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The Feature-Value Effect in Children; An Attempt to Replicate and Further Experimentation

Kathleen Wright
Western Michigan University

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THE FEATURE-VALUE EFFECT IN CHILDREN: AN ATTEMPT
TO REPLICATE AND FURTHER EXPERIMENTATION

by

Kathleen Wright

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
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THE FEATURE-VALUE EFFECT IN CHILDREN: AN ATTEMPT
TO REPLICATE AND FURTHER EXPERIMENTATION

Kathleen Wright, Ph.D.

Western Michigan University, 1985

In the "feature-value effect" faster acquisition occurs when a
distinguishing feature is placed on the correct stimulus (S+) during
discrimination training than when the distinguishing feature is
placed on the incorrect stimulus (S-). The former is a "feature
positive" discrimination task, whereas the latter is a "feature
negative" discrimination task. The feature-value effect only occurs
when the discrimination involves stimuli that are identical except
for one distinguishing feature. The effect has been obtained in a
number of nonhuman species as well as in children and adult humans.
Experiments 1 and 2 failed to replicate the findings of previous
experiments with young children using subjects, stimuli and
procedures similar to those used in previous experiments: Most of
the feature negative children did not make errors. Experiment 3
partially replicated Bitgood, Segrave and Jenkins' (1976) finding
that providing children with "yes"/blank feedback (rather than
"yes"/"no" feedback) greatly increased errors during training. (In
the "yes"/blank procedure the only scheduled consequence after
errors was the removal of the stimuli.) A different preschool was
used as the research site in Experiment 4 in an effort to determine
whether the site used in Experiment 1 was somehow related to the
failure to replicate the results of previous research. Even though
more subjects performed poorly in Experiment 4 than in Experiment 1, performance was not uniformly poor across all subjects exposed to the feature negative task as in the Bitgood et al. (1976) study. Differences related to the use of automated vs. nonautomated equipment may account for the different results obtained in Experiments 1 through 4 and previous research.

Experiment 5 failed to obtain the feature-value effect in children using stimuli and procedures similar to those used in previous experiments conducted with college students. College students served as subjects in Experiment 6 using stimuli and procedures similar to those used with college students by other researchers and a feature-value effect was obtained. It may be that the feature-value effect can only be obtained in children using stimuli of moderate difficulty for the particular subjects studied. It is also possible that the feature-value effect is not as robust a phenomenon as previous research suggests.
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I want to thank the faculty of Western Michigan University's Psychology Department for the thorough training I received in behavior analysis. I feel particularly fortunate to have been able to work with Drs. Galen Alessi and R. Wayne Fuqua. I know my behavioral training will help me, not only professionally, but in all aspects of my life.

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Kathleen Wright
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INTRODUCTION

The feature-value effect (FVE) is a term that has been coined for a peculiar phenomenon that results when asymmetrical stimuli are used in discrimination training. A FVE is obtained when an organism's acquisition of an asymmetrical discrimination is greatly improved by placing the distinguishing feature (d) on the S+ rather than on the S-. The former task (in which the d appears on the positive stimulus) is the feature positive (FP) task; the latter task (in which the d appears on the negative stimulus) is the feature negative (FN) task. A pair of stimuli is considered asymmetrical when the stimuli are identical except for a distinguishing feature that appears on one of the stimuli (Jenkins & Sainsbury, 1970). For example, if one stimulus display contains four squares and the other contains three squares and a triangle, the displays would be asymmetrical. In this example the only feature that distinguishes the two displays is the triangle. Conversely, each member of a symmetrical pair of stimuli has its own distinguishing feature. If one stimulus display contains three squares and one triangle and its pair contains three squares and one circle, the stimuli would be considered symmetrical because each stimulus has its own distinguishing element (a triangle vs. a circle). Determining whether a given pair of stimuli is symmetrical or asymmetrical is sometimes difficult. For example, consider a stimulus pair containing a square and a square with a missing corner. One could

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argue that the stimuli represent distinct shapes rather than being identical with the exception that the fourth corner serves as a distinguishing feature. Although discriminations involving asymmetrical stimuli may be rare in the natural environment, whatever processes are responsible for the FVE may also be operating in some symmetrical discriminations.

The FVE has been most widely studied with nonhuman species. The effect has been obtained with pigeons (e.g., Nallan, Miller, McCoy, Taylor, & Serwatka, 1984; Sainsbury, 1971a), rats (e.g., Crowell & Bernhardt, 1979; Reberg & LeClerc, 1977), and rhesus monkeys (e.g., McCoy & Yanko, 1983; Pace, McCoy, & Nallan, 1980). Young children have served as subjects in a few studies and each of these studies yielded a FVE (Bitgood, Segrave & Jenkins, 1976; Norton, Muldrew, & Strub, 1971; Sainsbury, 1971b, 1973; and Zerbel, 1984). Sainsbury (1973) obtained a large FVE in 4 and 5 year old children, a smaller FVE in 7 and 8 year old children, and no FVE in 9 and 10 year olds using the same stimuli across these age groups. Sainsbury hypothesized that the younger children's failure to learn the FN discrimination may have been due to a general difficulty in acquiring a chain of responses (i.e., if the d is on the left, respond on the right). On the other hand, the smaller FVE obtained with the 7 and 8 year olds and the absence of the FVE with the 9 and 10 year olds may have reflected a ceiling effect given the simplicity of the stimuli used. That is, if a more difficult discrimination had been used, the older subjects might also have shown a FVE. Most recently, college students have served as subjects and again the FVE was obtained.

The question that is of primary interest here is whether the effects obtained with each of the three types of subjects are more than superficially related. It is likely that the adult humans' advanced verbal skills were quite influential in determining their performance in FVE experiments. In other words, the adults may have verbally analyzed the task after having been exposed to a few trials and thereafter responded on a rule-governed basis. (In fact, the subjects in these experiments were explicitly asked to develop verbal descriptions about what made the stimuli "correct.") The children's less sophisticated verbal skills, on the other hand, may have produced feature value discriminations more like those of nonhumans; that is, discriminations developed by stimulus-stimulus relations and/or stimulus-response relations. Alternatively, the children may have verbally analyzed the task in a manner analogous to an adult's verbal analysis of the task (albeit at a less sophisticated level). It is also possible that the children's performances were partially rule-governed and partially contingency-shaped. It is not clear at what point on the continuum from solely contingency-shaped to solely rule-governed the children's performances lie. A rule-governed feature value performance would be superior to a contingency-shaped feature value performance because the rule-governed performance would probably result in faster acquisition of the discrimination (given that the "correct rule" is stated.)
Although the factors which determine the existence and magnitude of the FVE have not been well delineated, various hypotheses have been offered to explain the phenomenon. Hearst and Jenkins (1974) have been mainly interested in the FVE as an example of the phenomenon of sign tracking. Sign tracking refers to a behavioral tendency to approach and contact stimuli positively correlated with reinforcement and to avoid stimuli negatively correlated with reinforcement. (Sign tracking of aversive stimuli involves the avoidance of stimuli positively correlated with aversive stimuli and the approach of stimuli negatively correlated with aversive stimuli.) In all of the experiments with nonhumans and in most of the experiments with humans (i.e., those that assessed sign tracking) it was found that the subjects' responses were controlled by the d in both the FP and in the FN case even when "tracking" the d was not required for reinforcement. When the display that contained the d was presented the FP subjects pecked (or pointed to) the d and the FN subjects did not peck (or point to) to the d within the display that contained the d (although the FN subjects did not then switch displays). It has been argued that sign tracking enhances the discrimination between the S+ and the S- for the FP subjects. For FN subjects, however, the aversiveness of the d may not be strong enough to eliminate responding to the S- display. In addition, it has been found that FP pigeons will continue to engage in sign tracking even when doing so resulted in nonreinforcement (Hearst & Jenkins, 1974). Hearst and Jenkins consider sign tracking an important topic because it reveals the importance of S-S relations in the determination of
operant behavior. They have also hypothesized sign tracking to be phylogenically determined; those organisms that track stimuli positively correlated with reinforcement are more likely to survive and pass this behavioral tendency on to their offspring than those organisms that tend to avoid stimuli negatively correlated with reinforcement. A tendency to avoid stimuli negatively correlated with reinforcement may have less survival value because the avoidance of such stimuli would not necessarily result in the organism making contact with stimuli critical to survival. This analysis is supported by data obtained in FVE experiments that show that FN subjects tend to avoid the d (within the display that contains the d) but this tendency does not generally result in the subjects responding to the S+ display and thus receiving a higher frequency of reinforcement (e.g., Bitgood et al. 1976; Sainsbury, 1971a). An analysis similar to the sign tracking analysis of the FVE was offered by Morris (1977). Using pigeons as subjects, Morris found that the size of the common parts of the stimulus display relative to the size of the d was an important variable in FN performance. The larger the d, the less the FN subjects could avoid the d without switching displays. Morris called this the feature-avoidance theory.

More recently, Pace and McCoy (1981) studied the FVE in pigeons using a 3-key chamber. Two keys served as stimulus keys and the third key served as a response key. Reinforcement was only made available for responses to the response key. They found that requiring pigeons to respond to each stimulus key before reinforcement was made available for a response to the
spatially-separate response key eliminated the FVE. (The FN subjects learned the FN discrimination as readily as the FP subjects learned the FP discrimination.) In this experiment the common display consisted of two green keys (which served as the S+ for FN subjects) and the distinctive display contained one green key and one red key (which served as the S+ for FP subjects). Pace and McCoy (1981) tentatively concluded that the FVE in nonhumans could be a result of a failure of the organism to orient toward the d when the first S-element the subject approached was a common element. These authors noted that if the first stimulus the FN subjects (i.e., those that were not required to respond to the stimulus keys) approached was green (the common element) they generally pecked it and turned toward the response key without orienting toward the other stimulus key on that trial. If, on the other hand, the first stimulus key approached was red (the d) they would move to the back of the chamber.

Few analyses of why the FVE is obtained in humans have been offered. With young children, experimenters have drawn parallels from data obtained with nonhumans (Bitgood et al., 1976; Sainsbury, 1971b, 1973; and Zerbel, 1984). Likewise, experimenters who have used nonhumans have cited data obtained with children and have drawn parallels between the nonhuman and child data (e.g., Newman et al., 1980; Pace et al., 1980). However, because few manipulations have been made to increase confidence that the nonhuman data and the child data are a reflection of similar controlling variables such parallels can only be weakly drawn. Nevertheless, the most obvious commonality between the nonhuman data and the child data is the fact that the
children, like the nonhumans, tend to respond to the d in the FP case and to avoid the d in the FN case. Children who were successful in learning a simultaneous FN discrimination were observed to begin to point to the d in the S- display and then switch to the S+ display (Sainsbury, 1973; Zerbel, 1984). Sign tracking has also been obtained with adult humans (Newman et al., 1980).

