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ABSTRACT

One hundred twenty-eight preschool boys were subjects in a 4x2x2 factorial design to investigate the change in reinforcer efficacy as a function of prior stimulus exposure. The factors were: (1) amount of repetition, 5, 25, 45, or 65; (2) reinforcer, good or bell; and (3) satiator, good or bell. Two additional groups were run as control groups to determine the effectiveness of good and bell in the absence of satiation treatment. Following the experimental treatment, Ss were given 50 learning and 25 extinction trials on a fixed color-position discrimination learning task. Support for stimulus satiation and satiation generalization was found on both learning and extinction data. The obtained functional relationships were generally curvilinear. (Author)

[illegible]

FUNCTION OF STIMULUS SATIATION*

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Considering the impressive taxonomy of potential reinforcers of children's behavior, relatively little has been done that bears on the question of when will a stimulus be reinforcing. Only recently have investigators begun to move out of their absolutistic conception of reinforcement and into a more relativistic model including consideration of the contextual milieu in which the reinforcing stimulus is dispensed. The now classic studies by Gewirtz and Baer (1958a, 1958b) provided the initial impetus for this conceptual shift. Employing an "isolation" procedure, these investigators identified a functional relationship between amount of provision of social reinforcing stimuli (e.g., good, fine) and performance on a free operant task. Specifically, reinforcer effectiveness was increased by 20 minutes of social deprivation and decreased by 20 minutes of social satiation. At that time Gewirtz and Baer posited the existence of a social drive analogous to appetitive drives to account for their data.

The above functional relationship has been replicated numerous times (Dorwart, Ezerman, Lewis, & Rosenhan, 1965; Endo, 1968; Erickson, 1962; Hill & Stevenson, 1964; Lewis, 1965;

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[illegible], 1967; Stevenson & Odom, 1962; Walters & Ray, 1960). [illegible] the replications and [illegible] alternative interpretations of the findings. Among the hypotheses vying for prominence have been the anxiety hypothesis (Walters & Ray, 1960), the arousal hypothesis (Walters & Parke, 1964), and the frustration hypothesis (Hartup & Himeno, 1959). These hypotheses, along with the original social drive hypothesis of Gewirtz and Baer, have in common an appeal to an inferred motivational state in the child.

Gewirtz (Gewirtz, 1967, 1969; Landau & Gewirtz, 1967) has been engaged in an extensive research program that is conceptually based on the Gewirtz and Baer studies, but is an attempt to circumvent much of the controversy that has surrounded the isolation paradigm (i.e., isolation being an anxiety or arousal producing situation). Thus, he has attempted to control the availability of a single social stimulus without directly affecting the availability of any other social stimuli. The results of these studies have indicated that the reinforcing effectiveness of the social stimulus employed was an inverse function of the number of times that the stimulus had been presented contingently (Landau & Gewirtz, 1967) or non-contingently (Gewirtz, 1969) during the satiation treatment period.

In interpreting the results of these recent studies, Gewirtz (1967) has departed from his earlier social drive position. He now prefers to explain the observed stimulus-response changes without reference to motivational changes within the organism. He states, "Whatever the nature of the mechanism underlying the effects of stimulus satiation . . . the functional relations identified can stand independently, as do deprivation-satiation [illegible] that operationally the zero satiation condition in [illegible]' latest work is similar to the deprivation condition in the isolation studies. As Maccoby and Masters(1970) point out, this procedure involves a diminution in level of experimenter-child interaction and thus could be arousal producing.

A program of research that has been conducted by Cook (Cook, 1963; Cook, Hill, Emrick, & Wittrock, 1967) has also concerned itself with the change in efficacy of a reinforcer as a function of its prior provision. Employing a semantic satiation paradigm, Cook (1963) has shown that the child's continual repetition of a positive or negative reinforcer (good or bad)decreased the effectiveness of both reinforcers in a subsequent free operant task. The form of the functional relationship between amount of repetition and reinforcer effectiveness was curvilinear. Specifically, Cook used repetition levels of 0, 10, 20, 30, 40, and 30 and found that the 0 and 10 repetitions groups performed significantly better than the 20, 30, and 40 repetitions groups but not better than the 30 repetitions group.

