RATIO REINFORCEMENT OF THE SUPERSTITIOUS
MAND IN VERBAL BEHAVIOR

DISSERTATION

Presented in Partial Fulfillment of the Requirements
for the Degree Doctor of Philosophy in the
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By

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Although language is one of the most uniquely human forms of behavior, until recently few psychologists have concerned themselves empirically with this form of behavior. Many psychologists have used the verbal response as a dependent variable (e.g., nonsense syllables, paired associates, poetry) in the same manner that alphabet printing or the pursuit rotor have been used.

Few people have been engaged in the study of verbal behavior per se. Those who have, for the most part, have adopted the classical philosophical position that any verbal response is merely an expression of the "idea" or "image" that constitutes reality and that the idea is contained somewhere in the mind of the speaker (Osgood 1953; Skinner 1957).

Thus, words are said to "convey ideas" (Osgood 1953, p.680) and the occurrence of the words themselves is regarded as an unimportant detail in the complex process of "communication." It has been argued that since we may write or say orally "the same ideas," that these two forms of response spring from the same inner source. Most usually, even in the scientific literature, this inner source is the speaker's "mind"; although some writers do identify "mind" as a construct rather than an entity.
Many of those who have concerned themselves with "speech," "language," "communication," and "information," have attempted to account for the origin of language (Osgood 1953 Ch. 17). Unfortunately, after reading much of this material, it seems clear that in 1959 we are not likely to discover the origin of language.

It is a justifiable course of action, then, to attempt a functional analysis of verbal behavior. This point of view is more completely treated in Skinner's publication of the William James Lectures (Verbal Behavior, 1957). In this book Skinner has abandoned the classical approach to language and has attempted to set up a framework for pursuing a functional analysis of verbal behavior. The present experiments are concerned with one part of this analysis, a form of verbal operant called the "superstitious mand." Before outlining the rationale of the present experiments, a brief outline of one part of Skinner's system is necessary.

In Verbal Behavior, the importance of including both a "speaker" and a "listener" in an account of verbal behavior was stressed. It was argued that much of the time, a listener is simultaneously behaving as a speaker.

That the behavior of the listener has a reinforcing effect on the behavior of the speaker can readily be seen, intuitively, by comparing the frequency of one's own verbal responses in the absence of, and in the presence of, listeners. We spend little time talking to unoccupied spaces compared with the time spent talking when other
verbal or even non-verbal organisms are present.

A verbal organism can reinforce the behavior of a speaker by so simple a process as uttering "uhm-hmm" after the occurrence of the appropriate response (Greenspoon, 1951). To understand how inanimate objects gain control over the verbal behavior of the speaker is more difficult.

First, however, it is necessary to define some terms.

The term "mand" has a certain mnemonic value derived from "command," "demand," "countermand," and so on, and is conveniently brief. A "mand," then, may be defined as a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation.

A mand is characterized by the unique relationship between the form of the response and the reinforcement characteristically received in a given verbal community. It is sometimes convenient to refer to this relation by saying that a mand "specifies" its reinforcement (Skinner, 1957).

There are different kinds of mands. Some are under the stimulus control of other verbal organisms, others are under the control of inanimate objects. One instance in which inanimate objects can serve as discriminative stimuli \( S^D \)'s for the occurrence of verbal behavior arises when an organism makes an "extended mand." Such responses are exemplified by saying "stop" to a ball rolling toward the street, since we have, in the past, been reinforced by saying "stop" in other situations similar,
by the process of generalization, to the one in question.

"Stop that noise!" "Will you please stop!"

A specific class of extended mand is the "superstitious mand." These differ from extended mands in that responses of this form have not been reinforced systematically at other times. Superstitious mands are apparently maintained by chance occurrence of reinforcement (Skinner, 1957).

It is the purpose of these experiments to discover some of the variables of which the superstitious mand is a function. It is reasonable to suggest that an inanimate "listener" could gain some control of the verbal behavior of the speaker. This might occur if the speaker were reinforced according to some effective schedule. Operant levels of various verbal responses classified as superstitious mands could then be altered.

Greenspoon (1951) has shown that verbal behavior can be effectively manipulated by a listener even if the speaker does not correctly report the relationship between his verbal behavior and the behavior of the listener. By uttering "uhm-hum" following plural nouns emitted by the S, he increased the frequency of occurrence of plural nouns in a free operant situation. By using lights, tones, etc., as well as other verbal and mechanical stimuli, other experimenters have effectively changed the frequencies of different responses in verbal conditioning situations (Fattu and Mech, 1955; Cohen, Kalish, Thurston, and Cohen, 1954; Buss, Braden, Orgen,
and Buss, 1956; Buss and Buss, 1956; Mandler and Kaplan, 1956).

