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TAXONOMIC OR THEMATIC: CATEGORIZATION OF FAMILIAR  
OBJECTS BY PRESCHOOL-AGED CHILDREN

by

David Owen Calhoun

A thesis submitted in partial fulfillment  
of the requirements for the degree

of

MASTER OF SCIENCE

in

Psychology

Approved:

UTAH STATE UNIVERSITY  
Logan, Utah

1995

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## ABSTRACT

Taxonomic or Thematic: Categorization of Familiar Objects

by Preschool-Aged Children

by

David Owen Calhoun, Master of Science

Utah State University, 1995

Major Professor: Dr. J. Grayson Osborne  
Department: Psychology

To acquire language, children must learn how to categorize objects on the basis of the meanings that cultures have assigned to the objects. A series of six experiments tested how preschool-aged children categorize familiar objects. Each experiment used a matching-to-sample format in which children matched pictures of familiar objects (comparisons) to a sample stimulus picture. The sample and one comparison related taxonomically (on the basis of similar features) and the other comparison related thematically (on the basis of function) from which the children were to find another stimulus that was the same as the sample. Each experiment was a systematic replication of published research and of the prior experiment. In all six experiments, these preschool-aged children demonstrated a statistically significant preference for the taxonomic stimulus. No statistically significant differences were found between genders. The results of these six experiments did not support the development trend

described in the majority of the extant literature. These findings are also contrary to the research literature, with one noted exception.

(77 pages)

## ACKNOWLEDGMENTS

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I thank the staff, directors, parents, and especially the children of *Children's House, I and II; Morningside*; and *All About Kids, North and South*, preschools without whom this research could not have been conducted.

I am extremely thankful to my family for their patience, support, and tolerance. My children, Matthew and Joshua, who I am sure, at times, wondered what happened to their dad. I cannot express enough my gratitude to my wife, Carla, for her encouragement, understanding, and invaluable expertise (not to mention tolerance of my word processing program). Without the encouragement of these people and a myriad of others, this project would not have been completed.

David Owen Calhoun

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## INTRODUCTION

Children's cognitive development can be characterized in a number of ways (Inhelder & Piaget, 1964; Siegler, 1986). One area of interest is children's ability to relate objects and events in particular ways that appear to demonstrate how they organize their world. This organization involves the classification of objects and events into categories. Category has been defined as "a number of objects which are considered equivalent" (Rosch, Mervis, Gray, Boyes-Braem, & Johnson, 1976, p. 383). Categories can be related to one another via a variety of different criteria. Two of the ways categories have been related are through the use of taxonomies, a relation system based on level of class inclusion (Rosch et al., 1976), and on a thematic basis, according to causal, temporal, or spatial relations among items to be categorized (Markman & Hutchinson, 1984).

The bases of categorization change with age. Children appear to organize more frequently on a thematic basis until about age 7, after which they are more likely to arrange items taxonomically (Markman & Hutchinson, 1984; Waxman & Kosowski, 1990; Waxman, Shipley, & Shepperson, 1991). Moreover, younger children may be influenced to respond taxonomically when novel nouns are used to label the sample stimulus in a matching-to-sample procedure (Markman & Hutchinson, 1984; Waxman & Kosowski, 1990) and when noun labels are provided in categorization (Waxman et al., 1991).

Greenfield and Scott (1986) found that children across ages demonstrated a preference for thematic relations. A reversed matching-to-sample procedure, in which

two sample and one comparison stimuli were provided, was used to determine the preferred categorization relationship for subjects ranging from 3 to 15 years of age. The subjects were asked "where do you want to put this?" (p. 20); "this" referred to the comparison stimulus, related thematically to one sample and taxonomically to the other sample. Subjects placed the comparison stimulus next to the thematically related sample on a statistically significant proportion of the trials.

Contrary to the findings of the previous authors, Fenson, Cameron, and Kennedy (1988) found that children younger than 30 months categorized on a taxonomic basis when the perceptual relations between the stimuli were distinct. These subjects were exposed to one sample and four comparison stimuli. In each comparison group, one of the four stimuli was related to the sample on a taxonomic basis. When the comparison stimuli were from the same species and oriented the same way, the subjects categorized taxonomic relations 79% of the time, as opposed to 36% when stimuli differed in species and orientation.

Bauer and Mandler (1989) found that younger children, 16 to 31 months, categorized taxonomically on a matching-to-sample task. In their study, differential praise followed taxonomic and thematic choices: "cheering and clapping" (p. 162) followed taxonomic choices, and "Thank you. Good girl/boy" (p. 163) followed thematic choices.

Thus, outcomes in the literature are split between those who found that the younger the child, the more likely the child will categorize thematically (Markman & Hutchinson, 1984; Greenfield & Scott, 1986; Waxman & Kosowski, 1990; Waxman et

al., 1991) and those who found this not to be the case (Bauer & Mandler, 1989).

Fenson et al. (1988) found that young children (mean 27 months) were able to select items related taxonomically, although this study did not include a thematically related choice.

Aside from the use of differential praise in the Bauer and Mandler (1989) study, numerous differences existed among the previously mentioned studies that may have resulted in the discrepant findings. Markman and Hutchinson (1984), Waxman and Gelman (1986), Waxman et al. (1991), and Waxman and Kosowski (1990) all used a puppet to present the stimuli to their subjects. Yet, as Bauer and Mandler (1989) found in their pilot study, "some of the younger subjects were afraid of it [a puppet]" (p. 162).

Procedural differences also existed in the instructions for the matching-to-sample task. Markman and Hutchinson (1984) and Waxman and Kosowski (1990) used the phrase "find another one..." (p. 6 and p. 1464, respectively) to indicate that the subject should choose from the taxonomic and thematic comparisons. Bauer and Mandler (1989) asserted that the children "are given information about word class through the article 'a'... [and]... children are sensitive to word class from an early age" (p. 160). This situation is exemplified by Markman and Hutchinson's (1984) use of the instructions "See this? It is a sud. Find another sud that is the same as this sud." (p. 7). Therefore, Bauer and Mandler (1989) manipulated the instructions across experiments from "See this one? Show me another one just like this one" (p. 162) to "Can you find the ones that go together?" (p. 169). This discrepancy may have led to

Bauer and Mandler's (1989) finding that 16- to 31-month-old children were able to categorize taxonomically, whereas authors using the article "a" in their directions concluded that children younger than 7 years preferred thematic relations.

Several of the studies used a training procedure for a variety of reasons, including: (a) to introduce reinforcement (Fenson et al., 1988; Bauer & Mandler, 1989); (b) to demonstrate the procedures (Greenfield & Scott, 1986); (c) to pretest the children's understanding of the instructions (Markman & Hutchinson, 1984); and (d) to familiarize the subjects with the stimuli (Waxman & Gelman, 1986). Any or all of these experiences may have biased the children's basis for categorization.

Additional differences existed across studies in the stimuli and their presentation. Both Waxman and Gelman (1986) and Waxman and Kosowski (1990) used black-and-white line drawings. Waxman and Gelman (1986) mounted the pictures on cardstock, and Waxman and Kosowski (1990) arranged them in a book, with the sample stimulus surrounded by four comparison stimuli, two each taxonomically and thematically related to the sample. Waxman et al. (1991), Greenfield and Scott (1986), and Smiley and Brown (1979) used color photographs taken from magazines, children's books, and nature books as their stimuli. These stimuli were presented to the subjects as the experimenter demonstrated the categorization task by placing like stimuli in boxes. The experimenter then individually placed the remaining stimuli in front of the child, asking if each picture should go into one of the boxes. Bauer and Mandler (1989) used three-dimensional items as stimuli and placed them in a three-compartment tray. The sample was always

in the middle and the taxonomic choice was alternated on each trial. Fenson et al. (1988) used three-dimensional objects as samples and "black-on-white line drawings of common objects" (p. 899) as comparisons.

The number of stimuli comprising a trial type also varied throughout this literature. Smiley and Brown (1979), Markman and Hutchinson (1984), Greenfield and Scott (1986), and Bauer and Mandler (1989) used one sample and two comparison stimuli. Waxman and Kosowski (1990) used one sample and four comparisons, two each related thematically and taxonomically, per trial. Fenson et al. (1988) used one sample and four comparisons, with at least one comparison being taxonomically related to the sample. Waxman et al. (1991) used three sets of five interrelated comparisons to determine the effect of different levels of relatedness on thematic categories. Sidman (1987) elucidated a problem associated with the use of only two comparison stimuli or only two possible types of choices. The problem lies in the probability of selecting a particular stimulus, or stimulus type, by chance alone. This probability is .50 in the two-comparison, forced-choice situation. Therefore, a greater difference in type of stimulus choice is required to determine a preference for a categorization type. Selections made by chance alone are those that offer no evidence from which to adduce the controlling relation of the subjects' response pattern of stimulus selection and categorization on the particular trial or series (Sidman, 1987). Under such circumstances, the subjects' responses are considered to be under the control of stimuli unknown to the experimenter.

The body of literature cited suggests that there are differences in the ways that



children categorize familiar items. These differences may be caused by the wording of instructions, the use of reinforcement for selection type, the type of stimuli presented, and other procedural nuances (such as puppets). Predominant in this research body is the finding that preschool-aged children relate items on a thematic basis, and children at approximately age 7 begin to relate items on a taxonomic basis. It has been suggested that this change in categorization style maps changes in the cognitive abilities of the child at this age, which makes taxonomic relations more salient (Markman & Hutchinson, 1984; Waxman et al., 1991; Waxman & Kosowski, 1990). Several studies have indicated that using a novel noun to label a sample will produce taxonomic choices in younger children (Markman & Hutchinson, 1984; Waxman & Kosowski, 1990), whereas other research has demonstrated that manipulation of instructions alone will produce taxonomic choice (Bauer & Mandler, 1989).

