for thinking that Plant Stimuli are not alive. Presence of spontaneous movement is also the reason given most on the Animism Questionnaire when non-living items are said to be alive. It would seem then, that movement and human and animal characteristics (which include such things as talking, eating, having a face or legs) are responded to by these children as being most typical of living things. The design of the present study does not, however, allow for definitive answers concerning the structure of the concept of alive.

The overall learning pattern of the older subjects on the discrimination tasks does support the contention that the internal structure of a concept is important in determining how exemplars will be responded to. First Grade and Third Grade subjects have difficulty learning concept levels representing stages through which they have already passed. They are no longer typical for these children. And half of the Nursery and Kindergarten subjects do not reach criterion for concept learning on the Adult Task which is presumably not typical for them. It would seem that Piaget's stages predict typicality at the concept level.

Additional research is needed to more fully explore the internal structure of the concept of alive. The theory and methods developed by Rosch and her associates seem directly relevant to such future study.

Another possible interpretation of the error data from the discrimination tasks is that rather than learning the concept of alive as a unitary whole, subjects learned it as a conglomerate concept. On the Adult Task, for example, subjects may learn three separate concepts, people, animals, and plants which then appear to operate like a single concept. The differential learning rates found for some of the stimulus categories within concept levels would support this explanation.

Pilot data had suggested that most children over five years of age would be able to correctly explain their use of the concept of alive to learn the tasks. In fact, only in the Third Grade Group was a significant number of subjects able to do this. Within this group, many more correct explanations were given for the Adult Task than for the other two tasks. This is also evidence for the role of the stage of animism. More children give correct explanations for their responses on the task which represents the level of the concept at which they are functioning.

With regard to the performance of the children on the Animism Questionnaire, a most striking finding was the lack of consistency in the use of criteria to define alive. Piaget's work leads one to expect that, with perhaps the exception of children at transitional

points, children will use the criteria reliably. In the present study, most children use criteria associated with several different stages of animistic thinking. In examining the protocols, it is noted that explanations characteristic of non-adjacent stages are frequently used by the same child. Apparently, vestiges of earlier stages continue long after the child is able to use more sophisticated explanations. In spite of the fact that the majority of subjects at all ages are classified at Stage IV, the adult stage, only three subjects classified all of the items on the questionnaire according to the adult definition of the concept. The rest gave animistic responses which reflect earlier stages.

These data presented a serious problem in classifying the children according to stage. Laurendeau and Pinard (1962) also reported this lack of systematization in their data. As a result, they chose not to use Piaget's stages to classify their subjects, but instead, developed a new set of composite stages. Essentially, they combined Piaget's Stages I and II into the earliest developmental stage, and then, defined an intermediate stage between this and their adult stage. The intermediate stage included responses in which autonomous movement was used to define alive as does Piaget's Stage III, but also allowed responses indicating "some residual of earlier thinking." Laurendeau and Pinard report dealing with the problem presented by responses from divergent stages contained in a single protocol by scoring each protocol as a "comprehensive unit based on the overall trend." How this trend was determined was not specified.

In the present study, because of a desire to compare Animism Questionnaire performance with performance on the discrimination tasks, it seemed preferable to use Piaget's stages to classify the Animism Questionnaire results. Because of the range of responses on individual Animism Questionnaire protocols, classification according to Laurendeau and Pinard's stages would have presented some, though perhaps not as many, of the same problems as Piaget's stages.

In order to deal with the diversity of explanations within individual protocols, mode and median response categories were used to classify subjects into stages. The results of this classification method is that the overwhelming majority of subjects in the four age groups are classified at Stage IV, the adult level. As a result of this attenuation of the Animism Questionnaire scores, the direct relationship between subjects' performance on the discrimination tasks and on the Animism Questionnaire was not found.

The only obvious similarity between the data from the discrimination tasks and the Animism Questionnaire is that for both measures, subjects in each of the age groups were able to make some use of the concept at each level tested. The Animism Questionnaire, however, gives little evidence of an age trend associated with the stages which Piaget's theory would predict.

Within the Adult Stage IV on the Animism Questionnaire, a response analysis which subdivided the children in this stage into those who use only animal characteristics as criteria and those who also use scientific criteria does reveal that, on the whole, the use of scien-

tific criteria increases with age. This may reflect increased exposure to science instruction as schooling progresses.

The categories of animistic responses on the Animism Questionnaire also show a relationship to age. Third Graders, for example, give far fewer animistic responses on Plant Stimuli than younger subjects. And only the Nursery subjects give any animistic responses on Animal or Movement Stimuli. The total number of animistic responses also decreases with age.

The fact that subjects give so many adult level responses to the Animism Questionnaire is puzzling. One explanation is that most of the subjects in the present sample are simply functioning at Stage IV. This seems inconsistent, however, with the discrimination task data which show clear differences in the use of the concept levels associated with age. It is more likely that the standardized questionnaire which was used does not result in the depth of information produced by Piaget's clinical method. Perhaps if the responses had been explored further, earlier stages would have been revealed.