If it is possible to manipulate the verbal behavior of subjects by the use of inanimate objects over which the Ss have no control, and these changes are systematic, then evidence for the operation of superstitious mand would be at hand. Such a situation is conveniently provided by the relatively simple task of tossing dice. It is possible to specify a variable ratio schedule of reinforcement for any of eleven separate verbal operants. If one uses "fair" dice, there is truly a "random" ratio of reinforcement to non-reinforcement.

Another good reason for the use of dice is that they allow a large number of responses in a short period of time. It is possible to change the schedule of reinforcement simply by changing dice. By removing some numbers from the faces of the dice, some combinations of these faces are eliminated, thus providing a method for studying extinction. It is also possible to make a pair of dice that will give each possible number an equal chance of occurring.

In this experiment, reinforcement is defined as the occurrence of the number on the dice that was said by the subject prior to tossing the dice.

An effective way of changing the schedule quickly is to use several pairs of dice. By changing schedules it should be possible to study some of the variables of which the superstitious mand is a function.
It is a reasonable assumption that a subject will say those numbers most that he is most frequently reinforced for saying, and say those numbers least that he is least often reinforced for saying. If a number is never thrown after a person has had several reinforcements on that number, there should be a systematic decrease in the occurrence of the response, in such a way as to resemble the typical extinction curve.
METHOD

Subjects: The Ss were 155 freshman girl volunteers from general psychology classes at the Ohio State University. They were assigned to the various groups systematically, but without bias. The restriction required one subject in each group before any group had two subjects, and so forth.

Materials: The materials consisted of five pairs of dice, re-spotted to give the desired probabilities of reinforcement. One pair was "fair" and presented the empirical probabilities in Table 3. A second pair had one fair die, the second die having fives on all six faces. This so restricted the range that they threw only 6-7-8-9-10-11, each with equal probability. The third pair consisted of one fair die, and one whose faces were all twos. This pair threw only 3-4-5-6-7-8, each with equal probability. The fourth pair of dice had the numbers 1, 3, 5 on the faces, each number appearing twice. This pair gave the theoretical probabilities in Table 3. The fifth pair had numbers 2, 4, 6 with each number appearing twice. These probabilities are also contained in Table 3.

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Purchased from T.R. King and Company, Los Angeles, California.
Procedure

Experiment I

When S came into the experimental cubicle, she was seated, facing a blank wall, and read the following instructions:

During the first part of this experiment, begin saying numbers between one and thirteen, but not including either one or thirteen.

Then she was told to begin saying numbers. After fifty numbers, she was told to stop and then she was read the following instructions:

This is an experiment in extra-sensory perception, or more specifically in psycho-kinesis. Psycho-kinesis is the study of the phenomenon of 'mind over matter.' At other universities it has been found that some people are able to exert some kind of control over supposedly random events. We are interested in finding out if there are any such people here, and if they are really able to influence what goes on around them.

Here are your instructions:

Take the dice and the cup. Hold the cup in your preferred hand, shake up the dice, and toss them against the wall so that they will bounce on the table. (E demonstrates.) Each time before throwing the dice, do everything in your power to concentrate on some number that you wish to throw. Then, call out that number so that I can record it. After the experiment begins, you are to say nothing except the number that you wish to come up. Do not call out the number that you actually throw. (For group III experiment II, Ss were told to call out the number they actually threw.) Are there any questions?
After this, S was permitted to ask any questions that she wished. Then she was told, "When you are ready, you may begin. Go as fast as you can go, comfortably, but do not work too hard." S then tossed the dice against a wall 200 times, after which E re-read the first set of instructions. S was then asked to say fifty more "random" numbers. Before S began the second set of random numbers she was asked to hand the dice and cup to E. While S was saying the 50 random numbers, E made the dice changes indicated in Table 1. In groups 5 F-0, 2 F-0, and 2 F-W, E then told S that the dice had been changed and that they would not throw any number less than 2 nor greater than 12. These instructions were also given to Ss in other groups, where appropriate, prior to tossing the dice the first time. Ss in the E-F and O-F groups were not informed of the change, and only 3 of the Ss in these groups mentioned that they "thought" the dice had been changed. Upon questioning, it was learned that these 3 Ss had not made this discovery until very late in the experiment. Since the data analysis does not include this part of the experiment, data for these Ss were not discarded.

After condition II, S was again read the instructions dealing with the "random" numbers and instructed to begin calling out these numbers. After a third set of fifty "random" numbers, S was dismissed.
The part of the experiment including Test 1, Condition I, and Test 2, is a retroactive inhibition design of the models Test A Learn B Test A. The data analysis treats this condition, conceptually, as such a design.

