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The Effects of Given Versus Self-Derived Rules on Children's Performance of a Complex Discrimination Task

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THE EFFECTS OF GIVEN VERSUS SELF- DERIVED RULES
ON CHILDREN'S PERFORMANCE OF A
COMPLEX DISCRIMINATION TASK

by

Susan F. Roy

A Thesis
Submitted to the
Faculty of The Graduate College
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requirements for the
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Department of Psychology

Western Michigan University
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Two groups of preschool children were studied in a discrete-trial concept formation task involving identification of stimulus cards which shared a common feature (e.g., picture a color, or a facial expression). During training, one group (rule-given) was given a verbal description which delineated the aspect of the stimulus card that should control responding. The second (self-derived rule) group was exposed to the same cards, without a rule (verbal description) being given. Members of each group were reinforced for correct responses (i.e., identifying which of two pictures had the relevant stimulus property), and accuracy of description was recorded for each trial. After training with several different concepts, both groups were tested in a situation where no rule was given. It was found that students from the self-derived rule group performed better in this situation than those from the rule-governed group.
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Susan F. Roy
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Figure 1. Mean number of trials to criterion for self-derived rule (circles) and rule-given (triangles) groups during training and testing sessions. Conditions during training and testing are described in the text. . . . . . . 12
CHAPTER I

INTRODUCTION

The distinction between rule-governed and contingency-shaped behavior has been discussed at length by Skinner (1969). Rules are descriptions of contingencies; they describe relationships among responses and stimuli. One of the important and useful characteristics of a rule is that one need not be exposed to a contingency described in a rule to behave effectively with regard to it. However, descriptions of contingencies are never complete or exact; thus, the behavior resulting from rule-following may be different from the behavior resulting from exposure to actual contingencies of reinforcement. In defining rules, Skinner (1969) says they are "discriminative stimuli which improve the efficiency of behavior under given contingencies of reinforcement...but they must not be confused with the contingencies themselves, nor their effects with the effects of those contingencies...the results may be the same, but the controlling variables are different and the behaviors are therefore different" (p. 124). Rules, then, are descriptions of contingencies and function as discriminative stimuli.

Many studies have generated data which support Skinner's contention that instructed responding is in fact different from shaped responding. Baron, Kaufman, and Stauber (1969) found that human subjects responding under a fixed-interval (FI) schedule of reinforcement generated patterns of responding that differed from those typically
evinced by nonhumans (i.e., scallops). But when instructions were
given to the human subjects, they generated "scalloped" response
distributions. Harzem, Lowe, and Bagshaw (1978) have done further
research in this area, and found that subjects exposed to a tandem
fixed-ratio (FR) fixed-interval (FI) schedule of reinforcement who
verbally described the schedule as FI produced long post-reinforcement
pauses. Those who verbally described the schedule as FR did not pro-
duce pauses.

Investigators have also studied instructions as helpful tools for
inducing behavior. Ayllon and Azrin (1964) found that instructions
can alter behavior even when reinforcement is not systematically
arranged. In addition, maximum change in behavior was obtained with
psychiatric patients when the reinforcement procedure took advantage
of the verbal repertoire of the patients. These data suggest that,
in humans, instructions and reinforcement can in some cases produce
complimentary effects.

Other researchers have studied the effects of instructions on
behavior change in nonhumans. Boren and Devine (1968) investigated
the effects of instructional lights on monkeys' performance under a
repeated acquisition procedure. They attempted to determine whether
monkeys would learn the response sequence due to exposure to the
lights or whether the monkeys would simply learn the response sequence
without coming under the control of the instructional stimuli. They
found that instructional lights significantly reduced errors in the
learning phase, but in the re-learning phase (when the lights were not
programmed to serve an instructional function), error rates returned
to baseline (initial learning without instructions) levels. With instructions the monkeys pressed the levers in the appropriate sequence; when the specific stimuli were absent they failed to emit the sequence. That is, the monkeys did not come under the control of the sequence when they followed instructions.

The results reported by Boren and Devine (1968) were reproduced with human subjects by Peterson (1980). She found that preschool children did emit the appropriate responses in sequence when instructional stimuli were present. However, when the instructional stimuli were removed, their error rates returned to baseline, as if the children were encountering the sequence for the first time.