Blank's (1975) hypothesis that "why" and "how" questions hold different meanings for adults and children suggests one possible change in the Animism Questionnaire's inquiry which might produce more meaningful responses. Her work indicates that "which" and "what" questions are more likely to result in the attribute description desired in experimental tasks. The standardized Animism Questionnaire used in this study includes the question, "How did you know that _____ was alive/not alive?" In future research, the question should

be, "What makes you say that _____ is alive/not alive?"

Another explanation for the large number of adult level responses on the Animism Questionnaire in light of subjects' performance on the discrimination tasks focuses on the different requirements of the two measures. The discrimination tasks require that subjects produce concepts to use in learning the tasks. On the Animism Questionnaire, subjects have only to apply the concept introduced by the examiner. It seems possible that subjects would be able to use a more advanced level of the concept that was supplied to them before they would be able to produce it themselves and use it.

Margand (1977), for example, found that in a directed sort, children in the age range four to seven years could correctly categorize most living and nonliving items when requested to do so. In a free sort, only six and seven year olds spontaneously sorted living and nonliving items on the basis of animate and inanimate categories. This could partially explain the more advanced concept use found on the Animism Questionnaire in which the concept of alive was introduced by the examiner. The finding in the present study that for older subjects, the introduction of the concept before the discrimination tasks when the Animism Questionnaire was given first leads to faster learning on all discrimination tasks is also in line with Margand's data. In the present study the younger children did not learn the tasks faster when they were preceded by the Animism Questionnaire. The concept was not directly given to subjects, however, as it was in Margand's directed sort but had to be inferred somewhat

as in her free sort. The data from both Margand's study and the present one indicate that younger children tend not to use the concept when it is presented indirectly.

The discovery that the Animism Questionnaire presented before the discrimination tasks served a cueing function for the First and Third Grade Groups but not for the Nursery and Kindergarten Groups could also have been predicted on the basis the mediational theory of learning as described by Kendler and Kendler (1968). They report data which suggest an increase in mediational-type responding with increasing age beginning at three years, and continuing well past 12 years. The finding that younger children tend not to mediate their behavior verbally in spite of the fact that they can understand and use the appropriate words has been termed a "mediational deficiency."

The present discrimination task data support a mediational deficiency hypothesis. The Nursery and Kindergarten subjects who have the Animism Questionnaire prior to the discrimination tasks do not learn these tasks faster than Nursery and Kindergarten subjects who have the Animism Questionnaire after the tasks. First Grade and Third Grade subjects who have the Animism Questionnaire before the tasks do learn the tasks faster. These older subjects apparently use the information from the Animism Questionnaire to mediate their discrimination task learning. The Animism Questionnaire serves to cue these subjects to the concept of <u>alive</u> which then facilitates learning on the discrimination tasks.

In summary, this study indicates that the Animism Questionnaire

in its strictly standardized form is of limited usefulness in exploring the development of children's concept of alive. Its lack of flexibility in terms of allowing questions tailored to the individual child's responses apparently prevents the tapping of important data. It would seem that the power of Piaget's clinical method rests in the personalized questioning of children's responses. When this factor is eliminated through standardization, the technique loses much of its usefulness. Some changes in the Animism Questionnaire which might make it more workable were suggested. In the present study, the most interesting findings from the Animism Questionnaire were first, the lack of consistency in individual children's use of the response categories associated with the stages of animism, and second, the cueing function which the Animism Questionnaire served with regard to the discrimination tasks for the two older groups.

The verbal concept discrimination task proved to be a highly effective method for studying children's concept of alive. It is objectively administered and produced detailed data on the use of the concept in children aged four to seven years including some evidence of structuring within the concept levels. The stages of animism and the sequence of those stages proposed by Piaget were basically borne out by the task data. The children did use the levels of the concept described by Piaget and this use differed systematically with age.

APPENDIX A

SETS USED IN THE ADULT, INTERMEDIATE, AND PRESCHOOL TASKS

Table A-1

Adult Task Sets 1 through 4

Set 1		Set 2	
Farmer	Shoe	Singer	Row Boat
Child	Bell	Dentist	Submarine
Pig	Comb	Racoon	Hammer
Bird	Movie	Blackbird	Popcorn
Snake	Jar	Oak Tree	Apron
Rose Bush	Pencil	Cabbage Plant	Firecracker
Grass	Car	Bean Bush	Castle
Cherry Tree	Seesaw	Cricket	Glove
Set 3		**Set 4**	
Queen	Bicycle	Daddy	Star
Tennis Player	Steam Shovel	Clown	Dollar
Sister	Lake	Policewoman	Ball
Inchworm	Yo-yo	Whale	Glass
Cow	Magazine	Kangaroo	Egg Beater
Pumpkin Vine	Coat	Tomato Plant	Bedroom
Apple Tree	Bed	Maple Tree	Church
Tulip	Canoe	Daisy	Firetruck