The present research extended the Cook stimulus satiation paradigm in the following manner: (a) A non-social stimulus, the sound of a bell (bell), as well as the social stimulus, good, were employed in satiation treatment and as reinforcers in a subsequent discrimination learning task. Since good had been used in satiation research of this nature before, primary interest was on bell and whether it would be similarly affected by the satiation operation. In addition, the generalization of the satiation treatment was examined in those conditions where the nonsatiated stimulus served as the reinforcer. Generalization from non-social stimulus satiation to social reinforcement as well as from social stimulus satiation to non-social reinforcement was examined. Generalization was predicted on the basis of Cook's (1968) findings with verbal reinforcers. (b) The forms of the functional relationships (i.e., reinforcer effectiveness as a function of levels of the satiation operation) were examined and compared. Previous research involving such parametric variation with social stimuli has been equivocal. Gewirtz (1967) has posited, and found, an inverse relationship, while Cook (1968), Kozma (1969) and Lewis (1965) have reported curvilinear relationships. Since the density of the satiation operation most closely resembled that of Cook, a curvilinear relationship was expected. No comparable data were available for the non-social stimulus, but a similar relationship was expected. (c) The satiation operation used was a departure from Cook's (1968) paradigm in that the experimenter rather than the child repeated the stimulus. It was expected that this operation would yield similar results.

Method

Subjects

A total of 144 white, middle-class preschool boys from nursery schools serving the suburban communities of Camillus, DeWitt, and Liverpool, New York and from the Syracuse University Nursery School were used in this study. The mean age of the children was 57.3 months with a range of 41 to 66 months. Even though the children in the four schools were comparable socio-economically, the cells were balanced by school in light of [illegible]' (1969) findings.

Apparatus

The apparatus was a 36 cm. x 24 cm. x 17 cm. box specially built for this study. Two holes, 15 cm. apart and 3 cm. in diameter, were on the top surface of the box. The box was covered with blue contact paper. The hole on the *S*'s left had a red equilateral triangle overlay while the hole on the *S*'s right had a red circle overlay. The front surface of the box had an aperture 4 cm. square, from which *S* could pick up only one marble at a time. Marbles arrived at the aperture via a gravity feed "shelf" inside the box. This "shelf" housed 100 marbles (50 blue and 50 yellow) and provided random arrival of the marbles. Marbles, when dropped into either of the two holes on the top surface of the box, fell into a small container that was attached to the inside of the box. The other piece of equipment was a modified 10-volt door-bell chime available from Sears-Roebuck Company (Model No. 746-14830). The chime was mounted on a 25 cm. x 18 cm. x 13 cm. box. It was operated manually by means of a button on the side of the box facing *E*.

Design

The experimental design was a 4 x 2 x 2 fixed effects complete factorial. The factors were: (a) the amount of repetition (5, 25, 45, or 65 repetitions); (b) the stimulus used as the reinforcer (*good* or the sound of a door-bell, *bell*); and (c) the stimulus repeated in the satiation treatment (*good* or *bell*). There were 16 experimental cells with 8 *S*s in each cell for a total N = 128. In addition, two groups of 8 Ss each were run as control groups to determine the effectiveness of good and bell in the absence of the experimental treatment. These cells were not considered a part of the experimental design and were used only in supplementary analyses of the data.

Procedure

Each S was run individually. There were two phases of the experiment: (a) the satiation treatment and (b) the experimental task.

Satiation Treatment. The instructions to the Ss were:

"Hello. My name is Mr. Massari. What is your name? Today we are going to have some fun playing a special game. We are going to play a word (bell) game. I am going to say a word (ring a bell) over and over again. When I say the word (ring the bell), I want you to listen very carefully to the word (bell)."