In order to determine whether the data obtained with nonhumans, children and adults are, in fact, the result of similar controlling variables, the experimental methodologies and details of the procedures used with each of these subject types must be examined. As pointed out above, only a few studies have attempted to systematically replicate data across subject types using highly similar stimuli and procedures. Norton et al. (1971) used a successive discrimination procedure with 4 year old children and college students. A between-subjects comparison was used to determine whether a FVE would occur in each of these types of subjects. The stimuli used were a plain white circle and a white circle with a small black circle as the d. (The black circle appeared randomly in each of the four quadrants of the white circle.) For FP subjects the white circle with the black circle inside served as the S+; the plain white circle served as the S-. For the FN subjects the roles of the two types of stimuli were reversed. A FVE was obtained with the children and the adults (although the effect obtained was not as large as that obtained in previous research). Newman et al. (1980) obtained a FVE in pigeons using the same stimuli and a slightly adapted apparatus as were used in a previous study by

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the same authors with college students. In these experiments a successive discrimination procedure was used. The apparatus contained four stimulus keys on which three of four shapes could be projected on any given trial. The d was a circle for one half of the subjects and a triangle for the other half. The "common" elements (shapes other than the d) in each display varied within and across trials. The results obtained with adult humans were replicated with the pigeons; large PP superiority and sign tracking were obtained.

Probably the most glaring procedural difference across the studies has to do with the types of stimuli used. Although the stimuli used with children have been similar to the stimuli used with nonhumans, there has been a great difference in the types of stimuli used with adults and the other two types of subjects. With the exception of Norton et al. (1971), studies conducted with adult humans have varied the "common" elements in each display. That is, the features that are not correlated with reinforcement change from one trial to the next. For example, suppose that the task involves four shapes, a triangle, a circle, a square, and a plus and that the square serves as the d. Two stimulus pairs are presented simultaneously and either the right or the left pair is correct. The "common" features would be varied by changing the shape that appears in the same pair with the square (the d) and by presenting all possible combinations of the triangle, the circle, and the plus within the S- pair. With nonhuman subjects the common aspects of the stimuli have not been varied across or within trials (with the exception of experiment 7 in Newman et al., 1980). The stimuli used
with adult humans must be altered in order to obtain a FVE because the stimuli must be sufficiently difficult to cause the adults to make errors. The stimulus displays that have been most frequently used with young children have been square displays with either a square or a triangle in each of the four quadrants. For example, one display has four squares and the other display has three squares and one triangle. (The triangle appears in all four quadrants across trials.)

The initial purpose of the experiments reported here was to replicate the FVE with children using stimuli and procedures similar to those used in previous research with children and with adult humans. Once a FVE was obtained, the procedure for FN subjects was to be altered in ways that would clarify the relationship between a child's and a nonhuman's performance with some subjects and between a child's and an adult human's performance with other subjects. The initial purpose was altered when it was found that most of the children made fewer errors on the FN task than previously reported with similar stimuli. After the initial failure to obtain errors with the FN task experiments were conducted in an attempt to identify those variables responsible for the failure.
METHOD

General Procedure

Subjects were given tokens exchangeable for small items at the end of each session. (No attempts were made to determine whether the delivery of the tokens actually served as conditioned reinforcement.) The subjects were shown the items prior to each session and were told that the more "chips" they earned the more items they could select. The experimenter said "yes" and delivered a token into a small glass dish (14 cm in diameter) immediately following each correct response. A simultaneous discrimination procedure was used. The location of the pointing response within the S+ stimuli was not differentially consequated. Each trial was terminated when the subject touched one of the stimuli. If the subject did not touch a stimulus within a few seconds, s/he was prompted to do so. Sessions were terminated after a specific number of trials. At the end of each session the subjects were allowed to exchange their tokens for small items (e.g., stickers, marbles, and plastic animals).

Dependent Variable

The main dependent variable was percent correct within each session.

Reliability

During at least 29% of the sessions an independent observer re-
corded data on the dependent variable and on the integrity of the independent variables. The observer sat approximately 3 ft behind and to the side of the subject. The observer could not see the what the experimenter was recording. Whenever a subject looked at or talked to the observer the observer did not respond. The experimenter and the observer avoided eye contact and did not speak to each other during sessions.

The sessions in which these reliability data were collected were randomly interspersed across studies, groups, subjects, and conditions. An agreement on the dependent variable occurred when both the experimenter and the observer recorded a correct response (or when both recorded an incorrect response) on a particular trial. Independent variable agreement occurred when the observer recorded that a particular aspect of the procedure was implemented by the experimenter as stated in the method section. (See appendices for the independent variable reliability data sheets.) Reliability scores were calculated by dividing the number of agreements by the number of agreements plus disagreements.
EXPERIMENT 1

Recall that the initial purpose of these experiments was to obtain a FVE using stimuli and procedures similar to those used in previous research with children with the ultimate goal of altering the procedure in ways that would determine what parallels exist (if any) between nonhuman and child performances and between child and adult human performances on the FN task. This initial purpose was abandoned when it was found that few errors occurred with both the FP and the FN tasks. Consequently, Experiment 1 represents the initial attempt to obtain the FVE. Automated equipment was not used in these experiments as had been used in previously published research. However, measures were taken to prevent inadvertent cueing of correct responses.

Method

Subjects

Eleven children enrolled in a university affiliated preschool participated. Three children served as FP subjects and the remaining eight served as FN subjects. The mean age for the FP group was 4.6 years (range 4.5 - 4.8 years). The mean age for the FN group was 4.2 years (range 2.6 - 5.2 years).

Experimental Design

A between-subjects comparison was used to determine whether a
FVE would be obtained using stimuli and procedures similar to those previously used with children. The children were assigned to two groups. Children younger than 4.5 years were assigned to the FN group.

Apparatus and Stimuli

The experimental setting is shown in Figure 1. The setting was carefully designed to make it difficult for the experimenter to inadvertently provide the subjects with subtle cues. (Recall that previously published research with children presented stimuli with automated equipment and therefore the possibility of cueing by the experimenter was decreased.) Cueing could consist of the experimenter looking at the correct display, leaving her hand on the
correct display longer than on the incorrect display, etc. The experimenter was seated across from the subject and a barrier was placed between the experimenter and the subject so that the experimenter could not see the stimulus cards without leaning over the barrier. The experimenter did not look over the barrier until the subject had pointed to one of the pictures. Care was also taken to ensure that other subtle experimenter responses did not cue the subject. An independent observer looked for possible cues during reliability sessions and could not detect any such cues. The barrier consisted of a cardboard screen with two rectangular cutouts (holes) centered at the bottom (38.1 cm apart) and was placed between the experimenter and the subject. The screen was 30.4 cm high and 76.2 cm wide. (These dimensions also decreased the chance that the subject could see the experimenter's side of the table.) The cutouts were 16.5 cm in length and 2.5 cm high. Stimuli were presented through the cutouts. This arrangement resulted in the stimuli being presented to the subjects on the table rather than at eye level as in three of the previous studies with children (Bitgood et al., 1976; Sainsbury, 1971b, 1973).

Examples of stimuli used for both groups are shown in Figure 2. Each display measured 15.2 cm square. The elements on each display were black and the background was white. The displays were divided into four quadrants 7.5 cm square. The elements were centered in each of the four quadrants. The common feature was the square and the distinctive feature was the triangle. Four versions of the distinctive feature display were presented; the triangle appeared in...
Figure 2. Stimuli Used in Experiments 1 Through 4 With Children.

Figure 3. Stimuli Used in Experiments 5 (With Children) and 6 (With Adults).
a different quadrant in each of these displays. The d was shown in every position an equal number of times. The squares and the triangle were 1.9 cm per side. The position of the S+ varied across trials with the restriction that it could not be repeated on one side more than three consecutive trials. These stimuli were identical to those used by Zerbel (1984) and similar to those used by Bitgood et al. (1976) and Sainsbury (1971b, 1973). The latter three studies projected the stimuli on the back of Plexiglas screens.

Reliability

**Dependent variable**

Reliability data on the dependent variable were taken during 42% of the sessions. Reliability was 100% for all sessions.

**Independent variables**

Data on the integrity of the independent variables were taken during 45% of the sessions. Reliability was consistently 100%.

**Procedure**

Sessions were 40 trials in duration. (They ranged between 10 and 13 min from the first trial to the last trial.) The intertrial interval was variable with a mean of 10 s. Subjects were instructed to point to the "good picture."

**Correction Trials**

Correction trials were provided following errors. If the sub-
ject pointed to the incorrect stimulus the experimenter said "No" in a monotone voice, removed the stimuli, and then re-presented the same stimuli in the same positions on the next trial (in that order). No tokens were given on correction trials. If the subject did not get a minimum of 80% correct during the first 40-trial session, daily sessions were conducted until the subject obtained at least 80% correct during one 40-trial session.

Group #1: FP Condition - Subjects 1, 2, & 3

For these subjects the distinctive feature displays (those with a triangle in one of the four quadrants) served as S+. The common features display (the one with four squares) served as S-.

Group #2: FN Condition - Subjects 4 Through 11

For these subjects the distinctive feature display served as S- and the common feature display served as S+.

Results

The mean percent correct was 95.3% for the FP group (range 90% to 98%) and 90.5% for the FN group (range 60% to 98%). Only one subject (a FN subject) got less than 90% correct during the first session. During his second and third sessions this subject obtained percentages of 67.5% and 85% respectively. Observations of his eye and head movements revealed that the errors may have been due to a failure to compare the two displays. (The subjects could not view both displays with one eye fixation.)
Discussion

These results conflict with those obtained in the four previous studies in which the same stimuli were used with children. The ages of the subjects who participated in the present study and the ages of the subjects who participated in the previous studies were similar and thus age differences are not a plausible explanation for the conflicting results. A variable that might account for the conflicting results was the preliminary exposure to nondifferential training provided by Sainsbury (1971b, 1973) and Zerbel (1984). During this nondifferential training two stimuli were presented simultaneously and the consequences of pointing to one stimulus vs. the other were the same regardless of which stimulus the subject pointed to. Because the nondifferential training would be likely to train the subjects not to attend to the stimuli, the nondifferential training was not included in Experiment 1. Sainsbury (1971b, 1973) provided nondifferential training to assess initial response biases for one display over the other and for the d rather than the common elements of the display containing the d. In addition, Sainsbury (1973) included the nondifferential training to assure that the children understood the nature of the task prior to beginning the differential training. Zerbel (1984) included the nondifferential training to assess position preferences. The only response bias detected in these studies was a tendency to point to the d when a pointing response occurred to the distinctive-feature display. The nondifferential training may have generated enough errors such that a FVE could be obtained. Bitgood et al. (1976), however, obtained a
FVE without exposing subjects to nondifferential training thus weakening the possibility that the nondifferential training was responsible for the conflicting results obtained in the present study.
EXPERIMENT 2

Experiment 2 was conducted to assess the effects of two variables that may account for the discrepancy between the results of Experiment 1 and the results of previous FVE research with children. Specifically, Experiment 2 determined whether exposing subjects to nondifferential training prior to differential training and not providing correction trials during differential training would generate errors on the FN task. (Previous research with children did not provide correction trials.)