Another possible explanation for this discrepancy in performance is that the younger children may not have formed a rule for the taxonomic relation. The term rule has been defined by Hayes and Hayes (1989) as "to govern" (p. 154). Skinner (1969) characterized a rule as a contingency-specifying stimulus. In each definition, the role of a rule is to influence a behavior to be performed. Within the Skinner (1969) definition, the rule specifies the relationship to be reinforced. To apply this definition to the present situation, the rule would specify the relation (taxonomic or thematic) that should be responded to in the context of the sample stimulus provided. If younger children have learned a rule regarding a thematic relation, then the probability of selection on this basis is increased. Similarly, language cues are rules

that indicate how we should behave. Markman and Hutchinson (1984) found that when a sample stimulus was given a name (novel noun), the children were more likely to categorize on a taxonomic basis. When no name was presented, the children selected more often on a thematic basis. Thus, a novel noun contextually controlled the basis of selection, at least for taxonomic relations. The introduction of these nouns introduced a rule, probably based on semantic relations, in which the children's behavior was governed to select the taxonomically related stimuli.

Markman and Hutchinson's (1984) paper represents a seminal article in this research base. This article is frequently cited as a foundation for further exploration of categorical research. Many other researchers have used portions of the procedures used by Markman and Hutchinson (1984).

The purposes of the present study were to (a) replicate the findings of Markman and Hutchinson (1984) and (b) extend their model from the two-comparison, forced-choice situation to the three-comparison situation (Sidman, 1987). This study consisted of six experiments. Experiment 1 consisted of a replication of Markman and Hutchinson (1984), using more neutral instructions. Experiment 1 used the instructions, "Touch this one and the one that goes with it" as contrasted with Markman and Hutchinson's (1984) "find another one..." (p. 6). Experiment 2 was a replication using a third comparison stimulus, as suggested by Sidman (1987), unrelated to the sample stimulus either thematically or taxonomically. Experiment 3 was a replication of Markman and Hutchinson's Experiment 1, using the two-comparison, forced-choice situation, the more neutral verbal instructions, and random

positioning of the trial types to account for position effects. Experiment 4 involved a replication of Markman and Hutchinson's (1984) Experiment 1 and used their exact instructions to the subjects. Experiment 5 was a replication of Experiment 4, using an experimenter naive to the literature base to account for potential experimenter bias, which might have influenced the results of the earlier experiments. Experiment 6 compared the trial types used in Experiments 1 through 5 with trial types described in Markman and Hutchinson's (1984) Experiment 1. The naive experimenter presented each subject with both sets of trial types using a mixed presentation order to account for sequencing effects. These experimental manipulations are summarized in Table 1.

The statistics reported in the results herein are provided as a means for comparing the present findings with the results of the dominant articles from the extant literature. To facilitate comparison, the statistical procedures from that literature base were adopted. For all experiments, the ANOVA tables appear in Appendix A.

Table 1

Differences by Experiment

Variable	Experiment Number					
	1	2	3	4	5	6
Instructions <sup>a</sup>	a	a	a	b	b	b
Number of Comparison Stimuli	2	3	2	2	2	2
Random Order	No	No	Yes	No	No	No
Feedback after Choice	2	2	No	No	No	No
Blind Tester	No	No	No	No	Yes	No
Markman and Hutchinson (1984) Stimuli	No	No	No	No	No	Yes

<sup>a</sup>The instructions provided were from either (a) Bauer and Mandler (1989) or (b) Markman and Hutchinson (1984).

## EXPERIMENT 1

While reviewing this literature, a question arose as to why differences in results existed in very similar experiments, that is, Bauer and Mandler (1989), who found that younger children responded taxonomically in contrast to Markman and Hutchinson (1984), who found that children younger than 7 years old responded thematically. Were these discrepancies due to procedural differences (for example, use of verbal feedback or type of instructions used) or to differences in the type of stimuli used? Experiment 1 attempted to replicate the findings of Markman and Hutchinson (1984).

### Method

#### Subjects

For Experiment 1, as well as for all of the following experiments, an abstract of the procedures and an informed consent form were given to each child's parent or legal guardian (see Appendix B). The experimenter ensured that a signed copy of the consent form was in hand before the child was included in the project. Moreover, a summary of the research was submitted to Utah State University's Human Subjects Committee, and the Committee granted its approval (see Appendix C).

Subjects in Experiment 1 were 36 children (mean age = 52.67 months; range 38 to 73 months), 19 males and 17 females, who attended a preschool located on the campus of Utah State University. Thirty-eight permission forms were obtained, but two children were not included in the research sample because they failed to complete

the pretest. The failure was probably due to their age (mean = 36.5 months) and primary language, which was not English.

### Stimuli

Prior to beginning these experiments, an attempt was made to determine the exact stimuli used in the Markman and Hutchinson (1984) experiments. E. M. Markman (personal communication, June 5, 1992) was unable to provide any information regarding the standardization, size, color, or elaborateness of the stimuli they used. In an attempt to aid future research, the present study used the *Peabody Picture Collection* as the stimuli, with the intention of achieving some minimum level of standardization.

Forty-two of 48 stimuli were pictures from the *Peabody Picture Collection*. This collection consists of 1,144 full-color cards, 2.5 inches wide by 3.5 inches tall. The cards depict a variety of familiar objects and activities, people of both genders, and different ages and racial makeups. Prior to Experiment 1, these stimuli were presented to a variety of people (six adults and one child; age of child = 68 months) to ensure the desired object on each card could be discriminated. An additional six stimuli were hand drawings by one of the experimenters. The hand-drawn stimuli were presented to four adults and two children (mean age of children = 70 months) to ensure they were discriminated as the objects portrayed. The stimuli are listed in Tables 2 and 3.

Table 2

Pretest Stimuli

Sample	Comparison	Comparison
Triangle	Triangle	Oval
Circle	Circle	Diamond
Square	Square	Heart
Semicircle	Semicircle	Rectangle
Cross	Cross	Half moon
Star	Star	Octagon

Procedures

All subjects were tested in the basement of their preschool. The teacher accompanied a subject downstairs, a familiar but infrequently used area of the preschool, and introduced the subject to the experimenter. The subject was seated at a child-sized table, across from the experimenter. The experimenter asked the subject if s/he would like to play a game and proceeded to lay out the first pretest trial type. The placement of the stimuli is depicted in Figure 1.

Subjects were instructed to "Touch this one [sample] and the one that goes with it." The experimenter pointed to the sample stimulus as the instructions were given. After the subject had touched the sample stimulus and one of the comparison stimuli, the experimenter retrieved the stimuli and entered the results for that trial on the data sheet. The same procedure was followed on both the pretest and test trials.

Table 3

Test Stimuli

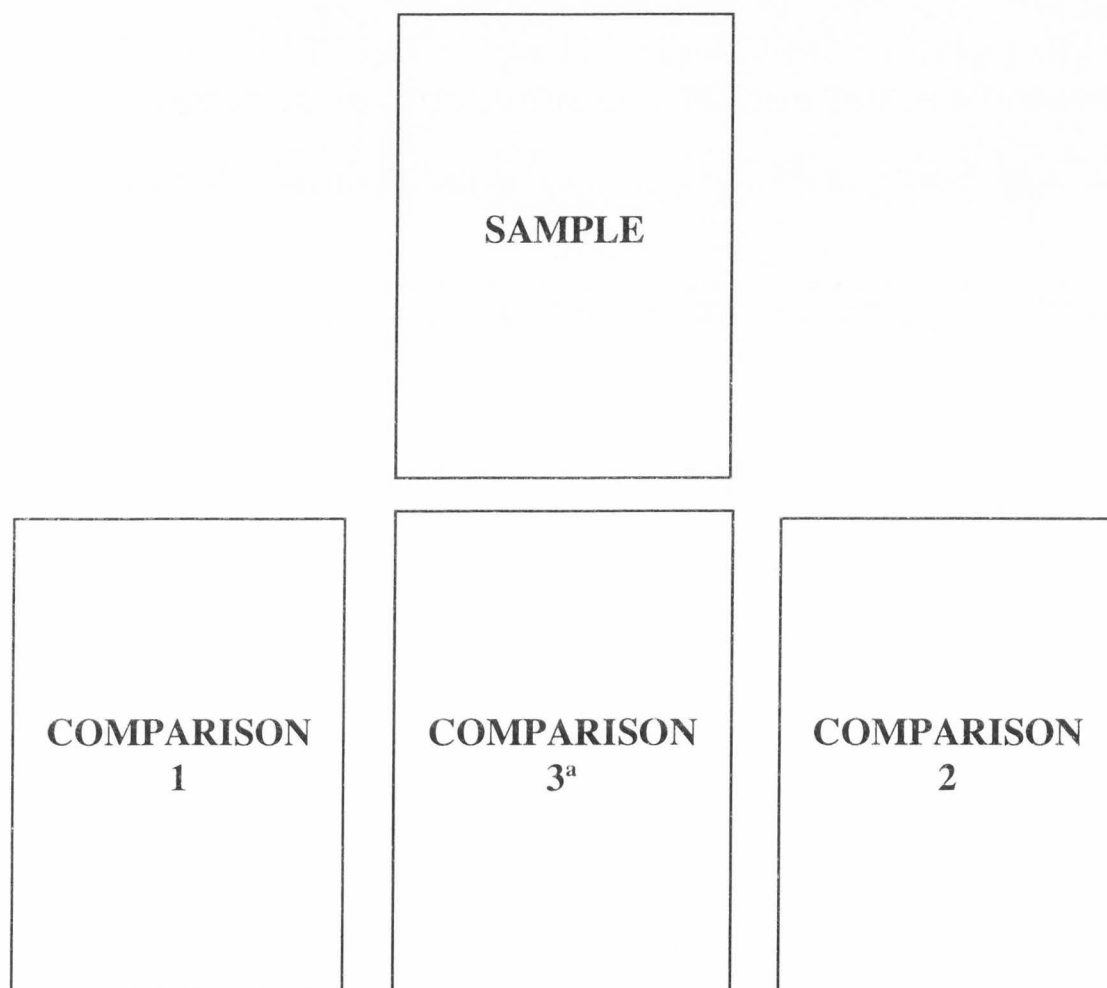
Trial No.	Sample	Taxonomic Comparison	Thematic Comparison	Arbitrary Comparison <sup>a</sup>
1	Cup	Glass	Kettle	Bracelet
2	Tennis shoe	Boot	Foot	Radio
3	Dog	Puppy	Dog food	Toothbrush
4	Cow	Pig	Milk	Telephone
5	Crib	Bed	Baby	Snowman
6	Bee	Ant	Flower	Necklace
7	Cardinal	Duck	Nest	Toothpaste
8	Dog	Cat	Bone	Wrist watch
9	Male baseball player	Man	Baseball	Cake
10	Train	Bus	Train track	Comb

<sup>a</sup>Arbitrary stimuli were used in Experiment 2 only.