Subjects were seated opposite E. E repeated the stimulus to be satiated for the specified number of times. In both the verbal and non-verbal conditions, E repeated the stimulus at a rate of approximately two per second. The actual repetition rate was .58 seconds per repetition or 1.7 repetitions per second. A 4 x 2 x 2 analysis of variance on the repetition rates indicated that there were no significant sources of variation for any of the treatment conditions.

Experimental Task. Immediately following the satiation treatment, E presented the experimental task to S. The instructions to the Ss were:

"Now we are going to play another game. It is a marble game. It is very easy. [illegible] there are many marbles. There are blue marbles and yellow marbles. Do you see the two holes on the top of the box? (E pointed to the two holes). Fine. You are to pick up one marble at a time and put it into one of the two holes. You can put the marble into either hole. Whenever you put a marble in the hole where it belongs, the correct hole, I will say good (ring the bell). Don't stop until I say, stop. Do you understand how to play the game? (E answered all questions by referring to appropriate parts of the instructions). Now begin putting marbles in the holes."

The task involved a fixed color-position discrimination (i.e., blue marbles in the left hole and yellow marbles in the right hole or vice versa). Following Gewirtz (1969), the "correct" responses were determined by S's response on the first trial which was always "incorrect," (i.e., if S's first response was placing a blue marble in the right hole, the reinforcement was contingent upon blue-left and yellow-right responses). All Ss were run on a 100 per cent reinforcement schedule for 50 learning trials. Following the learning trials, all Ss continued for 25 extinction trials, where E assumed an attentive, but non-reinforcing role. Thus, each S experienced 76 trials: one to determine the "correct" responses, 50 learning trials, and 25 extinction trials.

An attempt was made to determine whether the quality of the verbal reinforcer, good, that E dispensed was affected by his having repeated the stimulus during satiation treatment. Tape recordings were made of E dispensing good in those conditions in which good was the reinforcer and random samples were taken of 5 goods from each of the 4 repetition levels. A [illegible] of [illegible] random sequences of 10 goods representing the possible combinations of 2 satiation levels (i.e., 5 vs 25, 5 vs 45, 5 vs 65, 25 vs 45, 25 vs 65, and 45 vs 65) was constructed and 6 raters were asked to put each sequence into two "piles." Analyses of the raters' responses indicated that not one of them differed reliably from chance.

Results

Number of Correct Responses During Learning

Table 1 shows the results of the 4 x 2 x 2 x 5 analysis of variance with repeated measures on the last factor employing the number of correct responses during 5 blocks of 10 learning trials each. This analysis yielded a significant

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Insert Table 1 about here

F for Amount of repetition (A) ($F = 9.37$, *df* = 3/112, $p < .01$). Newman-Keuls individual comparisons indicated that the 5 repetitions group performed significantly better than the 25, 45, and 65 repetitions groups and that the 45 and 65 repetitions groups performed significantly better than the 25 repetitions group ($p < .01$ for all comparisons). The significant Reinforcer x Satiator (R x S) interaction ($F = 3.88$, *df* = 1/112, $p < .01$) and the Newman-Keuls individual comparisons showed that the $R_{good}S_{bell}$ group made significantly more correct responses than either the $R_{good}S_{good}$, $R_{bell}S_{good}$, or $R_{bell}S_{bell}$ groups when the amount of repetition was combined.

Because of the significant triple interaction (A x R x S) (F = [illegible], df = 3/112, $p < .01$), the A main effect and the R x S interaction must be interpreted with caution. Figure 1 depicts the manner in which the A factor affected performance with respect to the different R-S combinations. A clearer interpretation of the findings involving the A factor emerged by analyzing the factor separately for each R-S combination by means

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Insert Figure 1 about here

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of the simple, simple main effect analysis (after Winer, 1962, p. 252).