In a study of college students expanded to a multiple schedule of loss avoidance, Galizio (1979) found that subjects trained with instructions to differentiate schedule conditions failed to respond differentially to the schedule components when instructions were not provided. In a related vein, Shimoff, Catania, and Matthews (1981) found that instructed responding in humans was insensitive to changes in contingencies, but that shaped responding was sensitive to subtle changes in contingencies.

In discussing the differences between rule-governed and contingency-shaped behavior, Skinner (1969) claimed that although the behaviors may topographically look similar, they are, in fact, different operants under different kinds of stimulus control. The research previously cited seems to support this notion, and suggests that instructional stimuli (rules) frequently reduce sensitivity to behavioral consequences. Several variables have been suggested to influence the
degree of this insensitivity. These include the type of reinforce-
ment, the topographical properties of the response, details of rein-
forcer delivery, and the procedure used to initiate responding
(Mathews, Shimoff, Catania, & Sagvolden, 1977). For example,
Mathews et al. (1977) found that human subjects were more sensitive
to contingencies when instructions were minimal and the reinforcer was
consummatory.

Catania, Matthews, and Shimoff (1982) recently extended the rule-
governed/contingency-shaped distinction to include verbal behavior.
Their study with college students compared instructed versus shaped
verbal behavior (written answers to questions about their nonverbal
behavior) and the effects of the two types of verbal behavior on button-
pressing under random-ratio and random-interval schedules of reinforce-
ment. Their data suggested that shaped verbal behavior is more likely
to determine and reliably control nonverbal behavior than is instructed
verbal behavior. These findings are significant because of their
applied implications, and because they suggest that giving instruc-
tions to subjects can establish verbal responding quickly, although
this procedure is not always advantageous in the long run.

The purpose of the present investigation was to assess the effects
of verbal instruction (rules) on performance of a discrimination task
by preschool children. In the initial (training) phase, one group of
children was given rules for making a discrimination, while a second
group of children was required to perform the same discrimination with-
out formal instruction. The data attained are relevant to two questions,
each of practical as well as theoretical significance. These questions
are 1) in preschoolers, do verbal instructions facilitate the initial acquisition of a complex discrimination, and 2) does the use of verbal instructions in initial acquisition of a discrimination affect subsequent acquisition of a similar discrimination when rules are not provided?

The advantage of using preschool children in such an investigation is that, although they are able to describe verbally their own performance (which is important given that certain reports suggest verbal descriptions of contingencies to be especially useful data), they lack the long history of rule-following characteristic of adult humans. In addition, the formation of discriminations plays an important role in the education of this age group. Thus, determination of the factors which influence it is of considerable importance.
CHAPTER II

METHOD

Subjects

Sixteen children (mean age = 5.8 years) were selected from a local day care center and a neighboring grade school. Children were selected for training based on availability and mastery of the pre-training skills described in the Pretraining Procedure section. Guardian and school officials' (principal and teacher) consent was obtained for each subject participating in the study.

Setting

The study was conducted in two classrooms. Grade school children were tested in a 8.8 m x 6.7 m classroom; preschool children were tested in a 4.6 m x 5.5 m classroom. Each contained a small table and two chairs.

Apparatus/Material

Eight 30 cm x 30 cm white poster board cards were used. Two line drawings of children appeared on each card; these drawings were separated by a vertical strip of black paper. The children were drawn with dots for eyes and a half-circle for the mouth (see the Appendix for an example). The drawings on each card differed on four dimensions: height (20 cm vs. 10 cm), gender (male vs. female), expression...
(happy vs. sad), and color (red vs. blue). "Happy" was indicated by
a concave-up mouth, "sad" by a concave-down mouth. Hair was drawn on
female figures; male figures were bald. Each figure was drawn with
its hands hidden behind its back. The two figures were drawn so that
each of the stimulus dimensions was represented on each card (i.e.,
if the figure on the left was male, short, red, and happy, the figure
on the right was female, tall, blue, and sad).

Procedure

Before the beginning of any session that introduced a new problem
the child was allowed to select one scratch-n-sniff sticker from a
group of 20–30 stored in a box. The sticker was placed on the table
next to the stimulus cards, and the experimenter explained that upon
completion of a problem the child could keep the sticker. If a problem
was not completed in one session, the sticker was returned to the box
and the selection procedure was repeated at the beginning of the next
session. At the end of the session all children received verbal
praise (e.g., "Nice working, give me five!") for being cooperative
workers.