Method

Subjects

Five naive children and one child previously exposed to a FP task participated. These children were enrolled in the same preschool as the children in Experiment 1. Their mean age was 4.1 years (range 3.0 - 5.0). Subject #17 had been exposed to FP discrimination training with stimuli similar to those used by Brown et al. (1983), Newman et al. (1980), and Nallan et al. (1981) with college students. This subject only made one error during the 48-trial session using these stimuli.

Experimental Design

The data from subjects from this experiment were compared with the data from FN subjects in Experiment 1 to determine whether ex-
posing subjects to preliminary nondifferential training and not providing correction trials would generate errors on the FN task (and thus a between-subjects comparison was used).

Apparatus and Stimuli

The stimuli and apparatus were the same as those used in Experiment 1.

Reliability

Dependent Variable

Reliability data were taken on the dependent variable during 50% of the sessions and yielded 100% agreement during each session.

Independent Variables

Reliability on the independent variable was taken during 33% of the sessions and was consistently 100%.

Procedure

The basic procedure was the same as in Experiment 1 with two exceptions; twenty trials of nondifferential training were provided immediately prior to the first session of differential training and no correction trials were provided following errors during differential training. (It took four to five min to present the nondifferential training trials.) The amount of nondifferential training provided in Experiment 2 was the same as that provided by Sainsbury (1971, 1973) and less than that provided by Zerbel (1984).
Zerbel exposed children to two nondifferential training sessions of 40 trials each. During nondifferential training a distinctive feature display and the common feature display were presented on each trial. The four distinctive feature displays were presented randomly and the position of the common feature display varied as in differential training. The subject was instructed to "Point to one of the pictures." The experimenter said "Yes." and delivered a token regardless of where the child pointed on the displays. Once these 20 trials had been completed, the subject was allowed to exchange his/her tokens for one item. Immediately after the token exchange all subjects were exposed to FN training.

Results

The mean percent correct across all subjects was 83.8% (range 48% - 98%). Only one subject (#17) obtained a percentage below 83% during the first session. During sessions 2-5 anecdotal observations of subject #17's eye and head movements revealed that he rarely compared the two stimuli. During #17's fifth session, however, he compared the stimuli on 75% of the trials and yet he only obtained 67.5% correct during that session. During sessions 8, 9, and 10 Subject #17 was required to point to each shape in each display before he was allowed to point to the "good" picture. This manipulation did not improve his performance. Subsequently he was switched to the FP task and his performance further deteriorated. Finally he was instructed to point to the "picture that shows three" which resulted in a dramatic improvement in his performance.
Three subjects had lower percentages for the first 20 trials (75%) than those obtained by 7 of 8 FN subjects from Experiment 1. All three of these Experiment 2 subjects obtained at least 90% during trials 21-40. Thus it appears that the nondifferential training generates some errors initially but that the errors dissipate quickly (with the exception of Subject #17).

Discussion

These results demonstrated that exposing subjects to nondifferential training prior to differential training did not generate a substantial number of errors (with the exception of Subject #17). Therefore the nondifferential training provided by Sainsbury (1971b, 1973) and Zerbel (1984) appears to be an implausible explanation for slow acquisition of the discrimination task in those experiments. Moreover, the absence of the correction trials does not appear to be a critical variable. One variable that may account for the discrepancy between the present results and those of Sainsbury (1971b, 1973) is that in Sainsbury's experiments subjects were not given feedback after errors: the stimuli were simply removed. Bitgood et al. (1976) found that providing feedback ("No.") following errors greatly decreased errors although the decrease in errors on the FN task was not as substantial as in Experiment 2. The conflict between Experiment 2 and Zerbel's (1984) results may be attributable to inadvertent cueing differences. Zerbel did not take precautionary measures to ensure that the subjects' responses were not being cued to make errors. Both experiments were conducted in the same
preschool with children of similar ages and the same stimuli and the same mode of presentation (on the table with no automatic equipment) were used. (Experiment 2 subjects had not previously been included in research on the FVE.)

The poor performance of Subject #17 is difficult to account for. This subject had previously been exposed to a FP task involving four shapes (a square, a triangle, a circle, and a plus). (These stimuli are described in Experiment 5 below.) Only one error occurred during the one session of training. During this session Subject #17 consistently pointed to d (the square) on every trial except for the trial in which the error occurred. The triangle appeared with the square (the d) in the S+ on 33% of the trials. It may be that the triangle's correlation with the square prevented the triangle from developing sufficient inhibitory control during Experiment 2 sessions to result in #17 avoiding the distinctive feature display. However, #17 rarely pointed to the triangle during Experiment 2 which suggested that either the triangle had gained some inhibitory control and/or that the square had gained exclusive control over the response. The fact that #17 quickly learned the discrimination when told to "Point to the picture that shows 'three'" suggested that he was not incapable of learning the task. This fact also implies that a lack of verbal analysis of the task could account for his poor performance during the preceding sessions.
EXPERIMENT 3

Experiment 2 eliminated two procedural variables that were potentially responsible for the absence of errors in Experiment 1 (i.e., the provision of nondifferential training and correction trials). The purpose of Experiment 3 was to determine whether yet another procedural difference between Experiment 1 and previous research could be responsible for the lack of errors. Sainsbury (1971b, 1973) used a yes/blank feedback procedure in which errors were simply followed by the removal of the stimuli. Bitgood et al. (1976) compared the yes/blank feedback procedure with the yes/no feedback procedure and found that the yes/no procedure resulted in substantially fewer errors. (The yes/no procedure did not, however, result in so few errors that the FVE could not be detected.) Bitgood et al. (1976) hypothesized that the absence of feedback following errors was interpreted by the subject as meaning that his/her response was "O.K." on that trial. Experiment 3 was conducted to attempt to replicate the previous finding that the yes/blank procedure generated substantial errors. It is important to note that Experiment 3 could not determine the variables responsible for the difference between the results of Bitgood et al. (1976) and the results obtained in Experiment 1. The yes/no feedback procedure yielded a FVE in Bitgood's study but did not yield a FVE in Experiment 1 because the FN subjects in Experiment 1 did not make enough errors so that a FVE could be detected. Zerbel (1984) also
used a yes/no feedback procedure with FN subjects and obtained a FVE.

Method

Subjects

Nine children enrolled in the same preschool as used in Experiments 1 and 2 participated. These children had not been involved in either of the first two experiments. The mean age of these subjects was 4.3 years (range 3.9 - 4.7).

Experimental Design

The data obtained in Experiment 3 were compared with the data obtained in Experiment 2 to determine whether providing yes/blank feedback would generate a substantial number of errors on the FN task. (Thus a between-subjects comparison was used.)

Apparatus and Stimuli

The apparatus and stimuli were the same as used in Experiments 1 and 2.

Reliability

Dependent Variable

Reliability was taken on the dependent variable during 75% of the sessions and was consistently 100%.

Independent Variables

Independent variable reliability was taken during 56% of the ses-
sessions and was always 100%.

Procedure

The procedure was identical to that of Experiment 2 with the exception that when the child made an error no feedback was given; the experimenter simply removed the stimuli and presented the next trial. Because highly variable results were obtained by the main experimenter, a second experimenter conducted sessions for four subjects. The main experimenter observed the second experimenter's sessions and looked for subtle cues that might account for the variable results.

Results

Five out of nine subjects made a substantial number of errors. In comparison, only one out of six Experiment 2 FN subjects made many errors. The average percent correct for the five subjects who did poorly was 44% (range 38% - 55%). However, four subjects obtained an overall percentage of 83% or above. The results obtained did not vary across experimenters.

Discussion

These results showed that a substantial number of errors could be generated in some subjects with the yes/blank procedure. Therefore, the finding that FN subjects do very poorly with this procedure was at least partially replicated. Because Experiment 3 only partially replicated previous research with the yes/blank
procedure further investigation is necessary to account for why some FN subjects in Experiment 3 did not make a substantial number of errors. An additional explanation for the different results obtained in previously published research and the present studies is related to the characteristics of the subjects used. The subjects who participated in Experiments 1 through 3 were enrolled in a preschool in which students were exposed to highly structured academic training. The curriculum used was DISTAR, a direct instruction program (Engelmann & Bruner, 1974; Engelmann & Carnine, 1975; & Engelmann & Osborn, 1977). DISTAR was shown to be highly effective in Project Follow Through (Becker & Carnine, 1981). Neither Bitgood et al. (1976) nor Sainsbury (1971b, 1973) reported whether their subjects had been exposed to formal academic training. It is possible that the highly structured academic training provided by the preschool used in the present experiments made the children unusually facile in mastering discrimination tasks; Experiment 4 investigated this possibility. Experiment 4 could not, however, resolve the discrepancy between Zerbel's (1984) results and the present results because the same research site was used in both studies. (Because of the time delay involved in obtaining permission to work with children enrolled in another preschool, Experiment 5 and 6 were conducted before Experiment 4.)
EXPERIMENT 4

The purpose of Experiment 4 was to determine whether children enrolled at a preschool that did not provide formal academic training would perform poorly on the FN task. If the majority of these children made many errors on the FN task, then a subject history variable may account for the difference in results obtained in the present experiments and previously published research. The procedures used in Experiment 1 (provision of differential training only, yes/no feedback, and correction trials) were selected for use in Experiment 4.

Method

Subjects

The eleven subjects who participated in this study were enrolled in a preschool that did not provide structured academic training. The mean age for the FP group was 4.4 years (range 3.8 to 4.9). The mean age for the FN group was 4.2 years (range 3.1 to 4.9).

Experimental Design

The data obtained in Experiment 1 were compared with the data obtained in Experiment 4 to determine whether a lack of structured academic training would result in more errors on the feature value tasks. Subjects were randomly assigned to one of two groups. The FP group contained three children and the FN group included eight chil-
Apparatus, Stimuli and Procedure

The apparatus, stimuli and procedure were identical to those used in Experiment 1. (Thus the procedure included differential training only, yes/no feedback and correction trials.)

Reliability

Dependent Variable

Reliability data were collected on the dependent variable during 82% of the sessions and agreement was consistently 100%.

Independent Variables

Reliability data on the independent variables were collected during 82% of the sessions and agreement was always 100%.