The simple, simple main effect analyses for the $R_{good}S_{good}$ and $R_{bell}S_{bell}$ groups were both significant (F = 4.83, df = 3/112, $p < .01$; F = 5.90, df = 3/112, $p < .01$, respectively). Subsequent Newman-Keuls individual comparisons revealed that in both conditions the 5 repetitions group made significantly ($p < .05$) more correct responses than the 25, 45, and 65 repetitions groups, suggesting that satiation occurred. The forms of the functional relationships differed, however, with significant linear, quadratic, and cubic components ($p < .05$ for all components) for the $R_{good}S_{good}$ condition compared to a predominantly linear component ($p < .01$) for the $R_{bell}S_{bell}$ condition.

The simple, simple main effect analysis on the A factor for the $R_{good}S_{bell}$ group was not significant (F = 2.14, df = 3/112, $p < .05$) indicating that for this R-S combination satiation generalization did not occur reliably. A trend test, considered appropriate because of the prior interest in the form of the relationships, yielded a significant quadratic trend ($p < .05$). The corresponding analysis for the $R_{bell}S_{good}$ groups was significant ($F = 2.97$, $df = 3/112$, $p < .05$) with the Newman-Keuls analysis revealing that the 45 and 65 rapetitions groups performed reliably better than the 25 repetitions group. Trend analysis of the $R_{bell}S_{good}$ curve showed a significant cubic component ($p < .05$). Thus, analyses of the $R_{bell}S_{good}$ group's performance supported the conclusion that satiation generalization occurred.

Since all interactions involving the Trials effect were non-significant, the Trials effect can be attributed to the increment in performance with successive trial blocks. That is, despite the significant A effect, which indicated that the satiation operation was effective, learning occurred and did not interact with treatment condition effects. Moreover, trend analysis suggested that this increment in performance closely conformed to a linear equation ($p < .01$).

The relative effectiveness of the reinforcing stimuli, in the absence of any experimental treatment, was examined by contrasting the two groups that received no experimental treatment (procedures adapted after Winer, 1962, pp. 263-267). This analysis revealed that the mean number of correct responses for the _good_ and _bell_ (means of 38.0 and 40.3, respectively) did not differ statistically ($F < 1$). This result precluded the possibility that the interaction (R x S and A x R x S) reflected the differential reinforcer efficacy of the stimuli under standard conditions.

In addition, these two groups combined (the control group) were contrasted with all of the experimental treatment groups combined (the experimental groups). This analysis indicated that the control group performed reliably better than the experimental groups ($F = 6.34$, $df = 1/126$, $p < .05$). Subsequent individual contrasts between the control group and each experimental treatment group yielded the following results: (a) for the $R_{good}S_{good}$ and the $R_{bell}S_{bell}$ combinations, the control group made significantly more correct responses than the 25, 45, and 65 repetitions groups; (b) for the $R_{bell}S_{good}$ and $R_{good}S_{bell}$ combinations, the control group made significantly more correct responses than the 25 repetitions group ($p < .05$ for all comparisons).

Number of Correct Responses During Extinction

The 4 x 2 x 2 analysis of variance employing the number of correct responses during the 25 trial extinction phase as the criterion scores yielded a significant F for the A factor only ($F = 6.57$, $df = 3/112$, $p < .01$). The Newman-Keuls individual comparisons between means revealed that the 5 repetitions group made reliably more correct responses than the 25, 45, and 65 repetitions groups ($p < .01$), and that the 45 and 65 repetitions groups performed reliably better than the 25 repetitions group ($p < .01$). This curvilinear relationship between performance during extinction and amount of repetition was supported by a trend analysis which revealed significant quadratic and cubic components ($p < .01$).

<u>Playing Time</u>

The 4 x 2 x 2 analysis of variance performed on the total amount of playing time during the 50 learning trials failed to reveal any significant sources of variation. The comparable analysis for playing time during extinction yielded a significant *F* for the reinforcer factor ($F = 11.26$, $df = 1/112$, $p < .01$). This finding resulted from the groups that had <u>bell</u> as a reinforcer during learning taking more time during extinction than the groups that had <u>good</u> as a reinforcer during learning. Thus, analysis of playing time for both learning and extinction failed to support the conclusions that were reached regarding the other performance measures. That is, the playing time measures did not show that the satiation operation was effective.

