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The Effects of Reinforcement and Classroom Activity on Vocal Behavior

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THE EFFECTS OF
REINFORCEMENT AND CLASSROOM ACTIVITY
ON VOCAL BEHAVIOR

by

Eugene Ramp

A Thesis
Submitted to the
Faculty of the School of Graduate
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of the
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Eugene Ramp
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MEAN RESPONSE RATES AS A FUNCTION OF ACTIVITY
INTRODUCTION

This study was based, in part, on work done with animal non-vocal responses like the bar press in rats (e.g., Skinner, 1938) and the key peck in pigeons (Ferster and Skinner, 1957). Recently, a great deal of attention has been given to operant conditioning techniques, developed in the laboratory, for use in modifying human behavior (Krasner and Ullmann, 1965; Ullmann and Krasner, 1965; Ulrich, Stachnik and Mabry, 1966).

Social and non-social positive reinforcement have been found to be effective in producing beneficial changes in a large number of behaviors and in a variety of settings outside of the laboratory. In a classic study by Harris, Johnston, Kelly and Wolf (1964) conducted in a controlled environment, the crawling behavior of a child was replaced by more adaptive walking behavior. By the application of social reinforcement (attention) for upright behavior, and extinction (ignoring) of crawling behavior a four year old child was taught to walk. A reversal was conducted and crawling behavior returned. In another classic study Zimmerman and Zimmerman (1962) working in a special classroom setting, also offer evidence of the effects of social reinforcement for appropriate behavior and extinction of inappropriate behavior. By ignoring irrelevant verbal behavior and baby talk, and attending to more appropriate, incompatible behaviors, the inappropriate behavior was eliminated.

Although much research is currently being conducted under
relatively unstructured and flexible conditions, such as the experimental classroom, contemporary investigators are pressing for even more practical applications of reinforcement techniques. Hall, Lund, and Jackson (1968) investigated the effects of teacher attention on study behavior. The records for one first grade and five third grade pupils indicated that contingent teacher attention sharply increased the study rate. Candy and token reinforcement were found to be effective in a study by Quay, Werry, McQueen, and Sprague (1966) in improving a child's academic skills. An increase in the frequency of appropriate behaviors was noted in a study by Whelan and Haring (1966), when these behaviors were followed by food and praise. Similarly, a decrease in these behaviors was found to follow the termination of reinforcement. These authors also emphasize the necessity of applying modification techniques to problem behaviors in public school classrooms. Ideally, techniques that are useful in the special classroom should be applicable in the regular classroom.

Hawkins, McArthur, Rinaldi, Gray, and Schaftenaar (1967), working in both special and regular classroom settings, employed tokens, candy, and social reinforcement to produce appropriate classroom behaviors. Combined with a mild punisher (temporary isolation) these techniques were able to improve five academic behaviors important to the pupils' future success. In an attempt to help classroom teachers understand why certain procedures may be preferred over others, Madsen, et.al. (1968) investigated the
reinforcing function of "sit down" commands. It was found that these commands functioned as reinforcers and actually increased the rate of children standing up. Eventually, out of seat behavior was reduced by praising sitting and working and ignoring standing. Another group of studies conducted in elementary classrooms (Becker, et.al., 1967) reported how the selective use of teacher attention and praise was very effective in managing behavior problems. Schmidt and Ulrich (1968) reduced the noise level in a disruptive public school classroom by making the students' recreation time contingent upon very low classroom noise levels. Using a delayed reinforcement technique, Schwarz (1968) was successful in modifying the deviant behaviors of a maladjusted child in a regular classroom. The child was shown a videotape recording of her behavior during school and reinforced for desirable behaviors with token rewards.

The systematic application of reinforcement principles has been found to be effective in a number of settings, not commonly associated with research. In a study by Arnett and Ulrich (1968) reinforcement techniques were employed within a home setting in order to analyze their effects upon the task performance of a five year old girl. Correct performance was reinforced by a token, exchangeable for candy or cookies. By means of a limited hold contingency, the latency for performing each task was decreased substantially from its baseline (i.e., no reinforcement) level. And, in an experimental nursery school setting, Ulrich and Hunt (1968), using baby food as a reinforcer at mealtimes, were able
to shape verbal imitation in a six-month old infant.