Results

The three FP subjects performed almost identically to the three FP subjects in Experiment 1. The mean percent correct for Experiment 4 FP subjects was 97% (range 95% to 98%). On the other hand, more subjects in Experiment 4 had difficulty with the FN task in comparison to FN subjects in Experiment 1: Four out of eight FN subjects in Experiment 4 obtained a percentage of 55% or below during the first (and only) session whereas only one FN subject in Experiment 1 performed poorly.
Discussion

The results obtained in Experiment 4 were more like those obtained by Bitgood et al. (1976) than those obtained in Experiment 1. However, only half the eight FN subjects in Experiment 4 performed poorly whereas all five of the yes/blank FN subjects in the Bitgood et al. study performed poorly. It is unclear why all the Bitgood et al. FN subjects had great difficulty with the task. It is likely that some of the difference in the results obtained between Experiment 1 and Experiment 4 is due to differences in academic training provided by the preschools involved in the experiments. Recall that the preschool used in Experiment 1 provided structured academic training whereas the preschool used in Experiment 4 did not. (Six of the eight FN subjects in Experiment 1 had had fairly extensive academic training.) However, because not all the FN subjects in Experiment 4 perform poorly (as in the Bitgood et al. study) the failure to replicate the findings of Bitgood et al. had not been completely resolved. It is not feasible that a combination of the yes/blank procedure and a lack of formal academic training could account for the differences between Experiment 4 and Bitgood's study because each of Bitgood's FN subjects made a substantial number of errors with the yes/no feedback procedure. At this point a telephone call was made to Bitgood with the purpose of gaining information about the nature of the academic training provided for subjects in his 1976 study and about any variables potentially responsible for the failure to replicate. Bitgood reported that the research sites used in his 1976 study were similar to the site used
in Experiment 4 in that no formal academic training was provided at the school (S. C. Bitgood, personal communication, April 23, 1985). Further research is necessary to determine whether formal academic training had a causal effect on the paucity of errors in the present series of experiments. Experiment 4 only provided correlational data relevant to this subject variable. After Bitgood was told that the only apparent difference between the procedure used in the present experiments and his 1976 study was the use of nonautomated equipment, he reported that in follow-up experiments nonautomated equipment had been used and that fewer errors were obtained with the nonautomated equipment than with the automated equipment. It is possible that some aspect of using automated equipment creates errors. One possibly important difference between the automated and the nonautomated equipment was the fact that the stimuli were presented at eye level with the automated equipment whereas they were presented on a table with nonautomated equipment. Another difference was that with the automated setup, the experimenter sat behind the subject; with the nonautomated setup, the experimenter sat opposite the child. It may be that having a "teacher" in front the child causes the child to attend to the task more closely and thus make fewer errors. There are also other possible features of the use of automated stimulus presentations that result in great difficulty with the FN task. Future experimentation should determine whether using automated equipment does, in fact, result in children making many errors with these stimuli (and if so why). The determination of whether aspects of the automated setup caused errors was not investigated in the
present series of experiments because of time constraints. (Recall that Experiments 5 and 6 were conducted before Experiment 4.)
EXPERIMENT 5

As described in the introduction, the initial purpose of this experiment was to obtain a FVE in children using stimuli and procedures similar to those previously used with adult humans and pigeons. Once a FVE was obtained manipulations were to be performed with the FN subjects that could clarify the relationship between nonhuman and child data and between child and adult human data.

Recall that Experiment 5 was conducted before Experiment 4. (And thus the relevance of subject variables on the results of Experiments 1 through 3 had not been assessed at the time of Experiment 5.) The results of Experiments 1 through 3 reflected a failure to generate enough errors to detect a FVE. Because the stimuli used in Experiment 5 were more complex than those used in Experiments 1 through 3, a sufficient number of errors were more likely to be generated such that a FVE could be detected. Subjects were exposed to stimuli and procedures similar to those used with college students by Brown et al. (1983), Nallan et al. (1981), and Newman et al. (1980). A FVE has also been obtained in pigeons using similar stimuli by Newman et al. (1980).

Method

Subjects

Twelve children from the same preschool as used in Experiments 1 through 3 were used. Four of the children were included in Experi-
ment 1. Eight children were naive. In Experiment 1 Subjects #1 and #3 served as FP subjects and Subjects #7 and #8 served as FN subjects. (The lowest percentage any of these children achieved in Experiment 1 was 90%.) The children were assigned to two groups, six children per group. The mean age was 4.4 years for the FP group (range 2.8 to 5.8 years) and 4.9 years for the FN group (range 4.5 to 5.8 years). One subject was dropped from the study when he refused to attend sessions after his eighth session. This subject's performance was highly erratic and he engaged in many escape behaviors during sessions.

Experimental Design

A between-subjects comparison was used to determine whether the FVE could be obtained in children using more complex stimuli than those used in Experiments 1 through 3. Subjects #17, #27, #28, #29, #30, and #31 were assigned to the FP group (the d appeared on S+ trials) and Subjects #1, #3, #7, #8, #32, and #33 were assigned to the FN group (the d appeared on S- trials).

Apparatus and Stimuli

Stimuli were placed on a table which was 38.1 cm high. A glass token dish (14 cm in diameter) was placed directly in front of the subject approximately 15 cm from the front edge of the table. Stimulus cards were placed, one at a time, about 8 cm below the token dish. Plastic poker chips served as tokens.

An example of a stimulus card is shown in Figure 3. The stimuli
were shapes (a triangle, a circle, a square, and a plus sign). The square served as the d for all subjects and the other 3 shapes served as the common features (which could appear in any position). The sides of the triangle and the square, the diameter of the circle, and the lines in the plus sign measured 2.1 cm. Each of the shapes was stencilled with a felt pen on 7.6 cm x 12.7 cm cards. Two shapes appeared on the left side of the card and two appeared on the right side (1.7 cm apart). The distance between the shapes on each side of the card was .3 cm. All possible combinations of the 4 shapes resulted in 24 different cards. No one shape was duplicated on one card. Three random mixes of these 24 cards were prepared which resulted in a total of 72 cards. (Each random mix was presented backward as well as forward. Thus six sequences were presented at various times during the experiment.) No shape could appear on the same side of the card more than three consecutive times.

Reliability

Dependent Variable

Reliability on the side to which the child pointed was taken during 44% of all sessions. The lowest percentage of sessions for which reliability was recorded for an individual subject was 29% (Subject #28); the highest percentage of sessions was 60% (Subject #32). Percent agreement was consistently 100%. Reliability was also taken on each child's verbal report about the basis for the discrimination. Percent agreement was 100%.
**Independent Variables**

Reliability on the integrity of the independent variables was taken during 48% of all sessions. The lowest percentage of sessions for which reliability was recorded for an individual subject was 29% (Subject #28); the highest percentage was 100% (#17). Reliability was consistently 100%.

**Procedure**

Stimuli were presented one at a time in a predetermined order. (See stimuli section above.) The first four sessions for Subjects #1, #3, #8, #17, #31, and #32 consisted of 48 trials. All other sessions consisted of 24 trials. (The duration of the sessions was decreased because several children's performances began to worsen during the second half of the session and because some subjects began to refuse to come to sessions.) The 48-trial session durations were generally about 13 min (range 7 to 24 min) and the 24-trial session durations were generally about 9 min (range 4 to 15 min). It appears that the performances of subjects who were solely exposed to 24-trial sessions were neither harmed nor facilitated by the longer initial sessions. (See Figures 4 and 5.)

The experimenter sat next to the subject. The subject was instructed to point to the 'good' (correct) side just after each stimulus card was presented. Immediately following correct responses the experimenter said "Yes!", dropped a token into the token dish, and removed the card (in that order). Following incorrect responses the experimenter: (1) said "No" in a monotone voice, (2) pointed
between the two shapes on the S+ side of the card while saying "This is the good side," (3) removed the stimulus card, and (4) re-presented the same card in a correction trial. No tokens were given during correction trials. The mean ITI was 5 s (range 2 s to 7 s). Subjects were exposed to from one to six training conditions according to their rate of acquisition and according to the group to which they were assigned. (FP subjects were exposed to a maximum of five conditions whereas FN subjects were exposed to a maximum of six conditions.) Condition changes occurred when the subject's data showed no upward trend and when the subject's percent correct for the first and second halves of the two preceeding sessions' trials were no higher than 75%. Training was continued until a mastery criterion of 85% within one 24-trial session was met. After the last trial of the session in which mastery had been attained the child was quizzed about how s/he had "won the game." The experimenter asked the child: (1) how s/he "knew where to point on the cards," (2) what made each side good or not good, and (3) what would s/he tell another child so that another child could "win the game."

No-Delay-Required Condition (NDR)

During this condition the subjects were instructed to point to the cards with their index fingers. The instructions in the following paragraph were read to the subjects just prior to each session. The instructions were adapted from Brown et al. (1983).

I'm going to show you some cards. I'll show you one card at a time. Each card will have two sides. (E shows the first card, and
points to each side.) Each card will have a triangle, a circle, a square, and a plus on it. (Each shape is pointed to as the E says each label.) What is this? (E points to first shape.) What is this? (E points to the second shape.) What is this? (E points to the third shape.) What is this? (E points to the fourth shape.) (If the S makes an error, the E models the correct response and repeats the question for that shape. The S is asked to identify each shape on the card two consecutive times with no errors.) One of the sides is "good", the other side is "not good". You have to guess which side is good and then point to the "good" side. If you guess right, I'll say "yes" and give you a chip. The more chips you get, the more things you get to get out of the box. If you guess wrong, I'll say "no" and show you the good side.

The purpose of having the subjects identify each of the shapes before beginning each session was to eliminate a potential source of variability in the data caused by differences in the subjects' labelling repertoires for the stimuli used. Subjects were allowed to point to the card as soon as the card was placed on the table. Because several of the subjects began to point before they looked at the cards, a condition in which the subjects were required to delay their responses was implemented to increase the chance that the subjects were making eye contact with the cards for at least 2 s before pointing.

Delay-Required Condition (DR)

In the delay-required condition subjects were required to delay
their pointing response for 2 s before they were allowed to point to the cards. The instructions in the following paragraph were read to the subjects prior to the each session.

What is this? (E says this while pointing to each shape on the first card. E requires a correct response for each shape on two consecutive trials.) Remember, each time you guess right you get a chip. The more chips you get the more things you get to get out of the box. Each time I show you a card I'll ask you to look at it and then I'll give you the magic wand. (E shows wand.) You can only point to the card with the magic wand. You cannot point with your finger. After you point with the magic wand you have to give the magic wand back to me.

Subjects were given the "magic wand" after they had made eye contact with the card for 2 s. The experimenter carefully watched the child's eyes and only gave the child the wand after the child's eyes were fixated on the card for 2 s. If the child looked away from the card while the wand was being passed, the experimenter took the wand back and required the 2-s eye fixation once again. An independent reliability observer verified that this procedure was followed.

**Point-to-Each-Shape Condition (PES)**

During this condition the subjects were required to point to each shape on each card (starting with first position on the far left, then the second position, etc.). The purpose of this condition was to force the subjects to pay closer attention to each shape on
the cards than that required during the delay-required condition. The instructions read to the subject prior to each session are in the following paragraph.

What is this? (E says this while pointing to each shape on the first card and requires a correct response for each shape on two consecutive trials.) We're going to do something new today. I want you to point to each shape on the cards before I give you the magic wand. Watch me. (E demonstrates pointing to each shape one at a time from left to right.) Now show me how to do it. (E corrects the S if the S points too quickly, does not point from left to right, or does not touch each shape.) Remember, you get a chip each time you guess right and the more chips you get the more things you can get out of the box.