Pretraining

The experimenter (author) selected one card from a group of five
and told the subject that to win the game she/he had to find out what
kind of child always had the penny. The experimenter then placed a
penny on each picture that shared the common feature which was the basis
of the discrimination, and prompted the subject to describe the features
relevant to a solution. The experimenter instructed the subject to try one feature (i.e., "Why don't you try 'happy' because this child is happy and has a penny"). If needed, the experimenter assisted the child by presenting each card and prompting a statement that the happy child always had the penny. She then had a child state the rule, "All happy children have a penny; happy is the answer." The experimenter then selected five new cards and repeated the above procedure for each of the other seven stimulus dimensions.

Three pretraining sessions were conducted and subjects were selected for training based on their mastery of this pretraining task. Mastery was defined as being able to state the common feature without any prompts from the experimenter.

Training

**Self-derived rule group**

For members of this group, the experimenter began each trial by selecting 5 of the 8 cards. The experimenter presented one card from a stack of five and asked, "Which child always has the penny?" The subject responded stating a verbal description of the rule (e.g., "The happy child always has the penny"). The experimenter then said, "Touch the child hiding the penny." The subject touched one of the two pictures on the card, after which the experimenter gave the child feedback contingent upon the vocal and nonvocal response (e.g., "Yes, that's the child that's hiding the penny," or "No, that's not the child that is hiding the penny," or "Yes, that's the child that's hiding the
penny but it's not because she/he is happy"). The experimenter then waited 4 seconds and presented the next card.

**Rule-given group**

The procedure to which members of this group were exposed was similar to the procedure for the self-derived rule group. The only difference was that the trial did not begin with the experimenter asking the first question; rather, the trial began with the presentation of the first rule (e.g., "The happy child always has the penny") and the presentation of the first card.

For both groups, each training session was terminated after 25 blocks of trials (25 times through the 5-card problem) or when criterion was met (100% accuracy for 1 block of 5 consecutive trials). If a subject did not reach criterion in the session, the same stack of cards and the same problem were presented during the next session. A new problem was presented only at the beginning of a session. Training lasted for 40 sessions. Two sessions for each child were held each day.

**Testing**

Both groups were tested identically. The testing conditions were identical to the training sessions for the self-derived rule group. The testing phase was two sessions per day for five consecutive days.

**Dependent variables, data collection, and reliability checks**

Each time a card was presented, accuracy of the subject's vocal
and nonvocal responses was recorded on a data sheet by the experimenter. Accuracy of the response was recorded by marking a "+" on the data sheet if the response was correct, and a "-" if the response was incorrect. Vocal responses were defined as the verbal response to the experimenter's questions for each trial. The nonvocal response was touching one picture on a card.

During 10% of the sessions, data were recorded independently by a second observer. Interobserver agreement was calculated according to the following formula: \( \frac{\text{agreements}}{\text{agreements plus disagreements}} \times 100 \). Interobserver agreement was 100% for both vocal responses and nonvocal responses.
CHAPTER III

RESULTS

Figure 1 shows the mean number of trials to criterion in each training session for both groups. The results show that for the self-derived rule group, performance improved over time in the training sessions and variability also decreased over sessions. The rule-given group's performance was stable throughout the 40 training sessions with only slight variability between individual scores. All subjects in this group reached criterion by the end of the session each day.

Figure 1 also shows the mean number of trials to criterion in each testing session for both groups. The self-derived rule group's performance during test sessions was similar to their performance during training, but the rule-given group's performance during testing was poorer than their training performance (i.e., there was an increase in the number of trials to criterion).

For statistical analysis, composite scores were computed for both groups for both training and testing sessions. A composite score for training was calculated for each subject by summing all of the scores (number of trials to criterion) for the 40 training sessions. A composite score for the testing phase was calculated in the same manner. T tests (Hopkins & Glass, 1978) were then used to compare the performance of the two groups in training and in testing. During training, the rule-given group performed significantly better than
Figure 1. Mean number of trials to criterion for self-derived rule (circles) and rule-given (triangles) groups during training and testing sessions. Conditions during training and testing are described in the text.
the self-derived rule group ($t(14) = 2.49, p < .05$). However, during testing, the self-derived rule group performed significantly better than the rule-given group ($t(14) = 2.59, p < .05$).
CHAPTER IV

DISCUSSION

The present findings suggest that, in preschoolers, providing instructions (rules) facilitates the initial acquisition of a complex discrimination but not subsequent acquisition of a similar discrimination when rules are not provided. As predicted by Skinner's (1969) analysis of rule-governed behavior, the rule-given group behaved effectively from the first session. But, as also predicted by this analysis, their behavior resulting from rule-following (Sessions 1-40) differed from their behavior resulting from exposure to a contingency of reinforcement (Sessions 40-50) which the rule described.