In a university setting Verplanck (1955) reported that psychology students trained in operant conditioning principles, acting as experimenters, were very effective in controlling the casual conversation of others. By the use of such techniques as reinforcement (agreeing with the S) and extinction (disagreeing with or not responding to the S) the student E's were able to modify casual conversation in a free operant situation. Azrin, Holz, Ulrich, and Goldiamond (1962) had difficulty in replicating Verplanck's study. These investigators found that the results obtained by the student E's was a function of what they had been told to expect. Given no indication of what to expect, Ulrich (1962) established that the student E's obtained results which were, at best, due to chance. Although many investigators have applied operant conditioning techniques to the study of verbal behavior (also see Krassner, 1958; Salzinger, 1959; Greenspoon, 1962), most of them have dealt with verbally fluent adults. Some exceptions are a series of studies by Flanagan, Goldiamond, and Azrin (1958, 1959), who produced stuttering in normally fluent subjects, and relative fluency in stutterers.

Most research in the area of human verbal behavior has concerned itself with the quantitative aspects of a particular subclass of verbal behavior (e.g., increasing the frequency of plural nouns in a conversation; Greenspoon, 1962; modifying statements of opinion; Verplanck, 1955; etc.). The present study investigated
a procedure to increase the rate of all verbal responses in a non-verbal male child.
METHOD

Subject

The subject (S) was a third grade boy, eight years old at the beginning of the experiment. He had no apparent organic disorders.

The vocal classroom behavior of the S was brought to the attention of the experimenter (E) by the boy's teacher. According to the teacher, his major trouble was a speech problem, for which he was undergoing regular speech therapy. Vocal behavior in the classroom (when it occurred) was unintelligible. Social workers and counselors had diagnosed the S as regressed and withdrawn. According to his teacher the S would not respond in class. When asked a direct question, he would either shake his head, indicating he did not know the answer, or, if pressed for a response, would answer with just one word. His teacher believed that, due to the speech problem, he would not take part in class because he was afraid that he would be ridiculed by others; and, for this reason, he was failing the third grade.

The experimenter, seated in the classroom as an observer, found that in no instance was the S ever ridiculed for the way in which he spoke. In fact, just the opposite was true. On the rare occasions in which the S did speak to someone, the person spoken to would almost always ignore him.

One possible explanation for the students ignoring the S might
be that the other students did not understand the S, or that it was very difficult to carry on a conversation with him. By not responding, the other children may simply have been avoiding an unpleasant situation. Even the teacher was performing a similar operation. In attempting not to draw undue attention to the S when he did answer a question, the teacher appeared to move on to the next person as quickly as possible, responding minimally to the S.

At the start of this experiment the classroom teacher was not certain that she had ever heard the S say anything -- at least anything she could understand. The speech therapist working with the S had occasionally sent him back to the classroom before she normally would have finished his session. The therapist typically had four or five students at one time, and whenever she singled the S out for individual treatment, he would not answer her questions or speak to her. The therapist had told the E that there might be some hope for the S if he would only say something. As the therapist put it, "You can't correct something that doesn't exist." Thus the goal of the present experiment was to increase the S's overall rate of vocal behavior.

Apparatus

The study was conducted in a third grade, public school classroom. The room measured 27' x 27', with desks for 31 pupils and one teacher. Two desk counters and a stopwatch were used throughout the study for collecting data. A Gerbrand "event recorder" was
employed during the first two sessions of Experimental I in order to facilitate data collection. Its use was discontinued when it became apparent that the electrical device presented more problems than a simple desk counter.

Procedure

In all phases of the experiment, session length was exactly one hour, and was conducted during the same one hour period each school day. With the teacher's cooperation, classroom activity during this period of time was to be held as constant as possible. For a number of reasons classroom activity during the first three phases could not be held constant. The maximum number of activities taught during the sessions totalled four: (1) Science (four or five times a week), (2) Spelling (twice a week), (3) Art (once or twice a week), and (4) Reading aloud (five times a week). Therefore, the first thirty four sessions of this experiment were carried out within these limits. Throughout the study the E was seated in the classroom, about three feet from the S with an unobstructed view of him.

Due to the subjective quality of what constitutes a single vocal response, data were collected in ten second blocks. The onset of a vocal response designated the beginning of a ten second block. The first vocalization following the termination of this ten second block was recorded as the next response, and so on for each session. A response occurring within any ten second block was

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recorded as one response, whether its duration was one second or
ten. If a response occurred in excess of ten seconds, it was re-
corded as more than one response. The experimental procedure is
shown in Figure 1.

Vocalizations in this study were defined as any audible (to
E) vocal sound emanating from the S except coughing or sneezing.
Due to the nature of his speech problem, the "meaningfulness" of
a response could not always be determined, and therefore, was not
included in the criterion for a response. Vocal responses were
divided into two classes: one will be referred to as a "student
response", the other a "teacher response."

