THE FUNCTION-ALTERING EFFECTS OF
CONTINGENCY-SPECIFYING STIMULI

THESIS

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By

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Three children between the ages of 3 and 3 1/2 were asked to choose a colored object from an array of 5 colors in a baseline condition. After color preferences were established, stickers, small toys and praise were made contingent on choosing the least preferred color. After the first experimental condition resulted in consistent choosing of the least preferred color, a second experimental condition was implemented. At the beginning of each session a contingency-specifying stimulus (CSS) was presented, each CSS specifying a different color to be selected. Both contingency-shaping and CSS presentation resulted in stimulus control over responding. However, CSS presentation resulted in immediate redistributions of behavioral units across CSS sessions.

Key words: contingency-specifying stimuli (CSS), contingency-shaping, function-altering, human children
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INTRODUCTION

The distinction between contingency-shaped and rule-governed behavior was first addressed by Skinner (1953, 1969). In contingency-shaped behavior, a discriminative stimulus, either verbal or nonverbal, evokes the behavior due to a history of differential reinforcement. Skinner (1966) defined rules, with respect to their form, as contingency specifying stimuli (CSS) that describe behavior and the controlling environment (e.g., antecedent and consequent stimuli). Thus, rule-governed behavior is behavior under the control of a verbal stimulus which specifies the relation between a response and the environment.

Historically, contingency-specifying stimuli have been classified functionally as discriminative stimuli (SDs) (Galizio, 1979; Hayes, 1986; Shimoff, Catania, & Matthews, 1981; Skinner, 1969; Vaughan, 1985) and have been called rules. However, Blakely and Schlinger (1987) have argued that if rules are nothing more than verbal SDs, the term rule is unnecessary. The extensive literature and research on stimulus control would be applicable to rule-governed behavior and no distinction between rule-governed and contingency-shaped behavior would be necessary. Blakely and Schlinger (1987) have argued further that some rules
are verbal stimuli with function-altering effects and if the term rule is used, it should be reserved for these stimulus events. In view of this ongoing debate, Schlinger and Blakely (1987) suggest that those rules with function-altering effects be interpreted as function-altering contingency-specifying stimuli (CSS). CSSs do not evoke the behavior as discriminative stimuli. A CSS describes a contingency between antecedent stimuli, behavior and consequences or between any two of these three elements. Further, a CSS can also describe a contingency between two or more antecedent/consequent stimuli. In the view of Blakely and Schlinger (1987), CSSs alter the function of other stimuli and the behavioral relations involving those stimuli. SDs do not alter the function of other stimuli but rather evoke behavior that has a history of being differentially reinforced in their presence. A CSS has a function-altering effect when it establishes a new behavioral relation by bringing the response under the evocative control of a previously neutral stimulus.

CSSs do not meet the definition of discriminative stimuli. According to Michael (1980) an SD is a stimulus which evokes a response as the result of previous reinforcement in the presence that stimulus. Schlinger writes with respect to a CSS, "Behavior is not reinforced in the presence of the statement; reinforcement is not more
readily available in the presence of the statement, and the statement does not evoke the behavior" (1992, p. 5).

The purpose of this research is to experimentally examine if a description of a contingency (CSS) will override a recent history of contingency-shaped behavior. The procedures were designed to separate the function-altering and discriminative effects of verbal stimuli that generally have been classified as verbal SDs. The importance of this research lies in the possibility that CSSs represent a type of controlling relation different from that of verbal SDs. To date there has been little research or special methodology developed to specifically analyze the unique functions of verbal stimuli that appear to have function-altering effects. Perhaps demonstration of these effects will encourage the development of the necessary methodology in future research and ultimately lead us to a definition of a functionally distinct category of verbal stimuli.

METHOD

Subjects and Setting

Five normal children between the ages of 3 and 3 1/2 were selected to participate in the study. The children were attending the Child Development Laboratory at the University of North Texas. All children were recruited
based on their correct naming of five colors (red, blue, green, yellow, and pink) when objects of those colors were presented. Parental consent was obtained for each subject. The research was conducted in one of two rooms (based on availability): a small office or a large classroom/activity room. The study was conducted during the play period (i.e., children played freely with toys, painted, drew, listened to tapes, etc.) at the beginning of each school day. The children participated in the study two to four days per week. Two subjects were dropped from the study due to excessive absences (e.g., vacation, illness).