Table A-2

Adult Task Sets 5 through 8

Set 5		Set 6	
Hunter	Stove	Friend	Banjo
Wife	Police Car	Grandmother	Mountain
Goat	Bracelet	Fly	Record Player
Giraffe	Shirt	Owl	Ice Skates
Pigeon	Basketball	Horse	Candy
Radish Plant	Television	Mushroom	Bench
Dandelion	Table	Orange Tree	Soap
Pine Tree	Piano	Strawberry Plant	Truck
Set 7		**Set 8**	
Lady	Box	Cook	Rocket
Barber	Shovel	Fisherman	Ice Cream
Pilot	Nickel	Brother	Swing
Puppy	Rifle	Reindeer	Sink
Codfish	Tea Pot	Mouse	Letter
Lemon Tree	Sled	Watermelon Vine	Tractor
Lettuce Plant	Bomb	Carrot Plant	Taxi Cab
Bush	Ferris Wheel	Tree	Cake

Table A-3

Adult Task Sets 9 and 10

Set 9		Set 10	
Captain	Dump Truck	Sailor	Rocking Horse
Painter	Boat	Indian	Vacuum Cleaner
Lamb	Bubble	Cousin	Bookcase
Octopus	Belt	Bluebird	Shampoo
Monkey	Crib	Zebra	Room
Cucumber Vine	Flood	Grape Vine	Thunder
Willow Tree	Rake	Blackberry Bush	Chain
Corn Stalk	Mitten	Flower	Motorcycle

Table A-4

Adult Task Unreinforced Sets 1 and 2

Set 1		Set 2	
Child	Bird	Puppy	Lemon Tree
Pig	Apple Tree	Brother	Mouse
Dentist	Rose Bush	Flower	Reindeer
Kangaroo	Cricket	Monkey	Codfish
Canoe	Coat	Ferris Wheel	Box
Movie	Submarine	Cake	Flood
Row Boat	Glass	Thunder	Taxi Cab
Firecracker	Bed	Boat	Shampoo

Table A-5

Intermediate Task Sets 1 through 4

Set 1		Set 2	
Fireman	Sail Boat	Policeman	Fork
Teacher	Bottle	Weatherman	Pitcher
Alligator	Feather	Daughter	Bridge
Germ	Brush	Canary	Puppet
Cattle	Typewriter	Beetle	Tennis Ball
Rain	Wagon	River	Helicopter
Ocean	Eye Glasses	Flame	Cap
Clock	Flag	Landslide	Bicycle
Set 3		**Set 4**	
Lifeguard	Rock	Children	Fan
Milkman	Pool	Girl	Motorboat
Parrot	Scissors	Basketball Player	Oil
Jelly Fish	Garbage Truck	Hippopotamus	Suit
Dog	Street	Moth	Coat Hanger
Shooting Bullet	Toothbrush	Lightening	Road
Hurricane	Ring	Sleet	Kite
Elevator	House	Sun	Lawn Mower

Table A-6

Intermediate Task Sets 5 through 8

Set 5		Set 6	
T.V. Repairman	Ambulance	Man	Toy Train
Mother	Jacket	Butcher	Wheelbarrow
Crab	Marble	Sheriff	Screw Driver
Deer	Broom	Fish	Steam Roller
Baboon	Race Car	Sheep	Hat
Lighted Match	Butter	Star	Boot
Smoke	Medicine	Earthquake	Pie
Wind	Handkerchief	Waterfall	Table

Set 7		Set 8	
Husband	Necklace	Nephew	Washing Machine
Soldier	Garage	Baby	Raft
Shark	Baby Stroller	Cowboy	Snowplow
Calf	Crayon	Goose	Football
Flea	Bus	Bug	Store
Clouds	Pants	Rockslide	Spoon
Stream	Penny	Tornado	Rug
Escalator	Football	Watch	Nightgown

Table A-7

Intermediate Task Sets 9 and 10

Set 9		Set 10	
President	Book	Garbageman	Statue
Boy	Flower Pot	Baseball Coach	Pan
Fox	Riverboat	Father	Purse
Dove	Pencil Sharpener	Lion	Merri-go-round
Donkey	Sock	Rooster	Doll Carriage
Waves	Fiddle	Moon	Saw
Explosion	Soup	Creek	Blanket
Snow	Tricycle	Fire	Houseboat

Table A-8

Intermediate Task Unreinforced Sets 1 and 2

Set 1		Set 2	
Teacher	Ocean	Soldier	Flea
Dog	Lifeguard	Tornado	Watch
Clock	Hurricane	Fox	Clouds
Elevator	Parrot	Baby	Waves
Fork	Puppet	Bus	Spoon
Wagon	Rock	Riverboat	Penny
Brush	Sail Boat	Merri-go-round	Blanket
Bicycle	Toothbrush	Doll Carriage	Rug

Table A-9

Preschool Task Sets 1 through 4

Set 1		Set 2	
Mailman	Swimming Pool	Doctor	Bowl
Kid	Wall	Baker	Rope
Hen	Cookie	Rhinoceros	Ladder
Tiger	Lamp	Frog	Suitcase
Train	Barn	Mail Truck	Cup
Moving Van	Sand	Motor Scooter	Pipe
Balloon	Card	Barge	Picture
Tugboat	Umbrella	Baseball	Newspaper