The two types of comparison stimuli were counterbalanced so that each type appeared on each side an equal number of times across the trials for each subject. This approach was taken to preclude selection based solely on the position of the stimuli. After each trial, the experimenter gave nonspecific verbal praise, such as "You're doing good work" and "You are a hard worker." These statements were given regardless of the subject's selection.

Pretest. Each test was preceded by a pretest to ensure the subjects were able to perform an identity matching task. The pretest consisted of three of the trial types shown in Table 2. Subjects were required to correctly match a set of three trial types





<sup>a</sup>The three-comparison format was used only in Experiment 2.

Figure 1. Position of stimuli.

to pass the pretest. If this criterion was not met, the subject received three additional trial types, which required the same response criterion. If a subject failed the second set of pretest trials, s/he was thanked, given stickers, and escorted back to the preschool activities. Demographic information was not included for subjects who failed the pretest. Placement of stimuli followed Figure 1.

Each subject received one sticker after completing the pretest and two additional stickers after the last test trial type. Children who failed the pretest received

the same number of stickers as the subjects.

Test. Subjects who successfully completed the pretest were asked if they "would like to play the game more." All subjects indicated that they would like to continue. The test trial types were presented in the same manner described for the pretest. All subjects completed the 10 trials.

### Results of Experiment 1

A  $t$  test for dependent samples was performed to determine differences in choice between the taxonomic and thematic comparison stimuli. The results indicated a statistically significant preference for taxonomic stimuli ( $t = -2.37$ ,  $df = 35$ ,  $p = .02$ ). These results are shown in Table 4.

A one-way ANOVA was performed to determine if any difference existed between genders for the taxonomic stimuli. The results indicated no statistically significant gender difference in preference for taxonomic or thematic stimuli ( $F_{(1,34)} = 1.00$ ,  $p = .75$ ).

An examination of the percentages of taxonomic and thematic choices across trials in Experiment 1 revealed a steady decrease in percentage of taxonomic responses beginning with Trial 7. Numerically, the majority of subjects selected on a thematic basis on Trials 7 through 10. These results are shown in Figure 2 and in the percentages given in Table 4. A statistically significant difference was found between selection category on Trials 1 through 5 and Trials 6 through 10 ( $t = -6.66$ ,  $df = 35$ ,  $p = .001$ ).

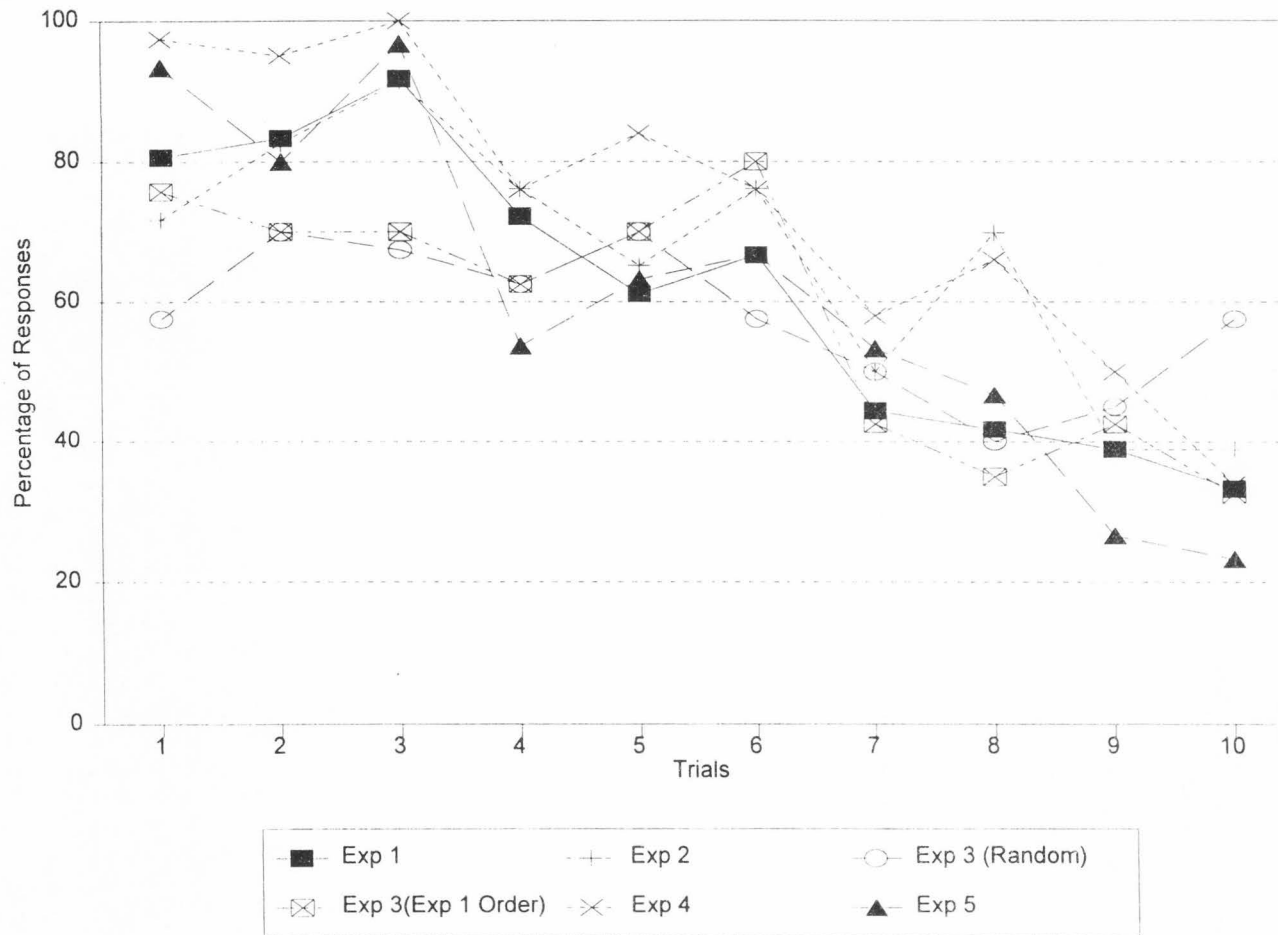


Figure 2. Taxonomic responses for Experiments 1 through 5.

Table 4

Number of Choices by Type, Experiment 1

Trial No.	Taxonomic (%)	Thematic (%)
1	29 (80.6)	7 (19.4)
2	30 (83.3)	6 (16.7)
3	33 (91.7)	3 (8.8)
4	26 (72.2)	10 (27.8)
5	22 (61.1)	14 (38.9)
6	24 (66.7)	12 (33.3)
7	16 (44.4)	20 (55.6)
8	15 (41.7)	21 (58.3)
9	14 (38.9)	22 (61.1)
10	12 (33.3)	24 (66.7)
Total	221 (61.4)	139 (38.6)

To assess differences in category selection based on age, the subjects were subdivided into three age groups: (a) up to 47 months ( $\underline{n} = 16$ ), (b) 48 to 59 months ( $\underline{n} = 10$ ), and (c) 60 months and above ( $\underline{n} = 10$ ). A one-way ANOVA was performed using age level by taxonomic choice. The ANOVA was not statistically significant ( $p = .30$ ).

A Boxplot analysis revealed no outliers within the taxonomic choice distribution, and it is assumed that normality of the distributions was preserved. The Bartlett-Box F and Cochran's C tests were not statistically significant for the taxonomic choice distribution; hence, there was no reason to believe the distribution

violated the assumption of homogeneity of variance. The assumptions underlying the use of the ANOVA were met.

### Discussion

The results of Experiment 1 indicate that these preschool-aged children selected on a taxonomic basis more often than a thematic basis with some exceptions. Overall, these results are contrary to the results of Markman and Hutchinson (1984), Waxman et al. (1991), and Waxman and Kosowski (1990). Each of these studies found that preschoolers classified on a thematic basis (in the absence of a novel noun attached to the sample stimulus). This difference could have been the result of one or more factors, including differences in verbal instruction, the nontask-related verbal reinforcement provided after each trial, the absence of a puppet for presenting stimuli, the reinforcement provided after the completion of the pretest and again after the last trial, or the trial type stimuli themselves.

Further, when the subjects' responses were compared across age ranges, no statistically significant differences were found between the groups. This lack of a developmental trend is contrary to the results of Markman and Hutchinson (1984) and Smiley and Brown (1979), although the range of the subject's ages in the present study, 38 to 73 months, may be too limited for these trends, if any, to emerge.

These results support the findings of Bauer and Mandler (1989), who examined the choice behavior of 16- to 20-month-old children. Bauer and Mandler (1989) found a statistically significant preference for the taxonomic choice when discriminative

verbal feedback was given contingent on the type of choice made. Bauer and Mandler (1989) provided "cheering and clapping" (p. 162) for taxonomic choices and "Thank you. Good boy/girl" (p. 162) for thematic choices. The verbal feedback used in the present experiment consisted of "Thank you for working this hard" and "You sure are a good worker" following any choice. Additionally, Bauer and Mandler (1989) used the following statements to introduce the stimuli: "See this? Can you find another one just like this one? Can you show me the other one like this?" (p. 162). Thus, a difference still existed between the verbal instructions and type of feedback (specific versus nonspecific) used by Bauer and Mandler (1989) and the present experiment.