**Apparatus**

I used large plastic belt buckles in various colors (red, blue, green, yellow, and pink) as manipulanda. In all conditions the children deposited the colored buckles in a large white "buckle" box with an opening in the lid. The position of the colored buckles was shifted with each presentation to deter position bias. A second, small box, covered with stickers and with an opening in the lid, held the reinforcers that were delivered (stickers and, later, small toys) during Condition 1. Prior to the experiment, I asked children in the lab what their favorite cartoon characters were. Teenage Mutant Ninja Turtles appeared to be the all-around favorite. The stickers provided for the
designated color choices were the various Teenage Mutant Ninja Turtle characters.

Interobserver Agreement and Observation Method

A graduate student from the Center for Behavior Analysis and I served as the observers. The second observer was not blind with respect to the experimental conditions. Observers were positioned so as to enable independent data collection. Agreement between observers was checked at the end of each experimental session. Data were taken on the color of each buckle deposited by each child and the percentage choice of each colored buckle was calculated daily. Written notes were kept on each child’s verbalizations throughout each session in the study.

Interobserver agreement on selection of the targeted colors was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Mean occurrence agreement for the dependent variable (color selected) was 99% for all subjects across all conditions.

Procedures

In all conditions, I approached each child and asked if he/she would like to work with me. All subjects always elected to go with me either to the office or the adjoining activity room (depending on availability) to work.
Each child sat across from me during experimental sessions. The large white "buckle" box was placed off-center on the child's right, between the child and me; the "sticker" box was placed off-centered to the child's left. I presented five different colored buckles to each child. When the child selected a colored buckle the remaining four buckles were removed. For each trial, a complete set of the five different colored buckles was presented. During the first condition (discrimination training) reinforcers were deposited in the "sticker" box within the child's range of vision. During the second condition stickers or toys were placed on the table in front of the child.

Baseline. The baseline condition was run in order to ensure the children responded reliably to my instruction and to determine a least preferred color. I presented the five different colored buckles and the instruction "Pick one and put it in there", while pointing to the large white "buckle" box. For all three subjects, I demonstrated this response when the children failed to respond to the instruction. With each child I demonstrated the response several times and selected a different color for each demonstration to control for color bias.

A least preferred colored buckle was specified as one that was picked 20% or fewer trials across three
consecutive sessions. A session consisted of 10 trials. A sticker was delivered after the third session in which the child showed a least preferred color and the child was thanked for his or her participation.

Experimental Conditions. The two experimental conditions were 1) contingency-shaped discrimination training and 2) CSS presentations specifying alternative behavior.

In the first condition (discrimination training) I continued presenting the same five different colored buckles to each child. When the child selected one colored buckle, the remaining buckles were removed. No verbal instructions were given during this phase. When a child selected a least-preferred colored buckle, he or she received a sticker or small toy. When a child picked any other color than the least-preferred color no stickers were delivered.

Initially, only stickers were used to reinforce color choices; however, I added praise and small objects (e.g. rings, doll brushes, cars, jets, army men, and various other toys). In the first condition praise in conjunction with sticker delivery was added in the 5th session for Subject 3, and in the 7th session for Subjects 1 and 2. Small toys were added in conjunction with stickers and praise in the 12th session for all subjects. Praise and
small toys were added to increase reinforcer effectiveness in establishing the various least-preferred color discriminations.

In the second experimental condition (CSS presentation), I specified the color to be selected prior to each session. The colors specified were different from the least-preferred color. I presented the same five different colored buckles to each child. When a child selected the specified color for all 5 trials of a session, he/she received a sticker or small toy after that session.

Immediately prior to the experimental session I presented a CSS, "Today, I will be giving stickers for picking ______ (a color that had not been reinforced in the first condition)." There was a minimum of 3 minutes to a maximum of 4 minutes between the time the CSS was presented and the session began. This condition consisted of four sessions. A different color (other than the least-preferred color) was specified in each session. When a child selected the specified color for all five trials, he or she received a sticker or small toy at the end of the session. When a child selected any other color in a session no reinforcers were delivered at the end of the session.