Set 3		Set 4	
Grandfather	Calendar	Truck Driver	Ice
Workman	Pajamas	Plumber	Sleeping Bag
Starfish	Bench	Crocodile	Diaper
Wolf	Hospital	Rat	Cookbook
Sewing Machine	Lightbulb	Mop	T.V. Antenna
Airplane	Fence	Ice Cream Truck	Light
Cart	Hose	Machine	Bandaid
Towtruck	Cave	Wheelbarrow	Diamond

Table A-10

Preschool Task Sets 5 through 8

Set 5		Set 6	
Football Player	Soup	Mountain Climber	Chalk
Janitor	Street	Mama	Jelly
Ant	Blouse	Bumblebee	Tablespoon
Chipmunk	Dress	Pony	Drawer
Wheel Chair	Tent	Electric Razor	Beer
Axe	Carpet	Windmill	Towel
Minibike	Basket	Ship	Chair
Baby Carriage	Tape	Delivery Truck	Brick
Set 7		**Set 8**	
Shoemaker	Porch	Neighbor	Hook
Delivery Man	Curtain	Storekeeper	Blackboard
Moose	Dish	Beaver	Lantern
Kitten	Clothes	Chicken	Block
Skis	Gold	Roller Skates	Nest
Toy Top	Dust	Jeep	Doll
Guitar	Bathroom	Can Opener	Dirt
Gasoline Truck	Button	Scooter	Puzzle

Table A-11

Preschool Task Sets 9 and 10

Set 9		Set 10	
Carpenter	Dime	Woman	Glue
Swimmer	Desk	Newspaper Boy	Can
Rabbit	Door	Lizard	Earring
Eagle	Tea Cup	Bear	Knife
Gun	Bread	Cement Truck	Sofa
Rocking Chair	Bath Tub	Jet Plane	Barrel
Snowmobile	Ruler	Bulldozer	Raincoat
Toy Truck	Bank	Jump Rope	Bag

Table A-12

Preschool Task Unreinforced Sets 1 and 2

Set 1		Set 2	
Doctor	Tiger	Kitten	Jeep
Frog	Car	Woman	Rabbit
Wolf	Machine	Carpenter	Scooter
Mailman	Train	Toy Car	Guitar
Rope	Cup	Puzzle	Desk
Cookie	Sand	Tea Cup	Nest
Calendar	Bandaid	Can	Ruler
Lamp	Picture	Button	Curtain

APPENDIX B

INSTRUCTIONS FOR ANIMISM QUESTIONNAIRE RATERS

INSTRUCTIONS FOR ANIMISM QUESTIONNAIRE RATERS

This questionnaire is a part of a study of animistic thinking in children. The questionnaire was presented to each child individually with the following instructions.

> We are going to play a game. I am going to ask you some questions to see what you think about some things. I will turn this tape recorder on and it will record what we say. (The tape recorder was turned on at this point.) Do you know what it means to be alive? You are alive, right? Now, I am going to name some things and you tell me whether you think they are alive or not alive.

Initially, each item was presented with only the question, "Is _____ alive?" When each of the 24 items in the list had been presented in this way, the list was presented a second time. The procedure for the second presentation of each item was to again ask, "Is _____ alive?" and then to ask, "Why do you think _____ is alive/not alive?"

On the protocol sheets, the first presentation of each item and the child's response is indicated by upper case type. The response to the second presentation is indicated by lower case type. For example:

(First Presentation): ROCK: YES.

(Second Presentation): Rock: Yes. (?) Because it can throw.

(First Presentation): TREE: NO, A TREE ISN'T LIKE ME.

(Second Presentation): Tree: No. (?) Because it can't talk.

Your rating of each item is to be based upon the child's response to the <u>second</u> presentation in which he explains why he thinks the item

is alive or not alive. For each of the 24 items on a protocol, choose the response category from the six response categories listed below which you feel most closely describes the explanation given by the child for the response. Write the number of the response category in the left hand margin next to the response. If you feel that a response does not fit exactly into one response category, but, in fact, could be described by two or more of the response categories, write the numbers of all of these categories next to the response. If possible, however, try to assign a response to only one response category. Next to each response category number assigned, mark a plus sign (+) if the child said the item was alive or a minus sign (-) if the child said the item was not alive. Indicate the basis for your assignment of each response category by circling the key word or words in the child's response or by noting your reason briefly below the child's response. A sample scored protocol is attached below.

It is important that the standards used to assign response categories remain constant for all of the protocols. To help insure this, please re-read the entire list of response categories and their examples after rating every five or six protocols.

There is no significance to the order in which you receive the protocols. They may be scored in any order. The numbers on the protocols were randomly assigned and do not indicate the age or sex of the child.

RESPONSE CATEGORIES

1. An object is alive because it is useful or not alive because it is not useful.

   Examples: a. The sun is alive because it gives light.

   b. Poison is alive because it can kill us.

   c. A cup is alive because I can drink out of it.

   d. The wagon is alive because I can play with it.

   e. The cup is not alive because it is broken.

   f. The milk is not alive because it is spoiled.

   g. The doll is not alive because it is broken.