**Feature Positive (FP)**

This condition was implemented for FN subjects who showed no indication of mastering the FN discrimination. The switch to a FP discrimination occurred with no warning to the subject at the beginning of a session. This FP condition was superimposed on the point-to-each shape condition. Subject #33 was switched to FP training even though he had mastered the FN discrimination because of the peculiar pattern of responses he exhibited during FN training. Subject #33's response pattern during FN training was to point to a particular shape (for example, the triangle) until doing so resulted in an error (which was when that shape appeared on the same side of the card as the square). Then he immediately switched to another
shape (for example, the circle) until an error occurred again. In effect this subject had discovered a flaw in the method of stimulus presentation such that he was able to respond with very high accuracy while having his behavior under the control of a specific shape on the S+ side of the cards. Subject #33 was switched to FP training to determine whether he would continue to respond to a particular shape as he had during FN training.

**Chips-for-Good-Behavior Condition (CGB)**

Chips for good behavior were delivered to those subjects who, in the experimenter's and the observer's judgment, may not have been mastering the discrimination because of interfering behaviors. Interfering behaviors included continual movement, pointing to each shape very quickly, playing with the wand, singing, etc. This condition always occurred in conjunction with the point-to-each-shape condition. The subject was told that colored chips would be given if certain "rules" were followed. The rules given to each subject were dependent upon the nature of subject's interfering behaviors. (An example of a rule was "no singing.") Blue or red chips were delivered contingent upon rule following. These chips were never delivered following errors nor during correction trials. White chips continued to be given after correct responses as during all other conditions.

**Rule-Induction-Training Condition (RIT)**

This condition was invoked when all other conditions failed to
result in mastery. The purpose of this condition was to determine whether the subject could learn the discrimination with verbal help from the experimenter. Subjects were trained to answer experimenter questions which were designed to result in the subject responding to the cards on a rule-governed basis.

As in all other conditions, the subject was tested (and practice was provided if necessary) on each of the shape labels prior to the presentation of the first trial. Then the experimenter said "We're going to try something new today. I'm going to help you figure out what makes a side good." Immediately before presenting each card the experimenter said "What do you think makes a side good?". If the subject did not respond or said something inappropriate (e.g., "the magic wand") the experimenter said "Which shape?". Once the subject had identified a shape, the wand was handed to the subject and the experimenter said "Point to the side with the (shape)." If the subject did not point to the side with that shape, the instruction was repeated. After the consequences for the pointing response occurred ("Yes" and a chip vs. "No" and no chip), the experimenter said "So could the (shape) make a side good?". If the subject responded incorrectly, the experimenter briefly explained why that shape could (or could not) make a side good. For example, the experimenter might say, "No, you said you thought the (shape) made a side good and when you pointed to that side you got it wrong. So it must be something else." For trials 2-24 the subject was required to continue to test whether the shape tested on the last card would yield a correct answer on the next card. For example, if on the
preceeding card the subject tested whether the circle made a side
good and the circle was, in fact, on the good side, then s/he was
required to continue to test the circle on the next card. When the
subject responded correctly on five consecutive trials (said "the
square" and then pointed to that side without any corrections) the
verbal prompting was discontinued. If the subject made an error
after the verbal prompting had been eliminated, the prompting was
reinstated. The subject was considered to have mastered the
discrimination when s/he responded correctly on 15 consecutive trials
with no verbal prompting by the experimenter.

Results

Figures 4 and 5 show the percent correct obtained during each
session for the three highest performing subjects from each group and
the three lowest performing subjects from each group respectively.
(It is interesting to note that the age of a subject was a poor
predictor of performance.) It is clear from these figures that a FVE
was not obtained; there is considerable overlap between the two
groups in speed of acquisition. The only evidence that suggests a
weak FVE (at best) is the fact that the two highest performing FP
subjects acquired their discrimination task much faster than the two
highest performing FN subjects.

Two FP subjects mastered the discrimination under the no­
delay-required condition. Requiring the remaining children to delay
their choice responses to the cards seemed to have resulted in
mastery for two FN subjects (#32 and #1). None of the FP subjects
Figure 4. Percent correct in each session for the three highest performing subjects from each group in Experiment 5. Adult stimuli were used with children. Subject ages are in parentheses after the subject's number.
Figure 5. Percent correct in each session for the three lowest performing subjects from each group in Experiment 5.

Adult stimuli were used with children. Subject ages are in parentheses after the subject's number.
benefitted from implementation of this condition.

The point-to-each-shape condition facilitated acquisition for only one subject from each group. Of the three FN subjects exposed to this condition, only Subject #7's performance improved after the point-to-each-shape condition was implemented. Similarly, one of the four FP subjects exposed to the point-to-each-shape condition seemed to have benefitted from it. (See Subject #31.)

When the two FN subjects (#8 and #3) who failed to master the FN discrimination were switched to the FP procedure neither one showed any strong indication of mastering the FP task. Subject #8's performance became erratic when she was switched to the FP task whereas Subject #3's performance continued its previous pattern (which was erratic).

Giving chips for good behavior to subjects who exhibited interfering behaviors did not result in any improvement for any subject. (See FP subjects #30 and #27 and FN subjects #8 and #3.)

Rule-induction training was required for three FP subjects and two FN subjects. Of these subjects Subject #28 experienced the most difficulty. During her first rule-training session she tested the circle 18 times, the plus 17 times, and the triangle 11 times. (She had to be repeatedly corrected to have her test on a given card correspond to the outcome on the last card.) The experimenter asked her to label the square at the end of this first session and she stated it without hesitation. During her second rule-training session she tested the circle on 9 trials, the plus on 7 trials, and the square on 16 trials. She responded correctly to the last 4
trials without experimenter questions. Prior to beginning the first trial of her third rule-training session she had to be corrected several times before she labelled each shape on the first card correctly. She made several errors by confusing the label for the square with the label for the triangle. Her first test for trials 1 through 13 involved either the plus or the circle. On trial 14 she said that the triangle was the critical shape. After the 14th trial the experimenter tested her on the label for the square and she said "triangle." After the experimenter reviewed the labels for each of the shapes Subject #28 tested the square on all but one of the trials. During her last rule-training session she responded correctly on trials 9 through 24 without verbal prompting from the experimenter.

**Individual Session Data Analyses**

Analyses of individual session data were made for each subject. Tables 1 and 2 show data analyses for one subject from each group. (Data from rule-induction training sessions were not analyzed.) The variables identified as controlling variables are not necessarily those that were, in fact, controlling the subjects' behavior. For example, even though a subject may have appeared to be avoiding the square, it was possible that his/her behavior was directly controlled by the three pairs that did not include the square. In addition, if there appeared to be more than one potential controlling relation, each relation was considered equal. (It is possible that more than one controlling relation was operating at any one time.) For exam-
Table 1

Number of Responses to Each Pair of Shapes and Potential Controlling Variables for a Feature Positive Subject (#31) from Experiment 5 in Which Adult Stimuli Were Used With Children.

<table>
<thead>
<tr>
<th>Pairs</th>
<th>Session</th>
<th>△+</th>
<th>△○</th>
<th>○+</th>
<th>○□</th>
<th>△○○</th>
<th>Controlled by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td></td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>Square/plus</td>
</tr>
<tr>
<td>1b</td>
<td></td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>Square/triangle</td>
</tr>
<tr>
<td>2a</td>
<td></td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>Triangle/circle; square/circle</td>
</tr>
<tr>
<td>2b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>71% right</td>
</tr>
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<td></td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>Random; circle</td>
</tr>
<tr>
<td>3b</td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>Square</td>
</tr>
<tr>
<td>4a</td>
<td></td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>Square/circle; circle</td>
</tr>
<tr>
<td>4b</td>
<td></td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>Triangle/circle, circle/plus; avoidance of square; circle</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>Random</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>Square/triangle; square</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>Triangle/circle; square/circle; circle</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td>Square/triangle, square/circle</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>Square</td>
</tr>
</tbody>
</table>
Table 2

Number of Responses to Each Pair of Shapes and Potential Controlling Variables for a Feature Negative Subject (#32) from Experiment 5 in Which Adult Stimuli Were Used With Children.

<table>
<thead>
<tr>
<th>Session</th>
<th>( \Delta^+ )</th>
<th>( \Delta_0 )</th>
<th>( \Delta_0^+ )</th>
<th>( \Delta_0 )</th>
<th>( +_0 )</th>
<th>Controlled by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td>4 Plus; triangle/plus, circle/plus; verbal behavior</td>
</tr>
<tr>
<td>1b</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>3 Avoidance of square; some shape tracking</td>
</tr>
<tr>
<td>2a</td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>0 Avoidance of square; triangle/circle, circle/plus</td>
</tr>
<tr>
<td>2b</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>0 Triangle</td>
</tr>
<tr>
<td>3a</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>0 Triangle</td>
</tr>
<tr>
<td>3b</td>
<td>--------------</td>
<td>-------------</td>
<td>---------------</td>
<td>-------------</td>
<td>--------</td>
<td>71% right</td>
</tr>
<tr>
<td>4a</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>0 Triangle/circle</td>
</tr>
<tr>
<td>4b</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0 Avoidance of square</td>
</tr>
<tr>
<td>5a</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0 Avoidance of square</td>
</tr>
<tr>
<td>5b</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0 Avoidance of square</td>
</tr>
</tbody>
</table>
ple, during session 4b Subject #31 could have been responding to two pairs, the circle, or avoiding the square. (See Table 1.) Pairs were considered controlling variables if the subject pointed to that pair at least 6 times within a session. Any given stimulus pair appeared 8 times within each 24-trial session (or half session). Thus, a score of 8 indicated that the subject responded to that pair each time it appeared during that session. Shapes were considered controlling variables if the subject pointed to the pairs that contained that shape on at least 67% of the trials. Avoidance of the square was considered to be potentially important if the subject did not point to pairs that contained the square on any more than 33% of the trials and did not point to any one pair that contained the square on any more than 4 trials per session.

In addition, session data were scrutinized for other controlling relations. If strong controlling relations other than control by particular pairs or shapes were detected, they were considered primary. For example, Subject #32 engaged in overt self-talk during his second session; so verbal behavior was treated as a potential controlling variable. (See Table 2, session 1a.) If the subject pointed to a particular side of the cards on more than 70% of the trials, a side preference was treated as the controlling relation. (See session 2b for Subject #31 in Table 1.) In the following section individual session data analyses are summarized for each subject in each group. For the purpose of clarity, the subjects' performances are described below in an order similar to that presented in Figures 4 and 5; in general, the subjects' performances
are discussed starting with the highest performing subject and ending with the lowest performing subject.

**FP Subjects**

Subject #17 explained the solution after he had mastered it; it is not clear whether he learned to verbally describe the task during the session or after the session. In other words, his behavior may have been solely contingency shaped during the sessions or he may only have analyzed the task verbally at the time he was quizzed about the nature of the task.