During the second experimental condition I attempted to engage all three subjects in conversation during the CSS
sessions. Immediately after stating the CSS I asked questions about the child’s family, dog, brothers/sisters, favorite games, favorite toy, etc.

**Schedule Changes.** In the first condition, reinforcement for selecting the least-preferred color occurred on a continuous schedule until a least-preferred color was chosen 80% or greater across 30 trials or 10 out of 10 consecutive trials. The schedule then shifted to an FR-2 based on the above criteria. In the first condition, I planned to gradually increase the ratio until each child selected the least-preferred color 80% or greater across 30 trials on an FR-10 schedule. However, due to the excessive absences of the children, spring break, and the lack of available space in which to conduct the research, the criterion was changed to three sessions per day with 5 trials per session until each child selected the least-preferred color 80% or greater across 15 trials on an FR-5 schedule.

In the second condition, a CSS specifying a different color was presented prior to each session and there were 5 trials per session. Reinforcers were delivered at the end of each session in which a child had selected the color specified by the CSS for all 5 trials in that session. There were four consecutive CSS sessions per child.
Results

Contingency-shaping procedures and presentation of CSSs both demonstrated the power to generate stimulus control of color over responding. But as shown in Table 1, dramatic differences were observed in the speed of acquisition of stimulus control.

Table 1 below illustrates that contingency-shaped behavior is time and work intensive. Compared to stimulus control shaped via contingent reinforcement, stimulus control generated directly by CSSs (and maintained by reinforcement) resulted in immediate redistributions of behavioral units across consecutive CSS sessions. Specific results for each condition are described next.

Table 1.  

Number of Trials Required to Demonstrate Stimulus Control

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<th>CONDITIONS</th>
<th>1. Contingency</th>
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<td></td>
</tr>
<tr>
<td>S1</td>
<td>465</td>
<td>*2</td>
</tr>
<tr>
<td>S2</td>
<td>435</td>
<td>5</td>
</tr>
<tr>
<td>S3</td>
<td>465</td>
<td>5</td>
</tr>
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* No Reinforcers delivered.
During baseline, the least-preferred color was chosen 13% of all trials by S1, 3% by S2, and 6% by S3. For each subject, Figures 1, 2, and 3 show the percentage choice of the least-preferred color in baseline and the two experimental conditions. Also graphed in the figures is the percent of color choices as specified in each session in the two experimental conditions. Each data point represents the percentage choice across 10 trials up to the 45th session for S1, and S3, and the 42nd session for S2. For the remaining sessions, each data point represents the percentage choice of the least-preferred color and specified colors across 5 trials.

All subjects eventually acquired the behavior of picking the least-preferred colors in the contingency-shaping condition. Subjects' behavior was maintained as the schedule shifted from CRF to FR-5.

Contingency-Shaping Condition

In the first condition, S3 was particularly insensitive to the experimental contingencies and alternated her choice between two colors for the majority of trials for sessions 1 through 30. Often, when beginning a session, she stated "I'm going to choose pink today" (which was one of her two preferred colors). I added praise in the 7th session and toys in the 12th session, but those consequences did not appear to modify her selection
of the least-preferred color. This lack of control suggested that these consequences (praise and toys) functioned weakly as reinforcers. S3 consistently announced the color picked concurrently with her selecting the color and dropping it in the box (e.g., "Pink"; "I picked pink"; "pink"; etc.) in the majority of trials. Over sessions 21 through 24, S3 chose one of her preferred colors (pink) 100% across 45 trials. In the 25th session, I prompted her to choose the least preferred color by pointing to that colored buckle 4 out of 10 trials. Prior to the 28th session, the preferred color (pink) was removed from the experimental sessions. In sessions 29 through 30, S3 selected another preferred color (red) 100% across 30 trials. However, in the 31st session, S3 selected the least preferred color 80% across 10 trials. The preferred color pink was reintroduced in the 35th session. When S3 returned from spring break, her selection of the least preferred color briefly decreased to 20% across 10 trials. However, in the 37th session, S3 stated, "I don't get anything [reinforcers] if I don't pick yellow" [the least preferred color] "I'm going to pick yellow". On subsequent trials I observed S3 reaching for the preferred color (pink) and then changing directions and selecting the least preferred color (yellow). In the remaining 11 sessions, S3
chose the least preferred color 100% across eight sessions of 10 trials and three sessions of 5 trials.