Concept formation, concept learning, problem-solving, and stimulus discrimination learning have been rigorously studied since the 1940's (Hull, 1945; Huguenin & Touchette, 1980; Kendler & Kendler, 1962; Wolff, 1967; Zeaman & House, 1963). Several theories have been developed to explain the differences in results reported by researchers in this area.

Matthews et al. (1977) have previously suggested that to increase sensitivity to contingencies of reinforcement one should give minimal instructions and use consummatory reinforcers. The present investigation differed in various ways from the Matthews et al. study. This investigator used preschoolers as subjects instead of adults to test the effectiveness of instructional control over human behavior when extensive histories of differential reinforcement for following rules
are not present. In the present study, subjects in the rule-given group were given detailed instructions and all subjects were given nonconsummatory reinforcers. These variations were used to test the effects of detailed instructions with nonconsummatory reinforcers on instructed responding. These results are consistent with Matthews' et al. (1977) analysis; instructed responding was insensitive to contingencies.

Catania, Matthews, and Shimoff (1982) found that although giving instructions to subjects can establish verbal responding quickly, this procedure is not always advantageous in the long run. The present investigator found similar results with non-verbal responding. One can establish non-verbal responding quickly with the use of instructions but this procedure is only advantageous in the short run. Once the rule was no longer given, responding was ineffective until it came under the control of the critical controlling variable. For the self-derived rule group, responding was initially ineffective until it came under the controlling variables. Later, in a similar discrimination, behavior quickly came under the control of those same variables once again.

It is possible that the two groups (self-derived and rule-given) may have learned different patterns of behavior. According to Skinner (1968), "Instructions designed simply to transmit what is already known has often neglected the teaching of thinking" (p. 116). Skinner suggests that although it is tempting for teachers to tell students answers, the probability of those problem-solving behaviors will not be increased in the future if solutions are provided: "If the behavior
is entirely under the control of the printed page or the teacher's voice, it is probably not being brought under the control of stimuli which will be encountered in similar problems" (p. 134). Although both groups in the present study emitted responses (vocal and nonvocal) that were topographically similar, the self-derived rule group had to develop an internal repertoire of behavior which one may call a hypothesis testing strategy. When presented with the first card, a self-derived rule group subject had to guess the rule. If the feedback given was "No, that's not the child that is hiding the penny," they could eliminate 4 of the 8 stimulus dimensions as appropriate answers. If the feedback was "Yes, that's the child that is hiding the penny, but it's not because she/he is happy," they could limit their future guesses to the 3 other stimulus dimensions depicted on the card by that drawing. If the feedback was "Yes, that's the child that is hiding the penny," they were correct and no further strategy was needed.

For the rule-given group, initial responses (Sessions 1-40) may have been entirely under the control of the experimenter's voice and not under the control of the stimuli (relevant dimensions on the card) which would be encountered in similar problems (Sessions 40-50) when rules were no longer provided. Subjects in the rule-given group were not taught rules or strategies useful in solving similar problems. Rather, subjects in the self-derived rule group had that problem-solving behavior shaped by exposure to the contingencies in all sessions.

With the present procedure, attending to the relevant stimuli (responding to stimuli so that subsequent behavior will be reinforced)
seemed to be learned behavior. By focusing on the relevant stimulus dimensions the children could make the stimulus more effective. Responding to the stimulus cards, verbally stating the stimulus dimension and pointing to the picture which depicted it, was reinforced. The reinforcement of these behaviors strengthened the attending or precurrent behavior. Children in the rule-given group did not have to attend to the relevant stimuli on the cards (Sessions 1-40) to emit reinforced responses; they were reinforced for repeating the rule and pointing to the picture that depicted that stimulus dimension. This strengthened echoic behavior and attending to verbal stimuli (i.e., what the experimenter was saying).

Many of the precurrent behaviors used in problem-solving are not obvious or overt. As a result, these behaviors are often overlooked by educators and are not taught to students. As Skinner (1968) suggested, and these results affirm, educators need to teach the precurrent attending behaviors at the overt level. Once the behavior has been strengthened, educators can allow it to recede to the covert level.
BIBLIOGRAPHY


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