Discussion

These data suggest that the effectiveness of both the verbal reinforcer, <u>good</u>, and the non-verbal reinforcer, <u>bell</u>, was diminished as a result of their prior exposure to the subject. Evidence for satiation generalization was obtained from the extinction data and from the control group-experimental group comparisons. Finally, the forms of the functional relationships between amount of repetition and performance were generally curvilinear with the exception of the learning data for the $R_{bell}S_{bell}$ group.

Since the curvilinear relationships obtained involving good have also been reported by Cook (1968) and Cook et al (1967), confidence in their validity is enhanced. Future research should focus on replication of the linear relationship for the non-social stimulus as well as sampling repetition levels above 65 repetitions to determine whether a parabolic function obtains.

Lewis (1965) in a parametric study involving the isolation paradigm also found a curvilinear relationship with 3 and 12 minutes of isolation increasing reinforcer efficacy significantly more than 6 or 9 minutes. Lewis interpreted his data as reflecting an increase in anxiety during the initial minutes of isolation, followed by a subsequent decrease in anxiety at the intermediate levels as a function of exploration of the surround, and a return of anxiety at the upper level as exploration wanes.

Such a motivational interpretation does not appear relevant in this study because of the relatively innocuous experimental treatment. That is, it is unlikely that the repetition of a stimulus by a familiar experimenter for a period ranging from 3 to 40 seconds could have effected a drive state. If, however, we assume that it did, it would have to be posited that 5 and 65 repetitions produced greater levels of arousal than did 25 and 45 repetitions. From this argument, one would expect that the zero repetition control group's performance, reflecting its lower arousal, should be at a lower level than the 5 and 65 repetitions groups. This was not the case.

Of the positions that have been offered to explain semantic satiation (Amster, 1964), the attentional response interpretation seems most relevant. This interpretation has been advanced by Das (1968) and is based on the Russian work on the orienting reflex (OR) (Lynn, 1966; Sokolov, 1963). Appeal to the concept of the OR to explain these data seems inappropriate for two different reasons. First, the OR to conditioned or signal stimuli is very stable and highly resistant to extinction (Lynn, 1966). It is likely that good and, to a lesser degree, bell were signal stimuli (several children remarked that bell was a door-bell sound). Moreover, "a habituated stimulus can be made into a conditioned stimulus . . . simply by telling the subject to pay attention to it (Lynn, 1966, p. 30)." This action restores the OR. Precisely this was done but without the predicted results.

In addition, the invoking of the OR would be an inference from the same observed behavioral changes which the OR is assumed to influence (i.e., the lack of an independent measure of OR). Thus, the functional relationships are viewed as being able to stand on their own; a position that is similar to Gewirtz' (1969).

The results are partially supportive of Cairns' (1963, 1969) information hypothesis. Cairns (1969), focusing on the cue or signal properties of reinforcing events rather than on their incentive properties, maintains that if a stimulus has been dispensed in either an unreliable or redundant manner, then the effectiveness of that stimulus will be reduced. The present satiation operation involved the unreliable or non-discriminative provision of a stimulus. This operation, by shaping "inattention" to the stimulus events, rendered them less effective in the subsequent learning task. Presumably, the finding that the effect of the satiation treatment generalization would be subsumed under stimulus generalization. The Cairns position also predicts that the reinforcing effectiveness of a stimulus can be increased as a function of its provision in a reliable, nonredundant manner. His model, although not outwardly predicting the curvilinear nature of the present data, could handle the data if the subject is considered to be actively involved in attempting to structure incoming stimulation through formulation and evaluation of hypotheses. For example, post hoc speculation about the curvilinear relationship obtained for <u>good</u> might go like this: During the initial repetitions, the child listens attentively to the stimuli because the experimenter has instructed him to do so and because he is curious about the nature of the "game;" at the intermediate levels of repetition he interprets the stimuli as being irrelevant and the game not very much fun; finally at the upper level, he begins again to search for meaning in the stimuli because there have been so many repetitions they must have some salience. Future research should involve inquiry of the subjects to bear out these hunches.