I noted that S3 was the most talkative of the three subjects and often began each morning session with an announcement of what she had eaten for breakfast and the health of her mother or other family members. I consistently responded to her questions and statements throughout all the sessions and began to speculate that the social interaction might function as a reinforcer if used contingently. In the 28th session, when S3 began to engage me in a conversation I stated, "I’ll be happy to talk with you after we finish working". Conversation and praise were paired with the delivery of a sticker or toy when the least preferred color was selected. It is difficult to determine whether the removal of the preferred color, contingent conversation or both influenced S3’s selection of the least preferred color since both changes occurred at approximately the same time.

S1 did not verbalize the contingencies that were operating, however, S2 stated in the 15th session "I’m going to pick red today. I get toys when I pick red". **CSS Condition**

In the second experimental condition S1 chose the specified colors 40%, 100%, 40%, and 100% of all trials in the four CSS sessions. S2 chose each of the four colors
specified by the CSS 100% of all trials in four CSS sessions. S3 chose the colors specified by the CSS 100% of all trials in the 1st, 2nd and 4th sessions. In the 3rd session S3 chose the color specified by the CSS 80% of all trials. For all subjects, choosing the specified colors had never been reinforced at the time choices were made.

In the first CSS session, S1 chose the specified color (yellow) on the first two trials and the least preferred (previously reinforced) color (red) in the last three trials of the session. In the third CSS session S1 chose the specified color the first and last trial of the session. A color (green) specified in a previous CSS session was chosen in trials 2 through 4.

In the 3rd CSS session, S3 chose the color (blue) specified by the CSS the first 4 trials of the session. In the last trial of this session, S3 chose the least preferred (previously reinforced) color (yellow).

The tactic of "keeping the child talking" was implemented to interrupt any verbal behavior the child may have emitted about the behavior specified by the CSS presented prior to each session. All subjects made the majority of their verbalizations immediately before or after the moment of selection.

During the first CSS session, S1 began actively conversing with me on the second trial of this session and
chose the least preferred (previously reinforced) color for the remaining three trials. In the third CSS session, S1 began conversing at the conclusion of the 1st trial of and continued to the conclusion of the 4th trial. For trials 2 through 4 of this session, S1 chose a color specified by a previous CSS in which that color had been consistently chosen and for which prior reinforcement had occurred. For sessions two and four, S1 did not converse with me but responded by nodding his head on occasion.

S2 actively conversed with me in all four CSS sessions; however, his verbalizations were limited to times immediately before or after his selections were made. Often I asked a question when he was making his selection. He consistently looked down, selected a colored buckle, and then responded to my question.

S3 did not verbally respond to my questions during the first two CSS sessions during which she chose the specified colors 100% across all trials. She looked up when I asked a question, nodded her head, but did not respond verbally until the session was complete. S3's verbal restraint could have been due to the contingencies in the first experimental condition wherein conversation had been contingent upon completion of a trial and/or session. In the 3rd CSS session, S3 chose the specified color in the first 4 trials of the session. On the last trial of this
session, S3 verbally responded to a question I posed to her and selected the least preferred (previously reinforced) color (yellow). In the 4th CSS session, S3 chose the specified color (pink) 100% of all trials. The color specified in this session was one of the preferred colors for S3. It is interesting to note S3’s verbal behavior during this session was similar to her verbal behavior in the first experimental condition. While making her selections S3 verbalized, "Pink"; "I choose pink"; "pink", etc. Overall, the specified color was chosen when the children refrained from verbally responding to my questions at the moment of selection.

Discussion

Blakely and Schlinger (1987) proposed that a CSS may alter the evocative function of discriminative stimuli in one of two ways: by establishing a new discriminative relation between a stimulus and behavior; or by strengthening or weakening an existing discriminative relation. In the second condition of the present experiment, the function-altering effects of CSSs were observed when subjects selected specified colors that previously had been neutral stimuli, thus demonstrating stimulus control relations not previously seen in their behavior during the experiment. The presentation of the
various CSSs appears to have repeatedly altered the function of specified colors.