2. An object is alive because it moves but with no reference to autonomous movement, or not alive because it does not move.

   Examples: a. Clouds are alive because they move.

   b. Trains are alive because they go fast.

   c. Trees are alive when the wind blows them.

   d. A man is alive because he moves.

   e. A rock is not alive because it cannot move.

   f. A chair is not alive because it just sits there.

   g. Blocks are not alive because they cannot roll.

3. An object is alive because it moves autonomously or not alive because it does not move autonomously.

   Examples: a. The sun is alive because it goes around by itself.

   b. A river is alive because it makes the water flow.

   c. Clouds are alive because they make the rain come down.

d. A tricycle is not alive because I must make it go.

e. A ball is not alive because you have to throw it.

f. A tree is not alive because the wind makes it move.

4. An object is alive because it possesses animal characteristics or not alive because it does not possess animal characteristics.

Examples: a. A dog is alive because it has blood.

b. A man is alive because he has a face.

c. A cat is alive because he can walk.

d. Blocks are not alive because they cannot talk.

e. A tree is not alive because it cannot walk.

f. The wind is not alive because it cannot see.

5. An object is alive because it possesses one or more of the biological characteristics of living things or not alive because it does not possess the biological characteristics of living things.

Examples: a. A tree is alive because it can grow.

b. A man is alive because he must eat.

c. A woman is alive because she has babies.

d. The sun is not alive because it does not breathe.

e. A rock is not alive because it takes no food.

f. A dish is not alive because it never gets bigger.

6. A response which cannot be placed into any of the above categories.

Examples: a. A refusal to respond.

b. No identifiable concept; "I just know."

c. A characteristic other than those listed above; "A cloud is alive because it is in the sky" or "A dog is alive because it is big."

APPENDIX C

SUMMARY TABLES OF TUKEY PROCEDURES

Table C-1

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Tasks for Four Age Groups: Nursery, Kindergarten, First Grade, and Third Grade

Order of Treatments	Third Grade	First Grade	Nursery	Kindergarten
Third Grade	-	466*	1369*	1396*
First Grade		-	903*	930*
Nursery			-	27
Kindergarten				-

*$p < .01$; $q_{.99}(4,\infty) = 422.66$

Table C-2

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Tasks for Two Conditions, Experimental (EXP) and Control (CON), and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-EXP	FG-EXP	N-EXP	K-EXP	TG-CON	FG-CON	K-CON	N-CON
TG-EXP	-	395*	662*	844*	1634*	1705*	2186*	2341*
FG-EXP		-	267	449*	1239*	1310*	1791*	1946*
N-EXP			-	182	972*	1043*	1524*	1679*
K-EXP				-	790*	861*	1342*	1497*
TG-CON					-	71	552*	707*
FG-CON						-	481*	636*
K-CON							-	155
N-CON								-

*$p < .01$; $q_{.99}(8, \infty) = 338.92$

Table C-3

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Tasks for Two Conditions, Experimental (EXP) and Control (CON); and Two AQ Positions, Before and After

Order of Treatments	AQ Before EXP	AQ After EXP	AQ Before CON	AQ After CON
AQ Before EXP	-	676*	3271*	3371*
AQ After EXP		-	2595*	2695*
AQ Before CON			-	100
AQ After CON				-

*$p < .01$; $q_{.99}(4, \infty) = 422.66$

Table C-4 (Part I)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Two AQ Positions, Before (B) and After (A); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-EXP-B	FG-EXP-B	TG-EXP-A	N-EXP-B	FG-EXP-A	N-EXP-A	K-EXP-A	K-EXP-B
TG-EXP-B	-	146	239*	386**	487**	515**	525**	558**
FG-EXP-B		-	93	240*	341**	369**	379**	412**
TG-EXP-A			-	147	248*	276**	286**	319**
N-EXP-B				-	101	129	139	172
FG-EXP-A					-	28	38	71
N-EXP-A						-	10	43
K-EXP-A							-	33
K-EXP-B								-
TG-CON-B								
TG-CON-A								
FG-CON-B								
FG-CON-A								
K-CON-B								
K-CON-A								
N-CON-A								
N-CON-B								

*$p < .05$; $q_{.95}(15, \infty) = 230.54$
**$p < .01$; $q_{.99}(15, \infty) = 261.76$