Analysis of the stimulus selection across trials revealed a trend of declining responses to taxonomically related stimuli beginning with Trial 7. A question arises as to the cause of this phenomenon. Is it a position effect, fatigue, or the salience of the stimuli with regard to their representativeness? It is not clear what caused this change, and the phenomenon warrants further investigation. To address these questions, Experiment 3 used a randomized procedure to minimize position effects and to determine if fatigue was responsible for the pattern.

To the author's knowledge, none of the other studies in the literature provided evidence based on individual trial types. Therefore, it is unknown whether the averaged results masked taxonomic responses on certain trial types or subjects indeed chose thematically across the entire series. For instance, Markman and Hutchinson (1984) had several outcomes where thematic preferences for the group of subjects were about 60%. This result suggests that about 40% of their choices were not thematic.

Yet, without analyzing Markman and Hutchinson's (1984) individual trials, it is impossible to determine whether such results were specific to trial types.

Contrary to the majority of the research literature cited, no statistically significant differences were found when responses were considered across ages. This result may have been due to the use of subjects from a university preschool and their parents' level of education. However, Markman and Hutchinson (1984), Waxman and Kosowski (1990), and Waxman et al. (1991) used subjects obtained from preschools serving middle to upper middle class parents who presumably would share an education level equal to the parents of the sample in this study.

## EXPERIMENT 2

Throughout this literature, a forced-choice situation has been used as the standard method to ascertain children's categorical bases for matching related items. Some authors have varied the procedures by using two samples and one comparison (Greenfield & Scott, 1986) or one sample and four comparisons, two related taxonomically and two thematically (Waxman & Kosowski, 1990). Still, the majority of these studies have chance probabilities of selection based on either a thematic or taxonomic basis of .50, which constitutes a forced-choice selection between thematic and taxonomic relations. Sidman (1987) has suggested that "two choices are not enough" (p. 11) to determine if the selection is made on anything other than chance factors. Experiment 2 followed the basic procedures of Experiment 1 and implemented Sidman's (1987) suggestion by introducing an arbitrary third stimulus, one neither taxonomically nor thematically related to the samples.

### Method

#### Subjects

Subjects in Experiment 2 were 46 children (mean age 52.88 months; range 29 to 73 months), 21 females and 25 males, who attended a preschool in Logan, Utah. Forty-seven permission forms were obtained, but one child failed to complete the pretest. This failure was probably due to his age (29 months).



### Stimuli

Forty-eight of 58 stimuli were pictures described in Experiment 1. An additional 10 stimuli were from the *Peabody Picture Collection* and were not related to the sample stimuli either thematically or taxonomically. These stimuli were presented to three adults and one child (age 68 months) to ensure the desired object could be discriminated in each stimulus. The stimuli are listed in Table 3.

### Procedures

All subjects were tested in a room on the main floor of their preschool. All other features of the procedure were identical to Experiment 1, with the exception of the one additional comparison stimulus per trial type.

Pretest. The same trial types and criteria described in Experiment 1 were used.

Test. The procedures of Experiment 1 were followed, with the noted addition of a third comparison stimulus within each trial type. The positioning of the comparison stimuli is shown in Figure 1.

### Results of Experiment 2

A Friedman's test was performed to analyze differences among the three choice types. (Friedman's test is a nonparametric, repeated-measures test for differences between subjects. This test was selected because uncertainties existed regarding the normality of the distributions tested. Friedman's test is comparable to the parametric F test for repeated measures. The results of Friedman's test are reported and

interpreted as a  $\chi^2$ .) The subjects chose the taxonomically related stimuli more often than either the thematically related stimuli or the nonrelated stimuli ( $\chi^2 = 66.42$ ,  $df = 2$ ,  $p = .001$ ).

An examination of the percentages of taxonomic and thematic choices across trials revealed a steady decrease in percentage of taxonomic responses beginning with Trial 7, as in Experiment 1. These results are shown in Figure 2 and in the percentages given in Table 5. A statistically significant difference was found between selection category on Trials 1 through 5 and Trials 6 through 10 ( $t = -4.63$ ,  $df = 45$ ,  $p = .001$ ).

One-way ANOVAs were conducted to determine if any difference existed between genders in preference for the taxonomic, thematic, or nonrelated stimuli. The results indicated no statistically significant gender difference in preference for taxonomic stimuli ( $F_{(1,44)} = 0.09$ ,  $p = .76$ ). A second ANOVA was performed for gender and the arbitrary choice; these results were not statistically significant ( $F_{(1,44)} = 1.50$ ,  $p = .23$ ).

To assess differences in category selection based on age, the subjects were subdivided into three age groups: (a) up to 47 months ( $n = 12$ ), (b) 48 to 59 months ( $n = 21$ ), and (c) 60 months and above ( $n = 13$ ). Separate one-way ANOVAs were performed using age level by taxonomic and arbitrary choices. The ANOVA for age by taxonomic choice was not statistically significant ( $F_{(2,43)} = 0.64$ ,  $p = .53$ ). However, for age versus arbitrary choice, a statistically significant difference was found ( $F_{(2,43)} = 6.63$ ,  $p = .001$ ). A Tukey HSD (honestly significant difference) post-

Table 5

Number of Choices by Type, Experiment 2

Trial No.	Taxonomic (%)	Thematic (%)	Arbitrary (%)
1	33 (71.7)	10 (21.7)	3 (6.5)
2	38 (82.6)	7 (15.2)	1 (2.2)
3	42 (91.3)	4 (8.7)	0 (0.0)
4	35 (76.1)	10 (21.7)	1 (2.2)
5	30 (65.2)	14 (30.4)	2 (4.3)
6	35 (76.1)	11 (23.9)	0 (0.0)
7	23 (50.0)	22 (47.8)	1 (2.2)
8	32 (69.9)	14 (30.4)	0 (0.0)
9	17 (38.9)	25 (54.3)	4 (8.7)
10	17 (38.9)	29 (63.0)	0 (0.0)
Total	302 (65.7)	146 (31.7)	12 (2.6)

hoc analysis revealed that the significant difference with respect to choice of the nonrelated stimuli was between the youngest age group, 0 to 47 months, and both of the other groups.

### Discussion

The results of Experiment 2 replicate those of Experiment 1. Preschool-aged children selected on a taxonomic basis more often than a thematic or arbitrary basis with exceptions. Again, these results are contrary to the findings of Markman and

Hutchinson (1984), Waxman and Kosowski (1990), and Waxman et al. (1991). These authors all found a clear preference for thematic relations among preschoolers. This difference could have been the result of one or more factors, including differences in verbal instructions (which were consistent across the present Experiments 1 and 2), the nontask-related verbal feedback provided within the testing situation, or stickers, ostensibly reinforcement, provided after the pretest and the last test trial. Other possible influences on these findings were the type of stimuli used, experimenter bias, the lack of a puppet to present the stimuli, and the number of presentations of each trial type.

As in Experiment 1, gender differences were not found for selection preference. This result is in agreement with the cited literature (Smiley & Brown, 1979; Markman & Hutchinson, 1984; Greenfield & Scott, 1986; Fenson et al., 1988; Bauer & Mandler, 1989; Waxman & Kosowski, 1990; Waxman et al., 1991). Analysis of the response trends across trials revealed a general decline in taxonomic responses beginning with Trial 7, although 69.9% of the responses were taxonomic on Trial 8. This finding was similar to the decline found in Experiment 1. The cause of this decline is unclear, although the percentage of taxonomic responses on Trial 8 indicates that the thematic responses for the other three trials (7, 9, and 10) must be large enough to account for this declining trend. Another possibility may be that the taxonomic stimuli for these three trials are not prototypic of the relations involved; therefore, the thematic relation is most salient.

When the subjects were compared across age ranges, a statistically significant

difference was found in the number of arbitrary stimuli chosen by only the youngest children. This group accounted for 9 of the 12 (75.00%) arbitrary selections made, with two subjects accounting for 5 of these 9 (55.55%) selections. This phenomenon may have been due to the salience of the particular stimuli, because 7 of the 12 (58.33%) arbitrary selections were made on two trials, Trials 2 and 9. The arbitrary comparisons for these trials were a radio and a cake, respectively.

These results suggest that children are indeed inclined to respond to stimuli related either taxonomically or thematically as opposed to the unrelated stimuli, given the context of the instructions to "find another that is the same as this." From the results of this experiment, the forced-choice nature of the tasks employed in the cited literature does not appear problematic.

## EXPERIMENT 3

Experiment 3 attempted to determine the reason for the decline in taxonomic choice selection on Trials 7 through 10 that was found in Experiments 1 and 2.

### Method

#### Subjects

Subjects in Experiment 3 were 40 children (mean age 43.83 months; range 35 to 51 months), 16 males and 24 females, who attended a preschool located on the campus of Utah State University. Forty-two permission forms were obtained, but two subjects failed to complete the pretest.

#### Stimuli

The stimuli were the same pictures from the *Peabody Picture Collection* and the same additional six drawings described in Experiment 1 (see Tables 2 and 3).

#### Procedures

All subjects were tested in a spare room of their preschool. The procedures of Experiment 1 were followed, with the exception that the trial types were placed in a paper bag and shaken prior to enlisting the subject. Trial types were then randomly selected from the bag and their order was recorded on the data sheet for that subject. Additionally, the placement of the comparison stimuli was counterbalanced to minimize the effects of stimulus position.