Of the FP subjects only #29 engaged in overt self-talk during training. After the first trial of her second session she said "The plus is bad." Her subsequent behavior corresponded with this statement until an error occurred (5 trials). After the 10th trial she stated the solution correctly and thereafter made no errors. This subject clearly learned the discrimination by verbally analyzing the task.

Subject #31's behavior appeared to be frequently controlled by particular pairs of stimuli. During seven of his nine sessions he pointed to at least one pair either seven or eight times. (Recall that each pair appeared 8 times per 24-trial session.)

Subject #28 exhibited a fairly consistent response pattern that was not related to the shapes on the cards. This subject pointed to whichever side was correct on the last card. (This pattern was evident during 67% to 83% of the trials during sessions 1 through 5.) This response pattern resulted in a very low percent correct and the
pattern disappeared in the 6th session. Subject #28 showed no tendency to master the FP discrimination prior to rule-induction training. Of the three FP subjects who required rule-induction training, only Subject #28 did not explain the task correctly.

Subject #30's individual session data showed little consistency across sessions. The most consistency this subject exhibited was a tendency to be controlled by a particular shape (4 sessions).

Subject #27's most consistent response pattern appeared to be a right side preference. This preference was evident for 5 out of 14 sessions. It was interesting to note that although Subjects #30 and #27 initially showed some indications of being controlled by the square, neither subject continued to be so controlled.

**FN Subjects**

Subject #33's behavior was clearly controlled by the S+ side of the card. This subject pointed to a particular shape (for example, the plus) and continued to point to that shape until corrected. He then pointed to another shape (for example, the circle) and, as before, pointed to that shape until corrected. He exhibited this response pattern on 91%, 87%, and 100% of the trials during sessions 1, 2, and 3 respectively. His behavior also reflected this pattern when he was switched to the FP discrimination. (Reliability data were calculated on which shape this subject was pointing to within a particular side. Agreement was 83% and 92% for the sessions in which reliability data were recorded. Reliability was taken during 2 of his 6 sessions.)
Subject #32 was one of two FN subjects who engaged in overt self-talk during training sessions. He made several statements about what made the "good side good" during his first session but this self-talk disappeared and it wasn't until the fifth session that he mastered the FN discrimination. Subjects #32 and #1 may have mastered the FN discrimination in three ways. First, they could have been avoiding the square. Second, their behavior could have been directly controlled by the pairs that involved all possible combinations of the triangle, the circle, and the plus. Third, they could have been engaging in covert self-talk and thus solved the task via their verbal behavior. (Subject #32 did not explain the nature of the discrimination at the end of the experiment; Subject #1 did explain.) It was impossible to determine from the data which of these three possibilities was operating.

Subject #7 engaged in overt self-talk during four sessions. During session #4 he made two statements about what made the "good side good." During the fifth session he stated the solution ("not the square") but his subsequent pointing responses did not correspond to this statement. During session #7 he stated the FN solution again and thereafter made few errors. This subject had clearly verbally analyzed the task and thereafter responded on a rule-governed basis. (He also stated the solution during session 8: "The other side is bad.")

Subject #8 showed no indication of mastering the FN discrimination. Her response patterns during FN training sessions varied considerably; sometimes her behavior appeared to be controlled by a
particular pair, sometimes by a particular shape, and other times by side preferences. When she was switched to the FP task she showed some indication of mastering the task prior to rule-induction training.

Subject #3 showed some signs of mastering the FN discrimination during 5 of her 12 FN sessions. Her most consistent pattern of responding during FN training appeared to be control by the triangle. She showed some tendency toward mastery of the FP discrimination during 3 of her 9 FP sessions without rule-induction training.

Summary

In summary, 3 out of 6 FP subjects mastered their discrimination task without rule-induction training whereas 4 out of 6 FN subjects mastered their task without rule training. Of the 4 FN subjects who mastered the task without rule training, one subject's responses were clearly controlled by the S+ side of the cards. One subject from each group solved the task via verbal behavior. Of the subjects who mastered the discrimination without rule training, two from each group explained the nature of the task correctly. Of the subjects who failed to master the task without rule induction training 2 out of 3 FP subjects and 1 out of 2 FN subjects showed some indication of mastery.

Discussion

The results of this study showed that children do not appear to master the FP discrimination any faster than the FN discrimination
when the "common" features of asymmetrical stimuli are varied during training (i.e., when stimuli previously used with adult humans were used). The only evidence that suggested a weak FVE was the fact that the two highest performing FP subjects mastered their discrimination faster than the two highest performing FN subjects.

The finding that switching FN subjects #8 and #3 to the FP task did not result in any improvement in performance is consistent with the results that Pace et al. (1980) obtained with Rhesus monkeys and pigeons and that Newman et al. (1980) obtained with adult humans. These authors found that FP performance was retarded following FN training on the same discrimination task. (And the d was the same in the reversal.) One interpretation of the present findings is that exposure to several sessions of failure on the task resulted in these subjects being less likely to look carefully at the stimuli. Anecdotally, the two subjects who were switched to the FP task engaged in more disruptive behaviors as training progressed. These disruptive behaviors may have prevented them from mastering the FP task. Nallan et al. (1981) found that transfer of FN college students to a FP task involving a different type of stimuli (colors vs. symbols) did not retard the FP acquisition. Similar results were obtained by Nallan et al. (1984) with pigeons. Therefore, it appears that FP learning is affected by FN training when the same discrimination task is involved, but not when a different discrimination task is used. This conclusion should be viewed with caution, however, due to the small number of studies which have addressed this issue. Further research is needed on the effect of
past FP and FN training on subsequent FP and FN performance when the prior training does and does not involve the same stimuli.

These results are contrary to those obtained with college students by Brown et al. (1983), Nallan et al. (1981), Newman et al. (1980), and Richardson and Massel (1982). Experiment 5 also failed to replicate the results of Newman et al. (1980) with pigeons. Newman et al. used an autoshaping procedure to generate discriminative responding among four shapes. (They used the same shapes as were used in Experiment 5.) Three of the four shapes appeared on any one trial. Large FP superiority was obtained; 7 out of 8 FP subjects mastered the discrimination within 30 sessions. (The mean number of sessions to mastery was 12.8 for the FP group.) None of the eight FN subjects mastered the discrimination within the 30-session limit. (Nor did any of the FN subjects get more than 65% correct for a single session.) Previous to Experiment 5, stimuli in which the "common" features were systematically varied had not been used in the study of the FVE with children. It is possible that an extention of training over several more sessions would have eventually resulted in a difference between the FP and FN subjects who failed to master their discrimination tasks without rule-induction training. Extended training may not be feasible with children in this line of research, however, because the task is not likely to be intrinsically reinforcing and it is difficult to motivate the children to work on the task for a protracted period. Future research with children might best be conducted with stimuli that are likely to be less difficult. (For example, three shapes rather than four could be used in a successive procedure.)
EXPERIMENT 6

Because the data obtained with children in Experiment 5 did not replicate the FVE using stimuli and procedures similar to those used in previous experiments with adults, Experiment 6 was conducted to determine whether the FVE could be replicated with adult humans.

Method

Subjects

Fourteen undergraduate students enrolled in an introductory psychology course participated. The students received a bonus point toward their course grade for participating.

Experimental Design

A between-subjects comparison was used to determine whether a FVE could be obtained. Each subject was randomly assigned to either the FP or the FN group. Seven subjects were assigned to each group.

Experimental Setting and Stimuli

Sessions were conducted in a 2.4 m x 1.8 m room. The subject sat at an office desk. The experimenter sat facing the subject's left such that the subject could not see data being recorded without turning around. A reliability observer sat on the subject's right approximately .9 m away. The stimuli used were identical to those used in Experiment 5. Each random mix of the 24 different cards was

58
presented starting with the first card. (None of the mixes was presented backward as in Experiment 5.) All subjects were presented with the same order of the random mixes (Mix A, followed by Mix B, followed by Mix C).

**Dependent Variables**

The two dependent variables were percent correct and number of trials to articulation of the correct solution.

**Reliability**

Reliability data were taken on the dependent and the independent variable during every session by an independent observer. Agreement was consistently 100%.

**Procedure**

One session was conducted for each subject and each session lasted from 3 to 20 min (The average was 11 min.) All 72 cards were presented unless the subject answered correctly for 10 trials following articulation of the correct solution.

At the beginning of the session the first card was placed in front of the subject and s/he was asked to read the following instructions:

In this task you will experience 72 trials. On each trial you will be presented a card, which will contain two pairs of symbols, a left pair and a right pair. The symbols Δ (triangle), O (circle), □ (square), and + (plus) will appear on each card, in a varying order.

One of the pairs of symbols on each card is "correct," the other pair of symbols on each card is "not correct." A system was used to decide which pairs of symbols are
correct and which are not correct. Your task is to figure out the system.

You will examine each card for 5 s. When I tap the desk with my pencil tell me which pair of symbols, the left pair or the right pair, you think is correct. Then, I will tell you which pair was in fact correct on that card. Then we will proceed to the next card.

As soon as you figure out the system which was used to decide which pairs of symbols are correct and which are not correct, tell me. I will not let you know if you are right or not, but I will write your solution down.

We will complete all 72 cards, whether you figure out the system or not. If you figure out the system before we finish the 72 cards, test your solution on the remaining cards.

Any questions?

These instructions were identical to those used by Brown et al. (1983) and Nallan et al. (1981). Whenever a subject had not offered a solution within the proceeding 24 trials or had answered correctly for the last 10 trials the experimenter asked "What do you think the solution is?". Immediately after feedback was given for a card, the card was removed. (All data were recorded after the card had been removed.) When the subject gave a verbal description of the task the experimenter said "O.K.. Test you solution on the rest of the cards."