For two of the subjects, there appear to be several explanations for the variability observed across CSS sessions. First, CSS sessions were conducted consecutively with a minimum of 3 minutes to a maximum of 5 minutes between sessions. In the third session S1's responding appeared to be under the control of more than one CSS. In future research, the time interval between sessions should be increased appreciably to eliminate the possibility that a subject's response could be under the control of more than one rule. Another alternative would be to use different manipulanda in each CSS session. Second, in the case of S1 a pattern emerged across four sessions that suggests a limited repertoire for discriminating verbally described contingencies. A session in which reinforcement did not occur was followed by a session in which the specified color was consistently chosen and reinforcement occurred. Across sessions the procedures themselves may have been training discriminated rule-following responses under control of the CSS; however, with only four CSS sessions, this would be difficult to determine. I speculate that with additional CSS sessions S1 may have responded to the stated contingencies with 100% accuracy.
The "talking" strategy may have disrupted control by the color specified in the CSS. When subjects 1 and 3 verbally responded to my questions, color selection reverted to the least preferred (previously reinforced) color or a color specified in a previous CSS session. S2, who refrained from talking while selecting the specified color, consistently selected the color specified by the CSSs in all four sessions. Determining a causal relationship between talking out loud, the interruption of any covert verbal behavior specific to the CSS, and the subsequent overt response is beyond the scope of this research. But the results may indicate that the childrens overt verbalizations may have been a "masking" technique that disrupted covert verbal behavior specific to the CSS and CSS control. It is interesting to note that S2 and S3 emitted tacts during the course of this research (e.g., "Pink"; "I chose pink"; "I get toys when I pick red"; etc.). Again, an analysis beyond the scope of this paper may indicate that the subjects were functioning as speakers when they verbalized a color choice and as listeners when they actually picked up the colored buckle. Some interesting questions arise. When a child tacts his/her own behavior does the child also formulate rules which are followed on future occasions? Does rule following then
occur under the control of overt or covert self generated rules?

An SD has been conceptualized as a stimulus in the presence of which a particular behavioral contingency has been more likely to be operative than in its absence Malott (1989). If a statement such as: "Today I will be giving stickers for picking yellow" is followed sometime later by the behavior of picking yellow, such a CSS does not function as a verbal SD because 1) reinforcement has not occurred in the presence of the CSS and 2) there is no history of reinforcement for that stimulus control relation (i.e., selecting the specified color). The question remains, how do we account for the effect of the CSS? Simply classifying the verbal stimulus, "Today I will be giving stickers for picking yellow" as a verbal SD appears inadequate. Again, verbal stimuli with function-altering effects do not meet the definition of discriminative stimuli. Discriminative stimuli do not alter the function of other stimuli, nor do SDs generally specify relations between antecedent stimuli, behavior, and consequences.

In the present study, the effectiveness of CSSs may have been due to the history established in the first condition during which I delivered reinforcers for correct responding. This order effect might indeed have increased the probability the children respond according to the
behavior specified in the CSS; however, this situation leaves unanswered why that experimental history did not sustain behavior consistent with it (choosing the least preferred color). Such a situation may not be unlike what happens in the real world where we discriminate whose rules are good to follow and whose are not.

The suggestions for future research are to separate CSS sessions by longer periods of time and to employ different manipulanda in consecutive sessions. In working with young children, it may be interesting to compare their behavior under conditions in which verbal stimuli specify relations between environmental and behavioral events with conditions under which the verbal stimuli do not. Such research would further distinguish verbal stimuli with function-altering effects (as a functionally distinct category) from verbal stimuli which function as discriminative stimuli.

In summary, CSS presentation overrode the evocative control established by discrimination training. Function-altering effects were observed in the immediate redistribution of behavioral units across CSS sessions. In each session, the colors specified by the CSS evoked the selection behavior. That is, the evocative function of the sight of the colors was altered by the various CSS presentations.
APPENDIX
Figure 1. Percentage choice for Subject 1 for the non-preferred and specified colors.
Figure 2. Percentage choice for Subject 2 for the non-preferred and specified colors.
Figure 3. Percentage choice for Subject 3 for the non-preferred and specified colors.
REFERENCES