Table C-4 (Part II)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Two AQ Positions, Before (B) and After (A); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-CON-B	TG-CON-A	FG-CON-B	FG-CON-A	K-CON-B	K-CON-A	N-CON-A	N-CON-B
TG-EXP-B	934**	939**	942**	1002**	1177**	1248**	1272**	1308**
FG-EXP-B	789**	793**	796**	856**	1031**	1102**	1126**	1162**
TG-EXP-A	695**	700**	703**	763**	938**	1009**	1033**	1069**
N-EXP-B	548**	553**	556**	616**	791**	862**	886**	922**
FG-EXP-A	447**	452**	455**	515**	690**	761**	785**	821**
N-EXP-A	419**	424**	427**	487**	662**	733**	757**	793**
K-EXP-A	409**	414**	417**	477**	652**	723**	747**	783**
K-EXP-B	376**	381**	384**	444**	619**	690**	714**	750**
TG-CON-B	-	5	8	68	243*	314**	338**	374**
TG-CON-A		-	3	63	238*	309**	333**	369**
FG-CON-B			-	60	235*	306**	330**	366**
FG-CON-A				-	175	246*	270**	306**
K-CON-B					-	71	95	131
K-CON-A						-	24	60
N-CON-A							-	36
N-CON-B								-

*$p < .05$; $q_{.95}(15, \infty) = 230.54$
**$p < .01$; $q_{.99}(15, \infty) = 261.76$

Table C-5

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Experimental Tasks Using All Sets for Three Tasks, Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-A	TG-I	TG-P	FG-I	FG-A	K-I	N-I	N-P	FG-P	N-A	K-P	K-A
TG-A	-	42	80	142	209	231	264*	283*	303**	459**	490**	503**
TG-I		-	38	100	167	189	222	241	261*	417**	488**	661**
TG-P			-	62	129	151	184	203	223	379**	410**	423**
FG-I				-	67	89	122	141	161	317**	348**	361**
FG-A					-	22	55	74	94	250	281*	294**
K-I						-	33	52	72	228	259*	272*
N-I							-	19	39	195	226	239
N-P								-	20	176	207	220
FG-P									-	156	187	200
N-A										-	31	44
K-P											-	13
K-A												-

*$p < .05$; $q_{.95}(12, \infty) = 252.48$
**$p < .01$; $q_{.99}(12, \infty) = 289.10$

Table C-6

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Four Age Groups: Nursery, Kindergarten, First Grade, and Third Grade

Order of Treatments	Third Grade	First Grade	Kindergarten	Nursery
Third Grade	-	246*	458*	499*
First Grade		-	213*	253*
Kindergarten			-	40
Nursery				-

*$p < .01$; $q_{.99}(4, \infty) = 108.15$

Table C-7

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON), and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-EXP	FG-EXP	N-EXP	K-EXP	TG-CON	FG-CON	K-CON	N-CON
TG-EXP	-	106*	197*	256*	439*	579*	642*	741*
FG-EXP		-	91*	150*	333*	473*	536*	635*
N-EXP			-	59	242*	382*	445*	544*
K-EXP				-	183*	323*	386*	485*
TG-CON					-	140*	203*	302*
FG-CON						-	63	162*
K-CON							-	99*
N-CON								-

*$p < .01$; $q_{.99}(8, \infty) = 86.78$

Table C-8

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); and Two AQ Positions, Before and After

Order of Treatments	AQ Before EXP	AQ After EXP	AQ Before CON	AQ After CON
AQ Before EXP	-	183*	1002*	1023*
AQ After EXP		-	819*	840*
AQ Before CON			-	21
AQ After CON				-

*$p < .01$; $q_{.99}(4, \infty) = 108.24$

Table C-9 (Part I)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Two AQ Positions, Before (B) and After (A); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-EXP-B	FG-EXP-B	TG-EXP-A	N-EXP-B	FG-EXP-A	K-EXP-A	N-EXP-A	K-EXP-B
TG-EXP-B	-	51	64*	98**	119**	153**	163**	167**
FG-EXP-B		-	13	47	68**	102**	112**	116**
TG-EXP-A			-	34	55	89**	99**	103**
N-EXP-B				-	21	55	65*	69**
FG-EXP-A					-	34	44	48
K-EXP-A						-	10	14
N-EXP-A							-	4
K-EXP-B								-
TG-CON-A								
TG-CON-B								
FG-CON-B								
FG-CON-A								
K-CON-B								
K-CON-A								
N-CON-A								
N-CON-B								

*$p < .05$; $q_{.95}(16, \infty) = 59.04$
**$p < .01$; $q_{.99}(16, \infty) = 67.04$

Table C-9 (Part II)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Two AQ Positions, Before (B) and After (A); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-CON-A	TG-CON-B	FG-CON-B	FG-CON-A	K-CON-B	K-CON-B	N-CON-A	N-CON-B
TG-EXP-B	247**	256**	320**	323**	339**	367**	402**	403**
FG-EXP-B	196**	205**	269**	272**	288**	316**	351**	352**
TG-EXP-A	183**	192**	256**	259**	275**	303**	338**	339**
N-EXP-B	149**	158**	222**	225**	241**	269**	304**	305**
FG-EXP-A	128**	137**	201**	204**	220**	248**	283**	284**
K-EXP-A	94**	103**	167**	170**	186**	214**	249**	250**
N-EXP-A	84**	93**	157**	160**	176**	204**	239**	240**
K-EXP-B	80**	89**	153**	156**	172**	200**	235**	236**
TG-CON-A	-	9	73**	76**	92**	120**	155**	156**
TG-CON-B		-	64*	67*	83**	111**	146**	147**
FG-CON-B			-	3	19	47	82**	83**
FG-CON-A				-	16	44	79**	80**
K-CON-B					-	28	63*	64*
K-CON-A						-	35	36
N-CON-A							-	1
N-CON-B								-