Table 1

Experimental Design for Experiment I

<table>
<thead>
<tr>
<th>Group</th>
<th>Operant Test 1</th>
<th>Condition I</th>
<th>Operant Test 2</th>
<th>Condition III</th>
<th>Operant Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>5FO</td>
<td>50 oral numbers 200 trials; 5-F dice</td>
<td>50 oral numbers 100 trials; fair dice</td>
<td>50 oral numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2FO</td>
<td>50 oral numbers 200 trials; 2-F dice</td>
<td>50 oral numbers 100 trials; fair dice</td>
<td>50 oral numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2FW</td>
<td>50 written numbers 200 trials; 2-F dice</td>
<td>50 written numbers 100 trials; fair dice</td>
<td>50 written numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-F</td>
<td>50 oral numbers 200 trials; 1-3-5 dice</td>
<td>50 oral numbers 100 trials; fair dice</td>
<td>50 oral numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-F</td>
<td>50 oral numbers 200 trials; 2-4-6 dice</td>
<td>50 oral numbers 100 trials; fair dice</td>
<td>50 oral numbers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 These dice throw only 6-7-8-9-10-11
2 These dice throw only 3-4-5-6-7-8
3 These dice throw only 2-4-6-8-10
4 These dice throw only 4-6-8-10-12
Summary of Hypotheses:

1. Group 1 F-0 will differ significantly from the population value of dice-guesses. (The interval estimate will not contain the population mean.)

2. Group 2 F-0 random number operants will not be significantly different from Group 2 F-W random number operants at Test 1, Test 2, or Test 3.

3. Group E-F random number operants will have significantly higher mean values than Group O-F random number operants at Test 2, but will not differ either at Test 1, or Test 3.

Experiment II

Procedures in this part of the experiment duplicated those in Experiment I with two exceptions: (1) random number guesses were omitted, (i.e. there was no predetermination of operant level), and, (2) no S was informed that the dice had been switched during her absence from the room.

Since there was no convenient point during the experiment to make the dice-change, S was asked to leave the room and take a break for a couple of minutes. She was given directions to the water fountain and every S availed herself of water. While S was leaving, E pretended to be adding up Ss score. No S indicated that she thought this procedure was unusual, nor did any S indicate during the course of the experiment that she suspected the dice had
been changed.

Some Ss were not competent adders. In many cases S reported one number when the numbers on the faces of the dice added to a different sum. In such cases, the number that S called was recorded rather than the actual number.

Table 2

Experimental Design for Experiment II

<table>
<thead>
<tr>
<th>Group</th>
<th>Condition I</th>
<th>Condition II</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>200 trials with fair dice</td>
<td>100 trials with 1-3-5 dice</td>
</tr>
<tr>
<td>II</td>
<td>200 trials with fair dice</td>
<td>100 trials with 2-4-6 dice</td>
</tr>
<tr>
<td>III</td>
<td>200 trials with fair dice, actual tosses said orally</td>
<td>100 trials with fair dice, actual tosses not said orally</td>
</tr>
<tr>
<td>IV</td>
<td>200 trials with fair dice</td>
<td>100 trials with fair dice</td>
</tr>
</tbody>
</table>

1 These dice throw only 2-4-6-8-10.

2 These dice throw only 4-6-8-10-12.

Hypotheses:

1. Group II will have a significantly higher mean score during trials 201-250 than group I.

2. Group III interval estimates of the population mean for actual tosses will contain this mean sooner than will Group IV interval estimates. Starting with trials 1-50. (That is, group III
will learn faster since they are required to "attend" to the re-inforcing stimulus.)

3. For group I, during condition II, numbers 3-5-7-9-11-12 will be guessed significantly fewer times than numbers 2-4-6-8-10.

4. For group II, during condition II, numbers 2-3-5-7-9-11 will be guessed significantly fewer times than 4-6-8-10-12.

Hypotheses 3 and 4 literally mean fewer times, even though in both cases there are more numbers in the series hypothesized to have a lower frequency. These predictions say that extinction will occur on numbers for which there are no reinforcements, since after trial 200, S cannot be reinforced when guessing any odd number and one even number not thrown by the dice.
Hypothesis I predicted that for group 5-Fair-Oral (5 F-O) the population mean value of actual dice-tosses would not be contained in interval estimates of that population mean at any time during the experiment; tests being made over each block of 50 trials. This hypothesis was not confirmed since the population mean of 6.997 was contained in each of the interval estimates.