### Results of Experiment 3

A  $t$  test for dependent samples was performed to determine differences in choice between the taxonomic and thematic stimuli. The results indicated a statistically significant preference for taxonomic stimuli ( $t = -2.03$ ,  $df = 39$ ,  $p = .05$ ). The raw data and corresponding percentages contributing to these results are shown in Table 6.

A one-way ANOVA was performed to determine if any difference existed between genders for the taxonomic stimuli. The results indicated no statistically significant gender difference in preference for taxonomic stimuli ( $F_{(1,38)} = 0.03$ ,  $p = .86$ ).

The percentages of taxonomic and thematic choices across trials in Experiment 3 were compared in two ways: (a) across trials of randomly presented stimuli and (b) across trials with stimuli ordered as in Experiments 1 and 2. The number and percentages for each trial type are presented in Table 6. A  $t$  test for dependent samples, comparing Trials 1 through 5 with Trials 6 through 10, was performed for both the random presentation order and the Experiment 1 presentation order. The  $t$  tests for both presentation orders were statistically significant ( $t = -2.96$ ,  $df = 39$ ,  $p = .001$  and  $t = -5.39$ ,  $df = 39$ ,  $p = .001$ , respectively).

To assess differences in category selection based on age, the subjects were subdivided into two age groups: (a) up to 47 months ( $n = 33$ ) and (b) 48 to 59 months ( $n = 7$ ). A one-way ANOVA was performed using age level by taxonomic choice. This ANOVA was not statistically significant ( $F_{(1,38)} = 0.96$ ,  $p = .33$ ). The Bartlett-

Number of Choices by Type, Experiment 3

Trial No.	Taxonomic (%) Random Order	Thematic (%) Random Order	Taxonomic (%) Exp 1 Order	Thematic (%) Exp 1 Order
1	23 (57.5)	17 (42.5)	30 (75.7)	10 (25.0)
2	28 (70.0)	12 (30.0)	28 (70.0)	12 (30.0)
3	27 (67.5)	13 (32.5)	28 (70.0)	12 (30.0)
4	25 (62.5)	15 (37.5)	25 (62.5)	15 (37.5)
5	28 (70.0)	12 (30.0)	28 (70.0)	12 (30.0)
6	23 (57.5)	17 (42.5)	32 (80.0)	8 (20.0)
7	20 (50.0)	20 (50.0)	17 (42.5)	23 (57.5)
8	16 (40.0)	24 (60.0)	14 (35.0)	26 (65.0)
9	18 (45.0)	22 (55.0)	17 (42.5)	23 (57.5)
10	23 (57.5)	17 (42.5)	13 (32.5)	27 (67.5)
Total	231 (57.75)	169 (42.25)	231 (57.75)	169 (42.25)

Bartlett-Box F and Cochran's C tests were not statistically significant for the taxonomic choice distribution; hence, there was no reason to believe the distribution violated the assumption of homogeneity of variance.

### Discussion

The results of Experiment 3 indicate that these preschool-aged children selected on a taxonomic basis more often than a thematic basis. These results replicate the results of Experiments 1 and 2 and are contrary to the results of Markman and Hutchinson (1984), Waxman et al. (1991), and Waxman and Kosowski (1990).



As in Experiments 1 and 2, Experiment 3 found no statistically significant differences between the groups when compared across ages. This finding supports the lack of a developmental trend. Further, the results of Experiment 3 support the findings of Bauer and Mandler (1989), which are in favor of a taxonomic preference for preschool-aged children.

The purpose of Experiment 3 was to account for a trend of declining responses to taxonomically related stimuli beginning with Trial 7 that was observed in Experiments 1 and 2. A similar decline was found with the random presentation of stimuli used in this experiment (see Figure 2), which suggests that this phenomenon is caused by something other than the presentation order used. However, the effect was greater for the stimuli presentation order used in Experiment 1. This finding suggests that the specific trial types themselves account for some of this decline, because a portion of Experiment 1, Trials 6 through 10, still appeared within this block under random placement conditions for Experiment 3. Means for the responses to the taxonomic stimuli for the random and Experiment 1 presentation orders were 6.73 and 6.53, respectively. Thus, these subjects may have categorized on the bases of where in a sequence of trials they experienced a particular trial type, as well as on the trial type itself.

## EXPERIMENT 4

The results of Experiment 3 failed to replicate the findings of Markman and Hutchinson (1984). Therefore, Experiment 4 was designed to follow the procedures of these authors, as closely as possible (without the puppet), in another attempt to replicate their results. These procedures used their instructions and provided no reinforcement (feedback) to the subjects for responses to comparison stimuli.

### Method

#### Subjects

Subjects in Experiment 4 were 38 children (mean age 53.66 months; range 37 to 70 months), 19 males and 19 females, who attended a preschool located in Logan, Utah. Forty-one permission forms were obtained, but three subjects failed to complete the pretest.

#### Stimuli

The stimuli were the same pictures from the *Peabody Picture Collection* and the same additional six drawings described in Experiment 1 (see Tables 2 and 3).

#### Procedures

All subjects were tested in the main room of their preschool at a table separated from the rest of the room by a divider, approximately 3 feet high.

The procedures were the same as in Experiment 1, with the following

exceptions: (a) the type of verbal instructions provided and (b) no verbal feedback followed either the pretest or any of the test trials. Subjects were given the same instructions used in Markman and Hutchinson's (1984) study. The instructions were "Look carefully now, see this?" (p. 6). [The experimenter points at the sample stimulus.] "Find another that is the same as this." (p. 6). [Experimenter points again to the sample.]

#### Results of Experiment 4

A  $t$  test for dependent samples was performed to determine differences in choice between the taxonomic and thematic stimuli. The results indicated a statistically significant preference for taxonomic stimuli ( $t = -6.27$ ,  $df = 37$ ,  $p < .001$ ). The raw data and corresponding percentages contributing to these results are shown in Table 7.

A one-way ANOVA was performed to determine if any difference existed between genders for the taxonomic stimuli. The results indicated no statistically significant gender difference in preference for taxonomic stimuli ( $F_{(1,36)} = 0.02$ ,  $p = .89$ ). The percentages of taxonomic and thematic choices across trials in Experiment 4 were compared, as in Experiment 1. A  $t$  test for dependent samples, comparing Trials 1 through 5 with Trials 6 through 10, was performed. This  $t$  test was statistically significant ( $t = -6.19$ ,  $df = 37$ ,  $p < .001$ ).

To assess differences in category selection based on age, the subjects were subdivided into three age groups: (a) up to 47 months ( $n = 8$ ), (b) 48 to 59 months ( $n = 18$ ), and (c) 60 months and above ( $n = 12$ ). A one-way ANOVA was performed

Table 7

Number of Choices by Type, Experiment 4

Trial No.	Taxonomic (%)	Thematic (%)
1	37 (97.4)	1 (2.6)
2	36 (95.0)	2 (5.0)
3	38 (100)	0 (00.0)
4	29 (76.0)	9 (24.0)
5	32 (84.0)	6 (16.0)
6	29 (76.0)	9 (24.0)
7	22 (58.0)	16 (42.0)
8	25 (66.0)	13 (34.0)
9	19 (50.0)	19 (50.0)
10	13 (34.0)	25 (66.0)
Total	280 (73.68)	100 (26.32)

using age level by taxonomic choice. This ANOVA was not statistically significant ( $p = .09$ ). The Bartlett-Box F and Cochran's C tests were not statistically significant for the taxonomic choice distribution; hence, there was no reason to believe the distributions violated the assumption of homogeneity of variance.

### Discussion

The results of Experiment 4 indicate that these preschool-aged children selected on a taxonomic basis more often than a thematic basis even when using instructions

that had previously been shown to lead to thematic selections (Markman & Hutchinson, 1984). These results confirm the results of Experiments 1, 2, and 3 and are contrary to the results of Markman and Hutchinson (1984), Waxman et al. (1991), and Waxman and Kosowski (1990). Each of these studies found that preschoolers classified on a thematic basis in the absence of a novel noun attached to the sample stimulus. The results of Experiment 4 suggest that the verbal instructions used by Markman and Hutchinson (1984) alone were not powerful enough to result in thematic selections in the present study.

Further, when the subject's responses were compared across age ranges, no statistically significant differences were found between groups. This lack of a developmental trend is also contrary to the results of Markman and Hutchinson (1984) and Smiley and Brown (1979), although the range of the subject's ages, 37 to 70 months, may be too limited for these types of trends to emerge.

These results provide further support to the findings of Bauer and Mandler (1989), who examined the choice behavior of 16- to 20-month-old children. These authors found a statistically significant preference for the taxonomic choice when discriminative verbal feedback was given contingent on the type of choice made. However, the present experiment did not use verbal feedback of any kind following the pretests or test trials.

A novel result emerged from Experiment 4: A decline in taxonomic responding was found (as shown in Figure 2), similar to the previous three experiments. However, this decline was more broad than in the previous experiments. This finding

suggests that the decline observed in the previous experiments may not be determined strictly by the order of trial presentation. More likely causes are fatigue, diminishing control of the instructions, or some other unknown factor.

## EXPERIMENT 5

One possible factor inhibiting replication of Markman and Hutchinson's (1984) results could be experimenter bias. In the previous four experiments, the experimenter was also involved in testing the children. Hence, the results could have been biased in favor of taxonomic selections given the experimenter's knowledge of the prior experiments. Therefore, a naive experimenter, unfamiliar with both the previous results and the literature base, was introduced in Experiment 5.

### Method

#### Subjects

Subjects in Experiment 5 were 31 children (mean age 51.47 months; range 33 to 62 months), 12 males and 19 females, who attended a preschool located on the Utah State University campus in Logan, Utah. Thirty-two permission forms were obtained, but one subject failed to complete the pretest.

#### Stimuli

The stimuli were the same pictures from the *Peabody Picture Collection* and the same additional six drawings described in Experiment 1 (see Tables 2 and 3).

#### Procedures

All subjects were tested in a side room of their preschool at a table separated from the rest of the children. The procedures were the same as in Experiment 4.