*$p < .05$; $q_{.95}(16, \infty) = 59.04$
**$p < .01$; $q_{.99}(16, \infty) = 67.04$

Table C-10

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Three Tasks, Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-A	TG-I	TG-P	FG-I	FG-A	FG-P	K-I	N-P	N-I	K-A	K-P	N-A
TG-A	-	16	19	62	91**	127**	133**	156**	164**	168**	193**	214**
TG-I		-	3	46	75**	111**	117**	140**	148**	152**	177**	198**
TG-P			-	43	72*	108**	114**	137**	145**	149**	174**	195**
FG-I				-	29	65	71*	94**	102**	106**	131**	152**
FG-A					-	36	42	65	73*	77**	102**	123**
FG-P						-	6	29	37	41	66*	87**
K-I							-	23	31	35	60	81**
N-P								-	8	12	37	58
N-I									-	4	29	50
K-A										-	25	46
K-P											-	21
N-A												-

*$p < .05$; $q_{.95}(12, \infty) = 65.60$
**$p < .01$; $q_{.99}(12, \infty) = 75.12$

Table C-11

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON), and Three Tasks: Adult (A), Intermediate (I), and Preschool (P)

Order of Treatments	EXP-I	EXP-A	EXP-P	CON-A	CON-P	CON-I
EXP-I	-	127*	140*	690*	700*	722*
EXP-A		-	13	563*	573*	595*
EXP-P			-	550*	560*	582*
CON-A				-	10	32
CON-P					-	22
CON-I						-

*$p < .01$; $q_{.99}(6, \infty) = 95.58$

Table C-12 (Part 1)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Three Tasks: Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-EXP-I	TG-EXP-A	FG-EXP-I	TG-EXP-P	FG-EXP-A	N-EXP-P	N-EXP-I	K-EXP-I
TG-EXP-I	-	1	13	22	42	56**	56**	59**
TG-EXP-A		-	12	21	41	55**	55**	58**
FG-EXP-I			-	9	29	43	43	46
TG-EXP-P				-	20	34	34	37
FG-EXP-A					-	14	14	17
N-EXP-P						-	0	3
N-EXP-I							-	3
K-EXP-I								-
FG-EXP-P								
K-EXP-A								
N-EXP-A								
K-EXP-P								

*$p < .05$; $q_{.95}(24, \infty) = 48.19$
**$p < .01$; $q_{.99}(24, \infty) = 54.72$

Table C-12 (Part II)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Three Tasks: Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	FG-EXP-P	K-EXP-A	N-EXP-A	K-EXP-P	TG-CON-P	TG-CON-A	TG-CON-I	FG-CON-A
TG-EXP-I	74**	104**	108**	116**	147**	149**	166**	199**
TG-EXP-A	73**	103**	107**	115**	146**	148**	165**	198**
FG-EXP-I	61**	91**	95**	103**	134**	136**	153**	186**
TG-EXP-P	52**	82**	86**	94**	125**	127**	144**	177**
FG-EXP-A	32	62**	66**	77**	105**	107**	124**	157**
N-EXP-P	18	48	52*	60**	91**	93**	110**	143**
N-EXP-I	18	48	52*	60**	91**	93**	110**	143**
K-EXP-I	15	45	48	57**	88**	90**	107**	140**
FG-EXP-P	-	30	34	42	73**	75**	92**	125**
K-EXP-A		-	4	12	43	45	62**	95**
N-EXP-A			-	8	39	41	58**	91**
K-EXP-P				-	31	33	50*	83**

*$p < .05$; $q_{.95}(24, \infty) = 48.19$
**$p < .01$; $q_{.99}(24, \infty) = 54.72$

Table C-12 (Part III)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Three Tasks: Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	FG-CON-I	FG-CON-P	K-CON-A	K-CON-I	K-CON-P	N-CON-P	N-CON-A	N-CON-I
TG-EXP-I	199**	204**	214**	224**	227**	250**	256**	258**
TG-EXP-A	198**	203**	213**	223**	226**	249**	255**	257**
FG-EXP-I	186**	191**	201**	211**	214**	237**	243**	245**
TG-EXP-P	177**	182**	192**	202**	205**	228**	234**	226**
FG-EXP-A	157**	162**	172**	182**	185**	208**	214**	216**
N-EXP-P	143**	148**	158**	168**	171**	194**	200**	202**
N-EXP-I	143**	148**	158**	168**	171**	194**	200**	202**
K-EXP-I	140**	145**	155**	165**	168**	191**	197**	199**
FG-EXP-P	125**	130**	140**	150**	153**	176**	182**	184**
K-EXP-A	95**	100**	110**	120**	123**	146**	152**	154**
N-EXP-A	91**	96**	106**	116**	119**	142**	148**	150**
K-EXP-P	83**	88**	98**	108**	111**	134**	140**	142**