Student responses (SRs)

This class of responses consisted of vocalizations directed
at another student. For example, if the S spoke to a student sit-
ting beside him, behind him, in front of him, etc., or if he walked
up to another student and said something to him, these were recorded
as SRs.

Teacher responses (TRs)

Vocalizations directed toward the teacher, or toward the class
as a whole were recorded as TRs. Some examples of this would be
asking the teacher a question, telling her something, or reading
aloud to the class.

The experiment was carried out in four phases: (1) the baseline
phase, (2) experimental phase one, (3) reversal phase, and (4) experimental phase two.

**Baseline**

Before reinforcement procedures were initiated, an objective record was obtained of the frequency with which the S engaged in vocal behavior (SRs and TRs were recorded). Classroom conditions during the Baseline phase were exactly as they were prior to this time, except that the S's vocal behavior was now being recorded.

**Experimental I**

After ten sessions of the Baseline data were secured, reinforcement procedures began. Two classes of reinforcement were used in this phase: social reinforcement, such as praise from the teacher, and non-social positive reinforcement which consisted of candy and tokens.

It should be noted that the classroom was on a token system. That is, the teacher rewarded students with a token for such things as turning in work on time, having a clean desk, and hanging their coats up properly. With these tokens, students could purchase 15 minutes of gym time (25 tokens), classroom privileges (15 tokens), and a number of other rewards. A chart was on the wall at all times indicating the number of tokens necessary to purchase particular privileges.

Although the classroom teacher had indicated that she would
like the $ to speak to anyone at anytime, she also suggested that
in terms of his future academic success it might be in his best
interest if he were to speak mainly to her or to the class rather
than to individual students during class. For this reason a dif­
ferential reinforcement procedure was instituted for the two re­
response classes; TRs were given much "richer" reinforcement than were
SRs.

In order to preclude the possible satiation effect of any one
reinforcer (see Bijou and Baer, 1966) various combinations of the
three were used. Social reinforcement for SRs was administered
intermittently by the classroom teacher. Because the teacher could
not attend to the $ at all times, this reinforcement was, of neces­
sity, intermittent. Responses to the teacher were reinforced every
time they occurred.

Non-social reinforcement for SRs consisted of Es delivering
one M&M upon the occurrence of each response for the first ten re­
sponses, followed on the eleventh response by the delivery of one
token. For TRs reinforcement was exactly double that received for
SRs. (i.e., two pieces of candy for the first ten TRs, followed
on the eleventh by two tokens.) If, for example, the $ made eleven
SRs, he would have received ten M&Ms and one token. If he made
eleven TRs, he would have received twenty M&Ms and two tokens.

This procedure was altered at session 19 because of a large
variability in response rate during the first eight sessions of
this phase. At this point SRs procured one candy reinforcer for
the first response, one token for the second, one candy again on
the third response, a token for the fourth, and so on for the re-
main ing sessions in this phase. One piece of candy and one token
were now delivered for each TR.

Reversal

During this phase all programmed reinforcement was discontinued.
As in the Baseline an objective record of the S's vocal behavior
was obtained.

Experimental II

In order to determine any possible differential effect of a
particular reinforcer, this phase of the experiment was carried out
in three parts. The independent variable in part one was token
reinforcement only, in part two candy reinforcement only, and in
part three it consisted of social reinforcement only. In order to
avoid social reinforcement for TRs during the first two parts of
this phase, the classroom teacher was instructed to respond to the
S only when asked a direct question by him; and then to respond only
to the question asked — having as little contact as possible with
him. During part three the teacher delivered social reinforcement
on the basis of a cue from the E.

In order to further enhance the probability of teacher responses
a single classroom activity (reading social studies) was used through-
out this phase. Although this activity did not present as much op-
portunity for SRs, responses to the teacher and the class were much
more likely to occur.

Quantitatively, the reinforcement procedure was identical in all three parts. Every third SR procured one reinforcement (three responses = one reinforcement); and a TR was reinforced every time it occurred (one response = one reinforcement).
RESULTS

Figure 2 shows an increased rate of vocal behavior toward the teacher (above) and toward peers (below) as a function of three consequences presented together (Experimental Phase I) or separately (Experimental Phase II). Each graph depicts the percentage of possible ten second intervals in which the vocal behavior occurred. The mean for each phase is indicated by a dashed line.