## Results of Experiment 5

A  $t$  test for dependent samples was performed to determine differences in choice between the taxonomic and thematic stimuli. The results indicated a statistically significant preference for taxonomic stimuli ( $t = -2.22$ ,  $df = 29$ ,  $p = .04$ ). Table 8 provides these results and presents the number and percentages for each trial type.

A one-way ANOVA was performed to determine if any difference existed between genders for the taxonomic stimuli. The results indicated no statistically significant gender difference in preference for taxonomic stimuli ( $F_{(1,28)} = 0.12$ ,  $p = .73$ ).

The percentages of taxonomic and thematic choices across trials in Experiment 5 were compared across trials as in Experiment 1. A  $t$  test for dependent samples, comparing Trials 1 through 5 with Trials 6 through 10, was performed. This  $t$  test was statistically significant ( $t = -6.16$ ,  $df = 29$ ,  $p < .001$ ).

To assess differences in category selection based on age, the subjects were subdivided into three age groups: (a) up to 47 months ( $n = 10$ ), (b) 48 to 59 months ( $n = 15$ ), and (c) 60 months and above ( $n = 5$ ). A one-way ANOVA was performed using age level by taxonomic choice. This ANOVA was statistically significant ( $F_{(2,27)} = 4.30$ ,  $p = .02$ ). The Tukey HSD test for post-hoc comparisons was used to determine which of the multiple comparisons were statistically significant. Only the comparison between group 1 (ages < 47 months) and group 2 (ages 48 to 59 months) was statistically significant for the taxonomic choice. The Bartlett-Box  $F$  and



Table 8

Number of Choices by Type, Experiment 5

Trial No.	Taxonomic (%)	Thematic (%)
1	28 (93.3)	2 (6.7)
2	24 (80.0)	6 (20.0)
3	29 (96.7)	1 (3.3)
4	16 (53.3)	14 (46.7)
5	19 (63.3)	11 (36.7)
6	20 (66.7)	10 (33.3)
7	16 (53.3)	14 (46.7)
8	14 (46.7)	16 (53.3)
9	8 (26.7)	22 (73.3)
10	7 (23.3)	23 (76.7)
Total	181 (60.33)	119 (39.67)

Cochran's C tests were not statistically significant for the taxonomic choice distribution; hence, there was no reason to believe the distribution violated the assumption of homogeneity of variance.

### Discussion

The results of Experiment 5 indicate that these preschool-aged children selected on a taxonomic basis more often than a thematic basis, even though the procedures were administered by an experimenter naive to prior results and the literature. These

results confirm the results of Experiments 1, 2, 3, and 4 and are contrary to the results of Markman and Hutchinson (1984), Waxman et al. (1991), and Waxman and Kosowski (1990). The results of Experiment 5 suggest that experimenter bias was not responsible for the results of Experiments 1 through 4.

For the first time, a statistically significant difference was found when the subject's responses were compared across age ranges. However, this difference was between the two lowest age ranges where the literature suggests that the developmental trend toward the selection of taxonomically related stimuli should be evidenced as children approach age 7. Therefore, the difference should have been found within the older age range, rather than the younger range, if the developmental trend existed. This trend may have been evident in the older group if a larger sample had been used.

The results of this experiment also supported the finding of the previous four experiments: A statistically significant decline occurred in taxonomic responding across trial types. This decline is shown in Figure 2. This decline was broad, similar to the decline found in Experiment 4. However, as in Experiments 1 through 3, a majority of subjects chose thematically on Trials 8, 9, and 10. This finding supports the results of the previous experiments, which found that this decline may not be determined strictly by the order of trial presentation. More likely causes are fatigue or other unknown factor.

## EXPERIMENT 6

Experiment 6 compared the trial types used in Experiments 1 through 5 with trial types using pictures described in Markman and Hutchinson's (1984) Experiment 1. Having failed to replicate the findings of Markman and Hutchinson (1984) in the previous five experiments, the experimenter hypothesized that a variable controlling the type of relation selected may have been the stimuli themselves. Markman and Hutchinson (1984) discussed differential responding when the taxonomic stimuli were related on a first-order basis versus a second-order basis. The stimuli from the present Experiments 1 through 5 represented a mix of first- and second-order taxonomic relations; therefore, it was entirely possible that the children's selection of taxonomic relations was a function of the stimuli themselves. To examine this hypothesis, a comparison was made between the trial types of Experiments 1 through 5 and the trial types used in Markman and Hutchinson's (1984) Experiment 1.

### Method

#### Subjects

Subjects in Experiment 6 were 39 children (mean age 54.64 months; range 37 to 68 months), 16 females and 23 males, who attended a preschool in Logan, Utah. Forty-two permission forms were obtained. Two children failed to complete the pretest, probably because the subjects did not speak English.

## Stimuli

The stimuli were the same pictures from the *Peabody Picture Collection* and additional six drawings described in Experiment 1 (old trial types), and pictures of objects described in Markman and Hutchinson's (1984) Experiment 1 (new trial types). These pictures were printed from *CorelDRAW!*® (1992), mounted to 3.5 by 3.5 inch cardstock, and laminated. Tables 2 and 3 list the stimuli used in Experiments 1 through 5, and Table 9 lists the trial types representing the Markman and Hutchinson (1984) stimuli.

## Procedures

All subjects were tested in a room on the main floor of their preschool. All other features of the procedure were identical to Experiment 4, with the exception that each subject received both the old and new trial types.

Pretest. The same trial types and criteria described in Experiment 1 were used.

Test. The procedures and instructions used in Experiment 4 were followed, with the noted addition of a second set of trial types. A mixed design was employed in which 19 of the 39 subjects received the old trial types first and the remaining 20 subjects received the new trial types first. The trial type orders were equated for gender; 8 females and 11 males received the old order first. No feedback was provided to the subjects between or within the trial types, and each subject received five stickers after they responded to the 20th trial type. Every subject who completed the pretest also completed both sets of trial types.

Table 9

Test Stimuli, Experiment 6

Trial No.	Sample	Taxonomic Comparison	Thematic Comparison
1	Police car	Car	Policeman
2	Tennis shoe	High-heeled shoe	Foot
3	Dog	Dog	Dog food
4	Straight chair	Easy chair	Man sitting
5	Crib	Crib	Baby
6	Birthday cake	Chocolate cake	Birthday present
7	Blue jay	Duck	Nest
8	Outside door	Swinging door	Key
9	Male football player	Man	Football
10	Male in swimsuit	Female child in overalls	Swimming pool

## Results of Experiment 6

A  $t$  test for dependent samples was performed to determine differences in choice between the taxonomic and thematic comparison stimuli for both the old and new trial types. The results indicated a statistically significant preference for taxonomic stimuli for both the old and new trial types ( $t = -5.19$ ,  $df = 38$ ,  $p = .001$  and  $t = -5.60$ ,  $df = 38$ ,  $p = .001$ , respectively). These results are shown in Table 10.

Separate one-way ANOVAs were performed to determine if any differences

Table 10

Number of Choices by Type, Experiment 6 (Old Trial Types)

Trial No.	Taxonomic (%)	Thematic (%)
1	37 (94.9)	2 (5.1)
2	34 (87.2)	5 (12.8)
3	37 (94.9)	2 (5.1)
4	27 (69.2)	12 (30.8)
5	33 (84.6)	6 (15.4)
6	29 (74.4)	10 (25.6)
7	24 (61.5)	15 (38.5)
8	21 (53.8)	18 (46.2)
9	19 (48.7)	20 (51.3)
10	16 (41.0)	23 (59.0)
Total	277 (71.0)	113 (29.0)

existed between genders for the taxonomic stimuli for each set of trial types. The results indicated no statistically significant gender difference in preference for taxonomic or thematic stimuli for either the old or new trial types ( $F_{(1,37)} = 0.18$ ,  $p = .67$  and  $F_{(1,37)} = 1.19$ ,  $p = .28$ , respectively). The Bartlett-Box F and Cochran's C tests were not statistically significant for the taxonomic choice distribution; hence, there was no reason to believe the distribution violated the assumption of homogeneity of variance.

As in the previous five experiments, an examination of the percentages of

taxonomic responding across trials for the old trial types revealed a steady decrease in responses beginning with Trial 7. The majority of subjects selected on a thematic basis on Trials 9 and 10. These results are shown in Figure 3 and in the percentages given in Table 10. A statistically significant difference was found between selection category on Trials 1 through 5 and Trials 6 through 10 ( $t = -6.02$ ,  $df = 38$ ,  $p = .001$ ). When the analysis was applied to the new trial types, the results were statistically significant ( $t = -6.01$ ,  $df = 38$ ,  $p = .001$ ), although the subjects demonstrated a clear preference for the thematic stimuli on only Trials 9 and 10. These results are shown in Figure 3 and in the percentages given in Table 11.

Separate independent  $t$  tests were computed for the two orders of old and new trial types, comparing the taxonomic responses for subjects receiving the old stimuli first versus subjects receiving the old stimuli second. The same analysis was computed for the new stimuli and both types of thematic responses. The  $t$  tests for neither the old nor new trial types were statistically significant ( $t = -0.51$ ,  $df = 37$ ,  $p > .05$  and  $t = -0.66$ ,  $df = 37$ ,  $p > .05$ , respectively).