Another plausible line of reasoning consistent with the information hypothesis is that the satiation operation shaped "inattention" to the experimenter--thus altering his effectiveness as a dispenser of cues (Barnhart, 1963). Thus, generalization occurred because of the salient similarity between the satiation manipulation and test situations (i.e., same room, same E, temporal proximity, etc.). Thus the present study has shown that alteration of the contextual milieu or setting events in which a stimulus is dispensed changes its effectiveness as a reinforcer. It remains for future research to determine what the critical feature(s) of the manipulation is (are).

The question of whether S is being satiated on the stimulus being dispensed and/or the dispensing agent is an important one that warrants future consideration. Indeed, a recent study (McArthur & Zigler, 1969) suggests that the change in valence of E may be the more important variable. Additional research is needed which places the deprivation-satiation operation orthogonal to the valence operation and examines the generalization to other stimuli.

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Table 1

Repeated Measures Analysis of Variance on Correct Responses During Learning

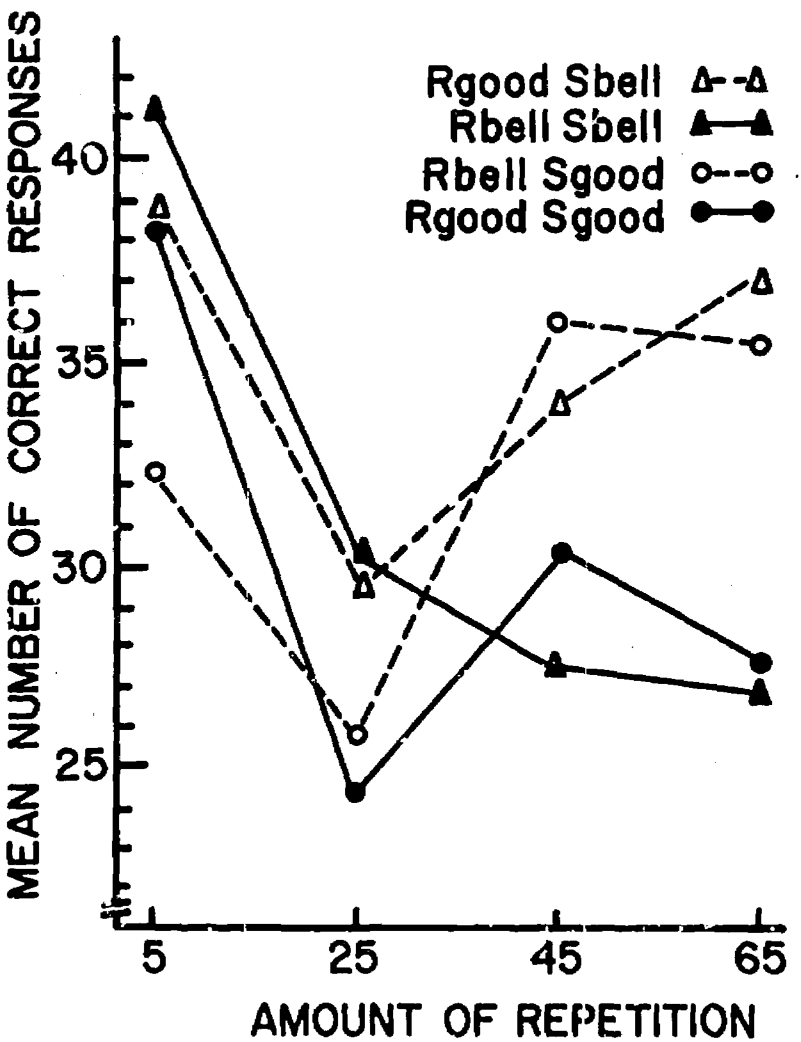
Source	*df*	*MS*	*F*
Between *S*	127		
Amount of repetition (A)	3	112.99	9.37**
Reinforcer (R)	1	22.88	1.90
Satiator (S)	1	1.50	<1
A x R	3	2.69	<1
A x S	3	19.37	1.60
R x S	1	46.76	3.88*
A x R x S	3	58.04	4.82**
Error (between)	112	12.04	
Within *Ss*	512		
Trials (T)	4	113.87	36.19**
T x A	12	2.86	<1
T x R	4	5.07	1.61
T x S	4	.40	<1
T x A x R	12	1.96	<1
T x A x S	12	4.58	1.46
T x R x S	4	2.90	<1
T x A x R x S	12	2.25	<1
Error (within)	448	3.15	