Although classroom activities varied somewhat, they were essentially the same during the Baseline as they were in Experimental I; however, the Baseline vocal behavior was relatively stable and, it should be noted, almost at zero. Data obtained for one session of the Baseline -- not included in Figure 2 because the activity during that session in no way conformed to any classroom or academic activity -- presented a noteworthy exception. This particular day was the S's birthday -- he was nine years old. The teacher allowed the S to bring his birthday gifts to school and had given the class free time to celebrate the occasion. On this day the S was the center of attention. Several students, and groups of students, actually asked the S to join them and everyone was playing with his toys and talking to him. The teacher response rate remained at zero but student responses during this session increased to 12.7 per cent -- well within the range of some experimental sessions. From these data it would appear that social reinforcement from peers is also a very effective reinforcer.
It can also be seen in Figure 2 that the mean response rate (dashed lines) increased for both TRs and SRs from the Baseline to Experimental Phase I. Responses made to the teacher increased from a mean of 0.23 per cent in the Baseline to a mean of 3.0 per cent in Experimental I (an increase of 1304 per cent); whereas SRs increased from a mean of 2.4 per cent in the Baseline to a mean of 19.4 per cent in Experimental I (an increase of 808 per cent). The drop in responding from Experimental I to the Reversal Phase is not as dramatic. For TRs there was a drop from 3.0 per cent to 0.9 per cent; for SRs the rate decreased from 19.4 per cent to 6.2 per cent.

For various reasons classroom activity during the first three phases could not be held constant. The lower case letters in Figure 2 may offer some assistance in assessing various activity effects on vocalization. The total number of activities taught in the afternoon were four: (1) Science, (2) Spelling, (3) Art, and (4) Reading aloud. All of the activities in Experimental I may be found in both the Baseline and Reversal Phases as well. The only possible exception may be data points "a" (session 6) when the class was playing a spelling "game." This was not like other spelling sessions in that the students could talk among themselves and yell out words which could be found in a single word, "Thanksgiving." During session 14 (data points "b" in Figure 2) the entire class was engaged in doing individual art projects. These projects involved sharing materials and ideas with one another, as well as the occasional necessity of asking the teacher for something. Throughout
most of session 18 "c" the class was reading their Weekly Readers. This activity provided only a small chance for individual communication because students must follow along with the oral reading. There was also a test on the reading given near the end of this one hour session. It was found that in all but one of the data points appearing above the Experimental I mean, the classroom activity was either art or some other relatively unrestricted activity. Data points "d" and "e" both involved groups of students working together on science projects. The last data points "f" in this phase and in the Reversal Phase (sessions 24, 26, and 28) are especially interesting for it was the same activity (reading social studies) that was maintained throughout Experimental II. It should be recalled that the average rate of responses to the teacher in Experimental II was 83 per cent greater than in Experimental I, and the reverse was true for responses made to a student. For most of the points where this activity occurred there is an increase in TRs and a decrease in SRs.

The final phase of this study employed two changes in the procedure different from the first three phases: (1) it will be recalled that this phase was carried out in three parts. Part one employed only tokens as a reinforcement, candy was the only reinforcement used in part two, and reinforcement in part three consisted of praise and attention. In no instance did any one kind of reinforcement show a much greater or lesser effect than another. The response to tokens was only slightly higher than it was to
candy and praise, and there was virtually no differential effect between candy and praise.

(2) Throughout the first three phases of the study it was observed that certain classroom activities yielded differential rates of responding to the teacher and to a student. From these observations a classroom activity (reading social studies) which would yield a higher TR rate and a lower SR rate was strictly maintained throughout this phase of the experiment. There was an increase in TRs of 83 per cent over the previous experimental phase and a decrease in percentage for SRs. As shown in Table 1, controlling the classroom activity and limiting it to one (reading social studies) yielded a marked change in vocal responding. The rate in Experimental II, as compared to Experimental I, decreased by 8.2 (or 43 per cent) for SRs, and it increased by 2.5 (or 83 per cent) for TRs. The mean (X) per cent SRs (11.2) for Experimental II represent the sum of the mean percentage of responses made in the token phase (12.5), plus the mean percentage of responses in the candy phase (10.3), plus the mean percentage of responses in the social phase (10.8), all of this was divided by three. The mean (X) per cent TRs (5.5) in Experimental II represent the same procedure as for SRs, but the mean for tokens was 6.1, for candy 5.1, and for social reinforcement 5.2.