In a two-comparison, forced-choice situation, the second analysis of the comparison responses yields results that are reciprocal to the first analysis. Therefore, the thematic analyses resulted in the same nonstatistically significant  $t$  values, with the exception that they were in the opposite direction ( $t = 0.51$ ,  $df = 37$ ,  $p > .05$  and  $t = 0.66$ ,  $df = 37$ ,  $p > .05$ , respectively). The averaged frequency of response for each order is shown in Figure 4, where values close to 1 represent mostly taxonomic responses, values approaching 2 represent a majority of thematic responses, and values

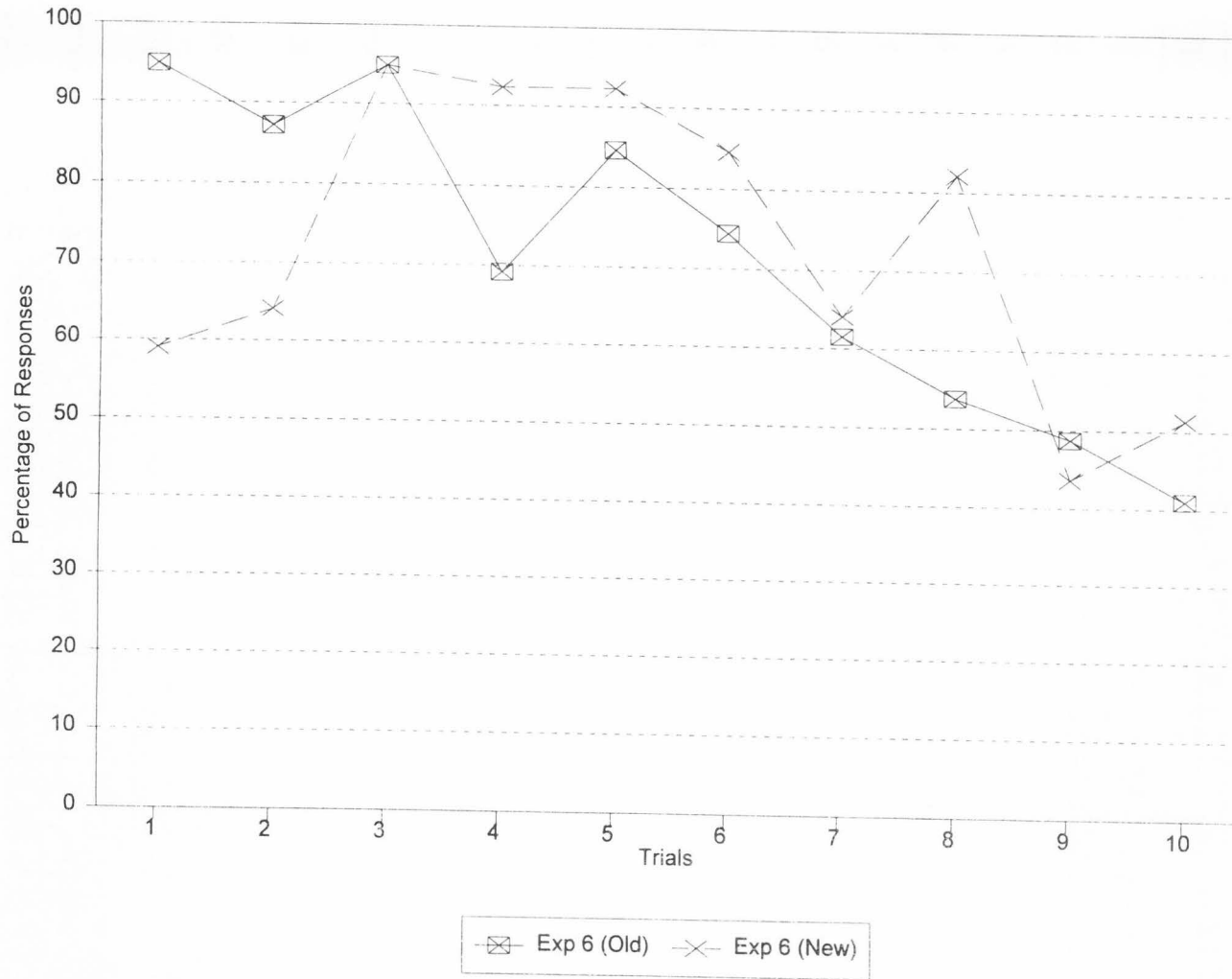


Figure 3. Taxonomic responses for Experiment 6, old and new trial types.



Table 11

Number of Choices by Type, Experiment 6 (New Trial Types)

Trial No.	Taxonomic (%)	Thematic (%)
1	23 (59.0)	16 (41.0)
2	25 (64.1)	14 (35.9)
3	37 (94.9)	2 (5.1)
4	36 (92.3)	3 (7.7)
5	36 (92.3)	3 (7.7)
6	33 (84.6)	6 (15.4)
7	25 (64.1)	14 (35.9)
8	32 (82.1)	7 (17.9)
9	17 (43.6)	22 (56.4)
10	20 (51.3)	19 (48.7)
Total	284 (72.8)	106 (27.2)

around 1.5 represent equal numbers of taxonomic and thematic responses. To assess differences in category selection based on age, the subjects were subdivided into three age groups: (a) up to 47 months ( $\underline{n} = 16$ ), (b) 48 to 59 months ( $\underline{n} = 10$ ), and (c) 60 months and above ( $\underline{n} = 10$ ). Separate one-way ANOVAs were performed using age level by taxonomic choice, for the old and new stimuli. These ANOVAs were not statistically significant for either the old or the new trial types ( $F_{(2,36)} = 1.66$ ,  $p = .20$  and  $F_{(2,36)} = 2.73$ ,  $p = .08$ , respectively).

A Boxplot analysis revealed no outliers within the taxonomic choice

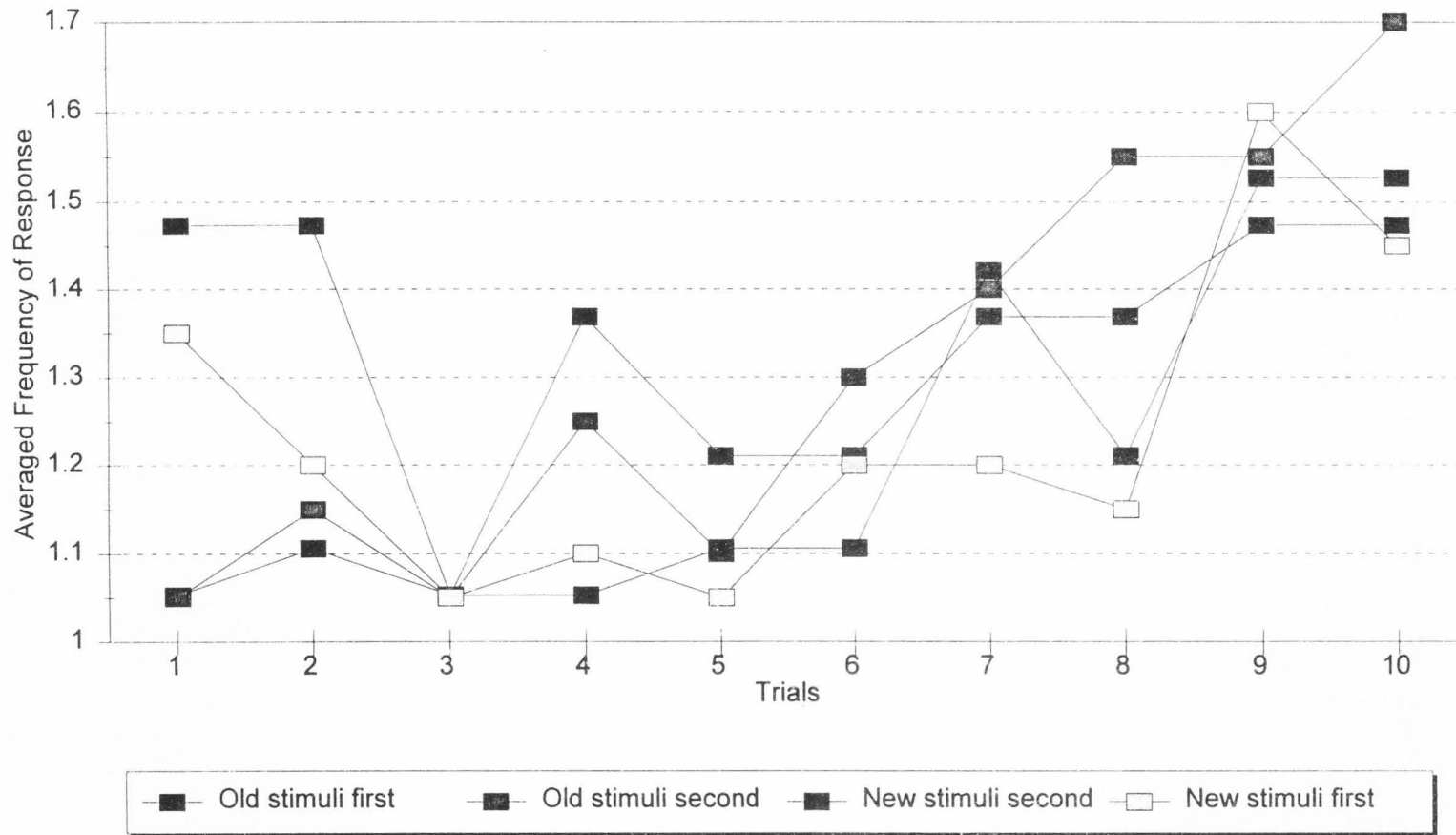


Figure 4. Experiment 6 responses by order.

distribution, and it is assumed that normality of the distributions was preserved. The Bartlett-Box F and Cochran's C tests were not statistically significant for taxonomic choices on the new trial type distribution; hence, there was no reason to believe the distribution violated the assumption of homogeneity of variance. Therefore, the assumptions underlying the use of the ANOVA were met. However, for the old trial types, the Cochran's C was statistically significant ( $C_{(12,3)} = .59, p = .04$  [approximately]). Because the Bartlett-Box F was not significant and the ANOVA is a robust test, it is assumed that the finding of nonsignificance is valid.

### Discussion

The results of Experiment 6 indicate that these preschool-aged children selected on a taxonomic basis more often than a thematic basis for both old and new trial types. These results replicate the results of Experiments 1 through 5 and are contrary to the results of Markman and Hutchinson (1984), Waxman et al. (1991), and Waxman and Kosowski (1990). Subjects in Experiment 6 responded taxonomically to trial types representative of Markman and Hutchinson's (1984) Experiment 1, which is in direct contrast to their results.