Results

Tables 3 and 4 show that the FVE was obtained. There was some overlap between groups; the three lowest performing FP subjects required more trials to state a correct solution than the highest performing FN subject. All seven FP subjects solved the task whereas five out of seven FN subjects solved it. Two FN subjects who stated a solution within the 72-trial limit stated the solution by referring to the $+$ side of the card. For example, Subject #9 said "If the
Table 3

Number of Trials to Solution and Percent Correct
Within Each 24-Trial Block for Each Feature Positive Adult
in Experiment 6

<table>
<thead>
<tr>
<th>Subject</th>
<th># of trials to solution</th>
<th>1st 24 trials</th>
<th>2nd 24 trials</th>
<th>3rd 24 trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>6</td>
<td>100%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>#2</td>
<td>10</td>
<td>100%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>#3</td>
<td>10</td>
<td>100%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>#4</td>
<td>13</td>
<td>83%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>#5</td>
<td>22</td>
<td>92%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>#6</td>
<td>30</td>
<td>75%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>#7</td>
<td>70</td>
<td>75%</td>
<td>96%</td>
<td>96%</td>
</tr>
</tbody>
</table>

Mean: 23 89% 99% -
Table 4

Number of Trials to Solution and Percent Correct
Within Each 24-Trial Block for Each Feature Negative Adult
in Experiment 6

<table>
<thead>
<tr>
<th>Subject</th>
<th># of trials to solution</th>
<th>#1st 24 trials</th>
<th>#2nd 24 trials</th>
<th>#3rd 24 trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>#8</td>
<td>18</td>
<td>92%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>#9</td>
<td>24</td>
<td>75%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>36</td>
<td>46%</td>
<td>92%</td>
<td></td>
</tr>
<tr>
<td>#11</td>
<td>40</td>
<td>65%</td>
<td>92%</td>
<td>100%</td>
</tr>
<tr>
<td>#12</td>
<td>45</td>
<td>92%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>#13</td>
<td>72+</td>
<td>71%</td>
<td>67%</td>
<td>58%</td>
</tr>
<tr>
<td>#14</td>
<td>72+</td>
<td>67%</td>
<td>88%</td>
<td>83%</td>
</tr>
</tbody>
</table>

Mean: 44  72%  92% -
plus is paired with the triangle or the circle, it's correct. If the circle and the triangle are together, that's correct." Subject #11 said "The plus and the circle is it. If they're not together, then if the plus or the circle is paired with the triangle that's correct." The fact that 2 FN subjects solved the task as a FP task resulted in 9 out of 14 subjects solving the task as a FP task and 3 out of 14 subjects solving the task as a FN task.

Discussion

The results of Experiment 6 were very similar to those obtained by Brown et al. (1983) and Nallan et al. (1981). The mean number of trials required before FP subjects stated the solution was approximately 26, 29, and 23 for Brown et al., Nallan et al., and Experiment 6 respectively. One of the 7 FP subjects in the Brown et al. study, 1 of the 20 FP subjects in the Nallan et al. study, and none of the 7 FP subjects in Experiment 6 failed to solve the FP task. The mean number of trials to a solution statement for FN subjects in Experiment 6 was somewhat lower than in the previous experiments. In Experiment 6 the mean number of trials to solution was 44; in Brown et al. and in Nallan et al. the mean was about 58 and 64 respectively. The number of FN subjects who stated the solution in each study was 2 out of 7 (Brown et al.), 12 out of 20 (Nallan et al.), and 5 out of 7 (Experiment 6). (Recall that 2 of the 5 FN subjects from Experiment 6 stated the solution as a FP task.) Although it appears that there was more overlap between the FP and FN groups in Experiment 6 than in the previous experiments the

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general results of the previous experiments were replicated.

Given that Experiment 6 replicated the results of previous research with adults, it is important to consider what subject characteristics may have been responsible for the discrepancy between the results of Experiments 5 and 6. One might be tempted to argue that differences in histories of FP learning might explain the discrepancy. This argument would have to be founded on the premise that asymmetrical discriminations in general and FP discriminations in particular occur in the natural environment (and that FP discriminations are more common than FN discriminations). However, if one were to argue that adult humans had more extensive FP histories than children, than one would expect adults to also have more extensive FP histories than nonhumans. Because there is a large body of literature that shows the FVE in nonhumans an interpretation of the discrepancy between the results obtained with children in Experiment 5 and the results obtained with adults in Experiment 6 on the basis of relative histories of FP learning is untenable.

A more viable interpretation of these results is that differences in the verbal repertoires of adult humans and children are important in determining the FVE with these stimuli. Adults have more sophisticated verbal behavior and in general this repertoire would allow them to solve the tasks faster than children. Experiment 5 did not determine how the children would have responded had training been extended for several more sessions. If training had been continued, a FVE may have been obtained. Extended training was not possible because of increasing difficulties in motivating the
children to work on the task in succeeding sessions. Motivation to solve the task is probably stronger in adults because of extensive training in following instructions and because of a "desire to appear smart" to the experimenter. In addition, the children's less sophisticated verbal repertoires may actually prevent mastery because the children may analyze the task in faulty ways. (For example, the child may say to him/herself that responding quickly is important.) Features of the experimental setting were probably more novel for the children than for the adults and thus their normal verbal repertoires may have been disrupted. This difficulty (of the children's verbal repertoires possibly interfering with mastery) might be solved by using an experimental setting similar to settings the child is exposed to in his/her natural environment. And the problem of needing to generate sufficiently strong motivational variables to maintain careful attention to the stimuli over several sessions might be circumvented by using stimuli of moderate difficulty.

Another interpretation of the contradictory results obtained in Experiments 5 and 6 is that the FVE is not as robust a phenomenon as previous research suggests. Although the nonhuman data are extensive, the number of studies that have been conducted with humans is relatively small. Further research with a wider variety of humans using a variety of stimuli is necessary to determine the generality of the FVE in humans.
GENERAL DISCUSSION

This series of experiments with children was designed to replicate and extend previous research on the FVE with pigeons, children and adult humans. Most of the FN children in Experiments 1 through 4 made considerably fewer errors than the FN children in previous research with children using similar stimuli and procedures. In Experiment 5 several subjects (both FP and FN) did not master discrimination tasks that had been previously used with nonhumans and adult humans. Further research is needed to determine what variables were responsible for the failures to replicate. One variable that may have contributed to the lack of errors in Experiments 1 through 3 was a history of formal academic training. The importance of academic training on the results of Experiments 1 through 3 could be determined by directly manipulating academic training while looking at how errors are affected.

A variable that may have contributed to the paucity of errors in the FN children in Experiments 1 through 4 was the presentation of the stimuli via nonautomated equipment. Previously published research which used similar stimuli with children (Bitgood et al., 1976; and Sainsbury, 1971b, 1973) presented stimuli with automated equipment. Future research is needed to determine whether some aspect of the automated equipment was, in fact, an important determinant of a child's performance in learning the FN discrimination with these stimuli. The discrepancy between the re-
results of Experiment 2 and those of Zerbel (1984) are difficult to account for. It is possible that Zerbel may have inadvertently cued subjects to make errors. Provision of precautionary measures against cueing was the only difference identified between the method used in Experiment 2 and Zerbel's study that may have accounted for the difference in the results obtained between the two experiments.

Experiment 5 showed that exposing children to stimuli similar to those used in previous research with adult humans and pigeons did not result in a FVE. The finding that the adults in Experiment 6 showed the FVE indicated that the failure to obtain a FVE with children in Experiment 5 was not due to general difficulties in replicating previous research. The failure to get the FVE in Experiment 5 may be attributable to the difficulty of the discrimination for the children. That is, the discrimination may have been too difficult for some of the children to master within the limits of their motivation to work on the task. Future research should address whether exposing children to stimuli of intermediate difficulty would result in a FVE. This need to find stimuli of moderate difficulty does not necessarily imply that the FVE is not as robust a phenomenon as previous research suggests. Detection of the effect may be more difficult in children because of problems involving the generation of sufficiently strong motivational variables across extended periods of time. It is also possible that the novelty of the experimental setting in Experiment 5 detracted from the children's ability to master the discrimination. (Their verbal repertoire may have been too unsophisticated to be useful under the experimental conditions.
they were exposed to.) Perhaps conducting a study in a manner more like the normal classroom situation would provide a FVE with the stimuli used in Experiment 5.

Another interesting replication of Experiment 5 would attempt to study the FVE in children in a way that would clarify the relationship between human and nonhuman data. One approach would be to use stimuli with children that the children are unlikely to label during the experiment (e.g., Greek symbols that do not look like letters, numbers or common objects). Using stimuli which children are unlikely to label may result in the children responding more like the nonhumans (i.e., not have their nonverbal behavior affected by their verbal behavior) than the adult humans.
APPENDIX A

Independent Variable Reliability Data Sheet for Experiments 1 and 4: Differential Training Only, Yes/no Feedback, Correction Trials

Subject: ________  Group: ____  Date: ________
Day: ________
Observer: ________________  (Record +, 0, or N.A.)

1. E sits directly across from S. Cutout in barrier is directly in front of S.
2. E tells S before beginning 1st trial: "You'll get to trade your chips for things out of the box at the end if you try hard. The more chips you get, the more things you can get out of the box."
3. E shows S box of items then puts them out of sight before beginning.
4. Immediately after presenting the stimuli on each trial the E says "Point to the good picture."
5. E presents stimuli through cutouts in cardboard barrier.
6. E presents stimuli in correct position vertically. (Triangles should be pointing to subject's right.)
7. E presents stimuli on sides (left vs. right) and in order specified on data sheet.
8. Following correct responses, E says "yes" enthusiastically, places a token in the token cup, and
removes stimuli (in that order).

9. Following incorrect responses, E says "no" in monotone voice, removes stimuli, and repeats trial (in that order).

10. Following correct responses on correction trials, E says "yes" enthusiastically and removes stimuli (in that order).
   (E does not give tokens on correction trials.)

11. Location of responses on displays is not differentially reinforced.

12. If and when the location of responses within displays is unclear, E says "Point in one of the boxes."

13. If S does not point to a display within 5 s, E says "point to the good picture."

14. ITI variable 10 s.

15. Subject allowed to exchange tokens for items at end of session.
APPENDIX B

Independent Variable Reliability Data Sheet for Experiment 2:
Nondifferential Training, Yes/no Feedback, No Correction Trials

Subject: _______ Group: _____ Date: _______
Day: _______
Observer: ______________ (Record +, 0, or N.A.)

___ 1. E sits directly across from S. Cutout in barrier is
directly in front of S.

___ 2. E tells S before beginning: "You'll get to trade your chips
for things out of the box at the end if you try hard. The
more chips you get, the more things you can get out of the
box."

___ 3. E shows S box of items then puts them out of sight before
beginning.

___ 4. E shows S where 'chips' will come out and does not tell S
s/he'll get one each time s/he's is 'right'.

___ 5. E presents 20 trials of nondifferential training (1st
session only). Instructions given to S: "Point to one of
the pictures." Token and "yes" occur after every trial.

___ 6. E allows S to exchange tokens for one item after the last
trial of nondifferential training.

___ 7. Immediately after presenting the stimuli on each trial the
E says "Point to the good picture."

___ 8. E presents stimuli through cutouts in cardboard barrier.
9. E presents stimuli in correct position vertically. (Triangles should be pointing to S's right.)

10. E presents stimuli on sides (left vs. right) and in order specified on data sheet.

11. Following correct responses, E says "yes", places a token in the token cup, and removes stimuli (in that order).

12. Following incorrect responses, E says "no" in a monotone voice, removes the stimuli, and presents the next trial (ITI minimum 10 s). No correction trials are given.

13. Location of responses on displays is not differentially reinforced.

14. If and when the location of responses within displays is unclear E says "Point in one of the boxes."

14. If S does not point to a display within 5 s, E repeats the instruction, "Point to the good picture."

15. ITI variable 10 s.

16. Subject allowed to exchange tokens for items at end of session.
APPENDIX C

Independent Variable Reliability Data Sheet for Experiment 3: Nondifferential Training, Yes/blank Feedback, No Correction Trials

Subject: ________ Group: ______ Date: ______

Day: ______

Observer: ______________ (Record +, 0, or N.A.)