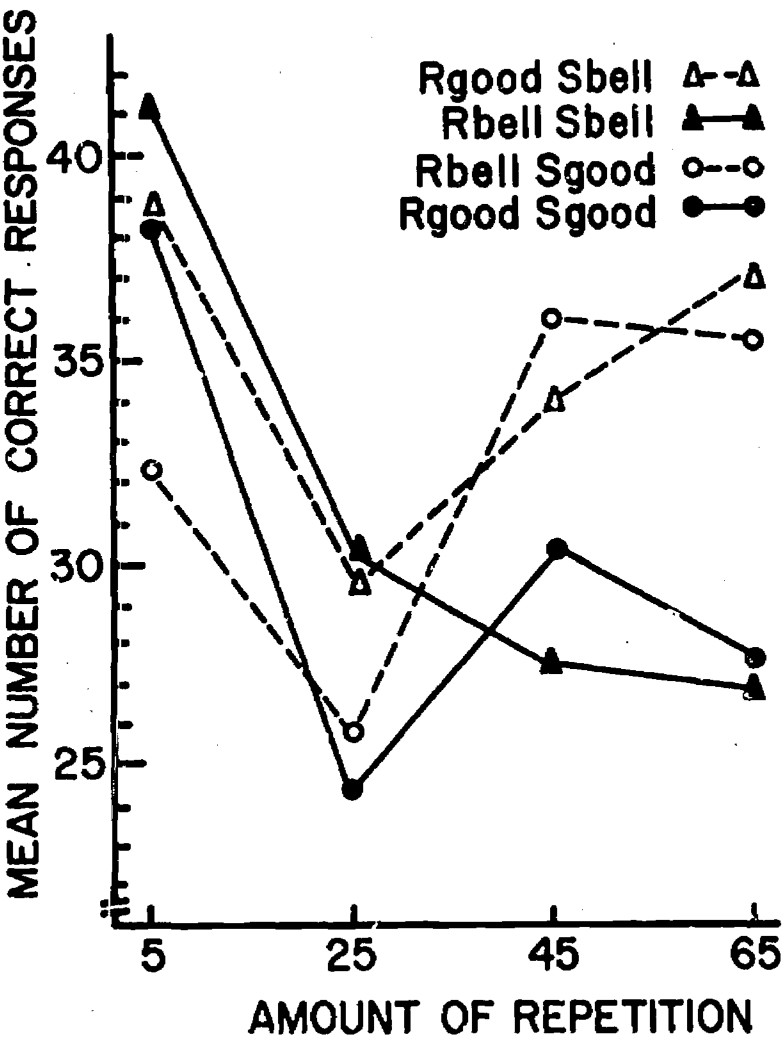
$^{**}p < .01$

$^{*}p < .05$

FIGURE CAPTION

Figure 1. Mean number of correct responses during learning as a function of amount of repetition for the four reinforcer-satiator combinations.


Rgood Sbell
Rbell Sbell
Rbell Sgood
Rgood Sgood
MEAN NUMBER OF CORRECT RESPONSES
40
35
30
25
5
25
45
65
AMOUNT OF REPETITION


MEAN NUMBER OF CORRECT RESPONSES
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