*$p < .05$; $q_{.95}(24, \infty) = 48.19$
**$p < .01$; $q_{.99}(24, \infty) = 54.72$

Table C-12 (Part IV)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Three Tasks: Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	FG-EXP-P	K-EXP-A	N-EXP-A	K-EXP-P	TG-CON-P	TG-CON-A	TG-CON-I	FG-CON-A
TG-CON-P					-	2	19	52*
TG-CON-A						-	17	50*
TG-CON-I							-	33
FG-CON-A								-
FG-CON-I								
FG-CON-P								
K-CON-A								
K-CON-I								
K-CON-P								
N-CON-P								
N-CON-A								
N-CON-I								

*$p < .05$; $q_{.95}(24, \infty) = 48.19$
**$p < .01$; $q_{.99}(24, \infty) = 54.72$

Table C-12 (Part V)

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Trials on Tasks for Two Conditions, Experimental (EXP) and Control (CON); Three Tasks: Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	FG-CON-I	FG-CON-P	K-CON-A	K-CON-I	K-CON-P	N-CON-P	N-CON-A	N-CON-I
TG-CON-P	52**	57**	67**	77**	80**	103**	109**	111**
TG-CON-A	50**	55**	65**	75**	78**	101**	107**	109**
TG-CON-I	33	38	48	58**	61**	84**	90**	92**
FG-CON-A	0	5	15	25	28	51*	57**	59**
FG-CON-I	-	5	15	25	28	51*	57**	59**
FG-CON-P		-	10	20	23	46	52*	54*
K-CON-A			-	10	13	36	42	44
K-CON-I				-	3	26	32	34
K-CON-P					-	23	29	31
N-CON-P						-	6	8
N-CON-A							-	2
N-CON-I								-

*$p < .05$; $q_{.95}(24, \infty) = 48.19$
**$p < .01$; $q_{.99}(24, \infty) = 54.72$

Table C-13

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Sets to Concept Learning on Tasks for Four Age Groups: Nursery, Kindergarten, First Grade, and Third Grade

Order of Treatments	Third Grade	First Grade	Nursery	Kindergarten
Third Grade	-	51*	62*	85*
First Grade		-	11	34
Nursery			-	23
Kindergarten				-

*$p < .01$; $q_{.99}(4, \infty) = 48.35$

Table C-14

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Sets to Concept Learning on Tasks for Two AQ Positions, Before (B) and After (A); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-B	FG-B	N-B	TG-A	K-A	N-A	K-B	FG-A
TG-B	-	30	49**	62**	68**	75**	79**	83**
FG-B		-	19	32	38*	45**	49**	53**
N-B			-	13	19	26	30	34*
TG-A				-	6	13	17	21
K-A					-	7	11	15
N-A						-	4	8
K-B							-	4
FG-A								-

*$p < .05$; $q_{.95}(8,\infty) = 33.33$
**$p < .01$; $q_{.99}(8,\infty) = 38.77$

Table C-15

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Sets to Concept Learning on Tasks for Three Tasks: Adult (A), Intermediate (I), and Preschool (P); and Four Age Groups: Nursery (N), Kindergarten (K), First Grade (FG), and Third Grade (TG)

Order of Treatments	TG-A	TG-I	FG-I	K-I	N-I	TG-P	FG-A	N-P	N-A	K-P	FG-P	K-A
TG-A	-	7	9	10	15	15	19	28	41**	41**	45**	56**
TG-I		-	2	3	8	8	12	21	34**	34**	38**	49**
FG-I			-	1	6	6	10	19	32*	32*	36**	47**
K-I				-	5	5	9	18	31*	31*	35**	46**
N-I					-	0	4	13	26	26	30*	41**
TG-P						-	4	13	26	26	30*	41**
FG-A							-	9	22	22	26	37**
N-P								-	13	13	17	28
N-A									-	0	4	15
K-P										-	4	15
FG-P											-	11
K-A												-

*$p < .05$; $q_{.95}(12, \infty) = 29.34$
**$p < .01$; $q_{.99}(12, \infty) = 33.59$

Table C-16

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Three Categories of Stimuli on the Adult Task: People, Animal, and Plant

Order of Treatments	People	Animal	Plant
People	-	.38	13.02*
Animal		-	12.64*
Plant			-

*$p < .01$; $q_{.99}(3, \infty) = 5.23$

Table C-17

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Three Categories of Stimuli on the Intermediate Task: People, Animal, and Spontaneous Movement

Order of Treatments	People	Animal	Spontaneous Movement
People	-	.35	4.79
Animal		-	4.39
Spontaneous Movement			-

$p < .05$; $q_{.95}(3, \infty) = 5.13$

Table C-18

Summary of Tukey Procedure for A Posteriori Comparisons of Number of Errors on Three Categories of Stimuli on the Preschool Task: People, Animal, Imparted Movement

Order of Treatments	People	Animal	Imparted Movement
People	-	1.89	8.31*
Animal		-	6.42*
Imparted Movement			-

*$p < .01$; $q_{.99}(3, \infty) = 4.94$

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