_____ 1. E sits directly across from S. Cutout in barrier is directly in front of S.

_____ 2. E tells S before beginning: "You'll get to trade your chips for things out of the box at the end if you try hard. The more chips you get, the more things you can get out of the box."

_____ 3. E shows S box of items and then puts them out of sight before beginning.

_____ 4. E shows S where 'chips' will come out and does not tell S s/he'll get one each time s/he's is 'right'.

_____ 5. E presents 20 trials of nondifferential training (1st session only). Instructions given to S: "Point to one of the pictures." Token and "yes" occur after every trial.

_____ 6. E allows S to exchange chips for one item out of box before proceeding to differential training.

_____ 7. Immediately after presenting the stimuli on each trial the E says "Point to the good picture."

_____ 8. E presents stimuli through cutouts in cardboard barrier.
9. E presents stimuli in correct position vertically. (Triangles should be pointing to subject's right.)

10. E presents stimuli on sides (left vs. right.) and in order specified on data sheet.

11. Following correct responses, E says "yes", places a token in the token cup, and removes stimuli (in that order).

12. Following incorrect responses, E simply removes the stimuli and presents the next trial (ITI minimum 10 s). No correction trials are given.

13. Location of responses on displays is not differentially reinforced.

14. If and when the location of responses within displays is unclear, E says "Point in one of the boxes."

15. If S does not point to a display within 5 s, E repeats the instruction, "Point to the good picture."

16. ITI variable 10 s.

17. Subject allowed to exchange tokens for items at end of session.
Independent Variable Reliability Data Sheet for Experiment 5: No-Delay-Required Condition

Subject: _____ Group: _____ Date: _____ Day: _____

Observer: ______________ (Record +, 0, or N.A.)

1. E shows S box of items and tells S s/he'll be able to get things out of the box if s/he works hard while playing the game.

2. E puts box of items out of sight.

3. E sits next to S.

4. E reads instructions to S and ensures S meets criterion on label names before proceeding (two consecutive times labelling each shape without hesitation).

5. Immediately after presenting each card the E says "Point to the good side."

6. E presents stimuli in order specified on data sheet.

7. Following correct responses, E says "yes" enthusiastically, drops a chip in the dish, and removes the card (in that order).

8. Following incorrect responses, E says "no" in a monotone voice, says "This is the good side." while pointing between the 2 shapes on the correct side, and repeats trial (in that order).

9. Following correct responses on correction trials, E says
"yes" enthusiastically and removes stimuli (in that order). (E does not give chips on correction trials.)

10. The location of responses within a particular side is not differentially reinforced.

11. E does not require S to clearly point to a specific shape.

12. If S does not point to a side within 5 s, E repeats the instruction "Point to the good side."

13. ITI variable 5 s.

14. Subject is allowed to exchange chips for items at end of session (1-12 = 1 item, 13-16 = 2 items; 17-21 = 3 items; 22-24 = 4 items).
APPENDIX E

Independent Variable Reliability Data Sheet for Experiment 5:
Delay-Required Condition

Subject: _______ Group: ___ Date: ______ Day: ___
Observer: _________ (Record +, 0, or N.A.)

___ 1. E shows S box of items and tells S s/he'll be able to get things out of the box if s/he works hard while playing the game.

___ 2. E puts box of items out of sight.

___ 3. E sits next to S.

___ 4. E reads instructions to S and ensures S meets criterion on label names before proceeding (two consecutive times labelling each shape without hesitation).

___ 5. Immediately after presenting each card (1) the E says "Look at it.", (2) E does not give magic wand to S until S has maintained eye contact with stimulus card for 2 s, (3) E repeats "Look at it." instruction each time S looks away before 2 s elapses, (4) E gives S magic wand, (5) E takes wand back if S looks away from card before pointing, and (6) E says "Point to the good side."

___ 6. E presents stimuli in order specified on data sheet.

___ 7. Following correct responses, E says "yes" enthusiastically, drops a chip in the dish, and removes the card (in that order).
8. Following incorrect responses, E says "no" in a monotone voice, says "This is the good side." while pointing between the 2 shapes on the correct side, and repeats trial (in that order).

9. Following correct responses on correction trials, E says "yes" enthusiastically and removes stimuli (in that order). (E does not give chips on correction trials.)

10. The location of responses on a particular side not differentially reinforced.

11. E does not require S to clearly point to a specific shape.

12. If S does not point to a side within 5 s, E repeats the instruction "Point to the good side."

13. ITI variable 5 s.

14. Subject allowed to exchange chips for items at end of session (1-12 = 1 item, 13-16 = 2 items; 17-21 = 3 items; 22-24 = 4 items).
APPENDIX F

Independent Variable Reliability Data Sheet for Experiment 5: Point-to-Each-Shape Condition

Subject: ________ Group: _____ Date: ______ Day: _____
Observer: ____________ (Record +, 0, or N.A..)

1. E shows S box of items and tells S s/he'll be able to get things out of the box if s/he works hard while playing the game.
2. E puts box of items out of sight.
3. E sits next to S.
4. E reads instructions to S and ensures S meets criterion on label names before proceeding (two consecutive times labelling each shape without hesitation).
5. Immediately after presenting each card: (1) the E says "Point to each shape.", (2) E does not give magic wand to S until S has pointed to each shape from left to right, (3) E gives S magic wand, and (4) E says "Point to the good side." If S looks away from the card between (2) and (3) or between (3) and (4) the E starts with (1) again.
6. E presents stimuli in order specified on data sheet.
7. Following correct responses, E says "yes" enthusiastically, drops a chip in the dish, and removes the card (in that order).
8. Following incorrect responses, E says "no" in a monotone...
voice, says "This is the good side." while pointing between the 2 sides on the correct side, and repeats trial (in that order).

9. Following correct responses on correction trials, E says "yes" enthusiastically and removes stimuli (in that order). (E does not give chips on correction trials.)

10. The location of responses within a particular side is not differentially reinforced.

11. E does not require S to clearly point to a specific shape.

12. If S does not point to a side within 5 s, E repeats the instruction "Point to the good side."

13. ITI variable 5 s.

14. Subject is allowed to exchange chips for items at end of session (1-12 = 1 item, 13-16 = 2 items; 17-21 = 3 items; 22-24 = 4 items).
APPENDIX G

Independent Variable Reliability Data Sheet for Experiment 5:
Chips-for-Good-Behavior Condition

Subject: _______ Group : ____ Date: _______ Day: ____
Observer: ___________ (Record +, 0, or N.A..)

___ 1. E shows S box of items and tells S s/he'll be able to get
tings out of the box if s/he works hard while playing the
game.

___ 2. E tells S that s/he will be earning red chips for "being
good." E lists things the S must do to earn the red
chips.

___ 3. E follows items 4 - 14 on the point-to-each-shape
condition reliability data sheet.

___ 4. Red chips are never delivered after errors nor during
correction trials.

___ 5. If S earns more than 24 chips, s/he is allowed to select 5
items out of the box.
Independent Variable Reliability Data Sheet for Experiment 5: Rule-Induction-Training Condition

Subject: _______ Group: _____ Date: _______ Day: _____

Observer: _______ (Record +, 0, or N.A.)

1. E shows S box of items and reminds S s/he'll the more chips s/he gets the more things s/he can get out of the box. E puts box out of sight. E sits next to S.

2. E requires S to meet criterion on label names before beginning.

3. E tells S before beginning 1st trial: "We're going to do something new today. I'm going to help you figure out what makes a side good."

4. Immediately before presenting the 1st card the E says "What do you think makes a side good?". If the S does not say anything or says something inappropriate, the E says "Do you think it's the plus?". If S says "yes", E gives the S the wand and says "So point to the side with the plus." If S says "no" E says "Do you think it's the (shape)?" for each remaining shape in the following order: circle, triangle, square. E presents the wand as soon as S says "yes" and tells S to point to the side with the shape just mentioned. The next card is not presented until S points to the side with the shape just mentioned.
5. After S points to the 1st card E consequates S accordingly ("Yes" and chip vs. "No" and no chip). Then E says "So could the (shape) make a side good?". If S answers correctly E says "Let's see if the (shape) makes a side good on the next card." and proceeds with card #2. If S answers incorrectly E says "No. You said you thought the (shape) made a side good and when you pointed to that side you got it wrong. So it must be something else." or "No. You said you thought the (shape) made a side good and when you pointed to that side you were right. So let's see if the (shape) makes a side good on the next card."

6. E follows the procedure described in steps 4 and 5 above for the remaining cards. The only difference between trials 2 - 24 and trial 1 is that if S does not answer the question "What do you think makes a side good?", the E asks about shapes according to what occurred on the last trial. For example, if the S tested the plus on the previous card and the side with the plus was, in fact, 'good' on the previous trial, then E asks about the plus. If the last shape tested was wrong, then E asks about the next shape in the series (plus, circle, triangle, square). If the subject's response to the question does not correspond to the outcome of the preceding trial E says "The (shape) was on the good side on the last card. Let's see if it's on the good side on this card." or "The (shape) was not on the good side on the last card so it
can't make a side good on the rest of the cards. What else do you think could make a side good?"

7. E continues the rule training until the S makes 5 correct responses in a row and the S has not had to be corrected on any responses (including pointing to the side with the square and vocal answers to E questions). Once rule training is discontinued the E gives the wand to the S when the S makes eye contact with the card. If the S makes an error after rule training is discontinued, the E goes back to rule training. Sessions are continued until the S responds correctly without vocal prompts to 15 consecutive trials with no errors.

8. E follows items 6-14 on "Point to each shape" reliability data sheet.
APPENDIX I

Independent Variable Reliability Data Sheet for Experiment 6: Adults

Subject: ________ Group: ___ Date: ______ Day: _____
Observer: ______________ (Record +, 0, or N.A.)

1. E sits to subject's left side, facing S. Data sheet is on E's right, out of subject's view. E does not look at cards after placing them in front of S. If S turns to look at data sheet at any time, E asks him/her not to.

2. E places 1st card in front of S and has S read instructions.

3. E presents cards one at a time in order specified on data sheet.

4. Five seconds after each card is presented, E taps desk with a pencil to cue S to respond. If S answers before 5 s have elapsed E says "Wait for the tap."

5. If S has not offered a solution in the last 24 trials or answered the last 10 trials correctly, E asks S what s/he thinks the solution is.

6. E gives S feedback immediately after each response ("left" vs. "right"). (e.g., "Yes." or "No, it's the left side.")

7. E removes card immediately after feedback is given and records the subject's solution (if any) after removing the card.
8. After recording a solution, E asks S to test his/her solution on the rest of the cards.

9. E presents all 72 cards or presents cards until S performs perfectly for 10 trials following articulation of the correct solution.
BIBLIOGRAPHY