Two reliability checks were taken, one at session 34 and the other two days after the study had been terminated. A second observer was brought into the classroom to independently record the
S's vocal responses to the teacher and to a student. The number of vocal responses for each class of responses (TRs and SRs) obtained by one observer was divided by the number of vocal responses obtained by the other observer. The percent agreement for each response class on both days yielded an index of reliability equal to 100 percent. Not to overemphasize this perfect agreement obtained on both sessions, it should be noted that data would not be as reliable if reliability checks were conducted during reinforcement phases because delivery of a reinforcer would be an erroneous cue that a response had occurred. For this reason these data were collected during the Reversal Phase and at the termination of the study, when the response rate was low, and separated over time.

Responses made to the teacher were almost always preceded by the S raising his hand. The only exception to this was when the teacher asked questions of one student after another, eventually calling on the entire class; but this was rarely done. According to the teacher the S had never raised his hand for anything — not even lavatory privileges. During the Baseline he did not raise his hand. The only TRs recorded above zero were instances in which the S responded to a question from the teacher. He began raising his hand early in Experimental II, and it gradually increased throughout this phase. When reinforcement was terminated in the Reversal Phase, hand-raising dropped to almost zero. It was during Experimental II that hand-raising reached its highest rate. Virtually every TR made in this phase was preceded by a hand-raise. The
$\text{S} \text{ was now raising his hand more than the best students in class.}$

Whenever the S raised his hand, it was usually to read aloud from his social studies book and often he would ask permission to read an extra one or two paragraphs.
DISCUSSION

The results clearly demonstrate the effectiveness of making reinforcement (tokens, candy, etc.) contingent upon the occurrence of some behavior (in this study a vocal response). The Baseline rate of vocal behavior was increased by more than 1300 per cent for TRs and more than 800 per cent for SRs when these behaviors were followed by reinforcement. There was no difference in the frequency of vocal responses with respect to a particular reinforcer. Classroom activity, on the other hand, was found to produce important changes in the rate of vocal behavior.

The classroom teacher had agreed to maintain the same, or very similar activities throughout every session; however, it was noted early in the study that classroom activity was likely to change drastically from one session to another. When questioned about this, the teacher said that it was not feasible for her to pursue the same activity for an entire hour, for the length of time this study would take. Furthermore there was a maximum of one hour and forty five minutes of class time in the afternoon. Two days a week one half hour of this time was spent in the gym. It was at this time that the teacher agreed to have a controlled activity throughout each session sometime during the second semester. It was also agreed that this period not exceed three weeks (or fifteen sessions) -- this is the time during which Experimental II was carried out.

The results indicate that the S benefited substantially from
this application of reinforcement techniques. Not only was the rate of vocalizations increased, but this increase in vocal behavior seemed to produce a number of other beneficial side effects. For example, the techniques employed were effective in increasing the S's contact with his environment. At the conclusion of this behavior treatment, the S was presenting projects to the class. Without reinforcement the S presented two science projects and one sketch to the entire class and the teacher within one week. According to his teacher the S is participating in class more than the average student, and at the present time he and another student are spending their noon hours working on a science project to present at the local science fair.\(^1\) Though reinforcement was never dependent upon academic performance, S's grades have improved a great deal. Before the study began, the S was receiving almost all "E's." For some time now he has received mostly "A's" and "B's" with very few "D's" or "E's." The exact grades could not be obtained.

In addition the speech therapist has stated that the S not only speaks a great deal in their sessions now, but that his "poor" speech is becoming less and less a problem. The therapist now has no trouble understanding the S and occasionally has to ask him to wait his turn before speaking. The S's teacher also stated that she has no difficulty understanding what he says in class, and that

\(^1\)Since the writing of this paper the science fair has been concluded and the project won second place out of almost fifty entries.
the class appears to have no trouble conversing with him. One third grade student even came over to the E one day and said, "You know, I can understand (S) now."

The dramatic change in the S's vocal behavior brought the speech therapist to the E with questions concerning other similar cases that she was working with at the time. The therapist indicated that, due to the nature of speech problems in general, there is a tendency in most clients to respond as little as possible. According to the therapist the S was a classic example of this tendency and she desired to know as much as possible about treating similar conditions. She has since employed some systematic reinforcement principles in dealing with a few of her clients with what she described to the E as very successful results.

Public school classrooms may not always provide ideal experimental conditions but they do provide vast areas for future applied research. As this study has shown, reinforcement procedures can succeed not only in the laboratory but also in a general classroom situation. A number of teachers at the school where this study was conducted have indicated that one of the primary problems in educating students is the lack of feedback they (the teachers) receive from their students. It also appears from observations in the classroom and outside the classroom that an individual's future success in many areas depends heavily on the ability to verbalize and to communicate.
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