As in Experiments 1 through 5, Experiment 6 found no statistically significant differences between the groups when compared across ages. This finding supports the lack of a developmental trend as evidenced by Experiments 1 through 5. Further, the results of Experiment 6 support the findings of Bauer and Mandler (1989) in favor of a taxonomic preference for preschool-aged children.

The present experiment was conducted to compare the responses of preschool-aged children to stimuli previously established as leading to a taxonomic basis (Experiments 1 through 5) with stimuli reported to lead to thematic responding (Markman & Hutchinson, 1984). This experiment found that the children demonstrated a preference for taxonomic relations regardless of the trial type presented.

## GENERAL DISCUSSION

In a series of six experiments, subjects between the ages of 29 and 73 months were presented with a matching-to-sample task. All experiments used a forced-choice procedure. Experiments 1, 3, 4, 5, and 6 presented subjects with two comparison stimuli, one related thematically and one related taxonomically to the sample. Experiment 6 also compared the trial types from Experiments 1 through 5 with the trial types used in Markman and Hutchinson's (1984) Experiment 1. Experiment 2 used three comparison stimuli, adding a nonrelated comparison stimulus to the related comparison choices. Each of these experiments resulted in a statistically significant preference for the taxonomically related stimuli on most trials for most subjects. An analysis of choice based on gender did not find a statistically significant difference within any experiment. To determine whether age was a factor influencing choice type, the data were examined across three age groups: (a) up to 47 months, (b) 48 to 59 months, and (c) 60 months and up. Only one statistically significant difference was found for any age group on taxonomic or thematic comparisons (Experiment 5, groups 1 and 2). In addition, in Experiment 2, the youngest group selected the nonrelated stimuli statistically significantly more often than the other age groups.

Some researchers in this area have found that children within this age range are more likely to select on a thematic basis (Markman & Hutchinson, 1984; Waxman et al., 1991; Greenfield & Scott, 1986; Waxman & Kosowski, 1990). These authors found that introduction of a novel noun could influence the choice selection in favor of

the taxonomic comparison. However, without such labeling, choices were thematic. These experiments differed in several ways from the present experiments, including the use of a puppet to present the stimuli (Markman & Hutchinson, 1984; Waxman et al., 1991; Waxman & Kosowski, 1990); use of a training procedure (Greenfield & Scott, 1986; Markman & Hutchinson, 1984; Fenson et al., 1988); the type and placement of the stimuli used (Smiley & Brown, 1979; Greenfield & Scott, 1986; Markman & Hutchinson, 1984; Fenson et al., 1988; Waxman et al., 1991; Waxman & Kosowski, 1990); and the number of times the subjects were tested (Smiley & Brown, 1979; Greenfield & Scott, 1986; Markman & Hutchinson, 1984; Fenson et al., 1988; Waxman et al., 1991; Waxman & Kosowski, 1990).

In agreement with the present findings, Bauer and Mandler (1989) found that young children readily selected taxonomically related stimuli without the use of novel nouns. However, several differences exist between the present series of experiments and the work of Bauer and Mandler (1989). These differences include a training procedure, differential praise for selection type, and multiple testings of the same subject.

Any of these factors may have contributed to the differences between the literature cited and the present series of experiments, but the obvious difference existed in the instructions provided to the subjects. The present experiments manipulated the instructions using both the Bauer and Mandler (1989) instructions, Experiments 1 through 3, and the Markman and Hutchinson (1984) instructions, Experiments 4, 5, and 6. The results were not affected by this manipulation. Additionally, Experiment 6

found that even the trial types used by Markman and Hutchinson (1984), to produce thematic preferences, resulted in taxonomic responses in the present experiments.

The results of these studies collectively raise questions as to the external validity of Markman and Hutchinson's (1984) Experiment 1. Conversely, these results replicate the findings of Bauer and Mandler (1989): Preschool-aged children categorize on a taxonomic basis. In addition, the subjects used in the present research were older than the Bauer and Mandler (1989) subjects, which extends the taxonomic categorization response to an age range previously believed to respond thematically (Markman & Hutchinson, 1984).

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APPENDICES

## Appendix A

### ANOVA Tables for All Experiments

Experiment 1 Taxonomic Choice by Age

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	2	21.80	10.90	1.27	0.30
Within Groups	33	283.20	8.58		
Total	35	304.00			

Experiment 1 Taxonomic Choice by Gender

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	0.90	0.90	0.1	0.75
Within Groups	34	304.10	8.94		
Total	35	305.00			

Experiment 2 Arbitrary Choice by Age

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	2	3.98	1.99	6.63	0.00
Within Groups	43	12.90	0.30		
Total	45	16.87			

Experiment 2 Taxonomic Choice by Age

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	2	7.01	3.51	0.64	0.53
Within Groups	43	236.40	5.50		
Total	45	243.41			

Experiment 2 Arbitrary Choice by Gender

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	0.56	0.56	1.50	0.23
Within Groups	44	16.31	0.37		
Total	45	16.87			

Experiment 2 Taxonomic Choice by Gender

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	0.51	0.51	0.09	0.76
Within Groups	44	242.90	5.52		
Total	45	243.41			

Experiment 3 Taxonomic Choice by Age

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	7.54	7.54	0.96	0.33
Within Groups	38	298.86	7.87		
Total	39	306.4			

Experiment 3 Taxonomic Choice by Gender

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	0.34	0.34	0.03	0.86
Within Groups	38	387.56	10.20		
Total	39	387.90			

Experiment 4 Taxonomic Choice by Age

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	2	26.36	13.18	2.64	0.09
Within Groups	35	174.49	4.99		
Total	37	200.85			

Experiment 4 Taxonomic Choice by Gender

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	0.11	0.11	0.02	0.89
Within Groups	36	200.74	2.58		
Total	37	200.85			

Experiment 5 Taxonomic Choice by Age

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	2	45.67	22.83	4.30	0.02
Within Groups	27	143.30	5.31		
Total	29	188.97			

Experiment 5 Taxonomic Choice by Gender

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	0.80	0.80	0.12	0.73
Within Groups	28	188.16	6.72		
Total	29	188.96			

Experiment 6 Taxonomic Choice by Age (Old Stimuli)

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	2	20.56	10.28	1.66	0.20
Within Groups	36	223.03	6.20		
Total	38	243.59			

Experiment 6 Taxonomic Choice by Age (New Stimuli)

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	2	32.34	16.17	2.73	0.08
Within Groups	36	213.56	5.93		
Total	38	245.90			

Experiment 6 Taxonomic Choice by Gender (Old Stimuli)

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	1.20	1.20	0.18	0.67
Within Groups	37	242.39	6.55		
Total	38	243.59			



Experiment 6 Taxonomic Choice by Gender (New Stimuli)

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	7.63	7.63	1.19	0.28
Within Groups	37	238.26	6.44		
Total	38	245.89			

Experiment 6 Taxonomic Choice by Order (Old Stimuli)

Source	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	1	1.69	1.69	0.26	0.62
Within Groups	37	241.90	6.54		
Total	38	243.59			

Appendix B

Consent Agreement Form and Project Information



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**UTAH STATE UNIVERSITY**

DEPARTMENT OF PSYCHOLOGY  
Logan, Utah 84322-2810  
Telephone (801) 750-1460

CONSENT AGREEMENT

I have read a brief description of the project and I give my permission for (child's name) ,  
(date of birth) , to participate in a Utah State University research project on categorization by preschool children. I have been informed of the procedures involved and I understand that there are no anticipated risks or discomforts for my child. I also understand that I or my child may terminate my child's permission in the project, at any time, without attendant penalty of any kind. Finally, I understand that confidentiality of my child's performance and identity will be maintained in any written or oral presentation resulting from this project.

---

Parent/Guardian

---

Date



## UTAH STATE UNIVERSITY

DEPARTMENT OF PSYCHOLOGY  
Logan, Utah 84322-2810  
Telephone (801) 750-1460

22 January 1993

Dear Director,

Thank you for consenting to participate in our experiment. A brief description of the project follows, and a letter and consent form for the parents are attached. We would like to start testing in your school at your earliest convenience and as soon as the consent forms are returned.

Under the supervision of the USU Department of Psychology, and with the approval of the University's Human Subject's Board, we are conducting a research project involving the choices children make when categorizing objects.

For this project children will be asked to view a picture of a familiar object (for example, a tennis shoe) and then choose between two or more pictures of related objects, such as a high-heeled shoe, foot, or an unrelated object, such as a block. A maximum of 15 sets of objects will be presented and the entire procedure should not take more than 15 minutes.

The data from each subject will be coded to ensure confidentiality and the results of this study will only be presented at professional conferences, again with all identifying information removed. The results of the study will be made to available to all participant's familys who request them.

If you have further questions or concerns, feel free to contact David Calhoun. Thank you, again.

Sincerely,

David O. Calhoun  
Department of Psychology  
Utah State University  
Logan, UT 84322-2810  
(801) 750-1460

Dr. J. Grayson Osborne  
Department of Psychology  
Utah State University  
Logan, UT 84322-2810  
(801) 750-1454

Appendix C

Institutional Review Board Approval



## UTAH STATE UNIVERSITY • LOGAN, UTAH

RESEARCH AND TECHNOLOGY PARK  
1780 North Research Park Way, Suite 104  
North Logan, Utah 84321  
(801) 750-6924

MEMORANDUM

TO: Dr. J. Grayson Osborne and David O. Calhoun

FROM: Sydney Peterson *SP*

DATE: September 25, 1992

SUBJECT: Proposal titled, "Categorization of Objects by  
Preschool Children: Taxonomic versus Thematic  
Choices"

The above-referenced proposal has been reviewed and approved by the Institutional Review Board. Please contact me at 750-6924 if you have any questions.