Hypothesis II predicted that the random number operants for group 2-Fair-Oral (2 F-O) would not differ significantly from the random number operants of group 2-Fair-Written (2 F-W) at any time during the experiment. During Test 1, prior to differential treatment, there was no reliable difference in the mean values, ($t = 1.13, df = 28, NS$), a finding which indicates these groups may be compared.

If the independent variable affects these groups differentially, it should be observable after 200 tosses of the dice. During Test 2, after 200 tosses, the difference between these two groups was reliable, ($t = 2.77, df = 28, p < .05$). This result suggests that direct comparisons between oral and written operants of the form used in this study should not be made, and cannot be considered as equal.

The third hypothesis predicted that the mean of the random number operants for group Even-Fair (E-F) would be reliably higher
than the mean for the random number operants for group Odd-Fair (O-F). Again, t-tests were computed for all three test periods in an attempt to locate differences existing prior to the beginning of the experiment. The t-test for the comparison during Test 1 was not significant, (t = .619). The t-test of the main hypothesis was computed for Test 2 of the experiment and the value obtained permitted retention of the hypothesis, the difference being in the predicted direction, (t = 2.236, df = 28, p < .05).

A third t-test was computed to test the difference after condition II of the experiment. The t-value for Test 3 was not significant, (t = .612).

Thus, it seems to be relatively easy to modify the verbal operants used in this experiment by the method used, and it also seems to be just about as easy to eliminate the differences once they have been established.

The random number operants of groups O-F and E-F were studied further, and, by a "correction-for-bias" technique, were plotted in figures 1 and 2. It can be seen that the Ss did not guess the odd numbers as frequently as they guessed the even numbers. This result was predicted since a certain amount of extinction is expected following 200 non-reinforced trials.

The bias correction data is presented in table 3 and was computed by subtracting the pre-experiment (Test 1) operant level
figures from the operant level figures obtained during Test 2. This factor (Operant level) was subtracted from each of the eleven numbers, and the results plotted so that a "0" score indicates no measurable change in the operant from Test 1 to Test 2.

The figures present evidence that S discriminated between even and odd numbers. All numbers that can be thrown by the dice fall above the "0" line, while all but one of the numbers that cannot be thrown by the dice fall below the line. The one reversal, that of number 3 in the O-F group, cannot be accounted for and must be treated simply as error.

Figure 3 shows the operant level for each number prior to Condition I of the experiment. Figure 3 shows the operant level of the 15 Ss who were required to write their guesses on paper, and are group 2F-W in the analysis. These data are presented also in table 4.
<table>
<thead>
<tr>
<th>Number</th>
<th>Fair&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Fair&lt;sup&gt;2&lt;/sup&gt;</th>
<th>1-3-5*</th>
<th>2-4-6*</th>
<th>5F*</th>
<th>2F*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>.028</td>
<td>.031</td>
<td>.111</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>.055</td>
<td>.053</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.167</td>
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<td>4</td>
<td>.083</td>
<td>.087</td>
<td>.222</td>
<td>.111</td>
<td>-</td>
<td>.167</td>
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<td>5</td>
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<td>.110</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.167</td>
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<td>-</td>
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<td>.167</td>
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<tr>
<td>12</td>
<td>.028</td>
<td>.026</td>
<td>-</td>
<td>.111</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1 Rational probabilities of fair dice based on binomial expansion.
2 Empirical probabilities of fair dice based on 6270 tosses of dice.

*Rational probability, based on binomial expansion.
Figure 1. Relative frequency of guesses by Group 1.

Figure 2. Relative frequency of guesses by Group 2.

Initial operand level.

Corrected for even and odd operand levels.
Figure 3. Pre-experiment operant level for random number guesses. All comparable groups are combined. Group 2FW is separate because written responses were made instead of oral ones.
Table 4
Data for correction of bias:
Operant Level Prior to Experimentation

<table>
<thead>
<tr>
<th>Number</th>
<th>2FO</th>
<th>5FO</th>
<th>O-F</th>
<th>E-F</th>
<th>Total</th>
<th>Bias(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>65</td>
<td>69</td>
<td>67</td>
<td>62</td>
<td>263</td>
<td>.0875</td>
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<tr>
<td>3</td>
<td>69</td>
<td>72</td>
<td>68</td>
<td>65</td>
<td>274</td>
<td>.0912</td>
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<tr>
<td>4</td>
<td>71</td>
<td>75</td>
<td>73</td>
<td>64</td>
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<td>55</td>
<td>64</td>
<td>65</td>
<td>63</td>
<td>227</td>
<td>.0756</td>
</tr>
</tbody>
</table>

\(^1\) This proportion is used for the operant level. It is subtracted from the number obtained in Test 2. The result is then plotted in figures 2 and 3.
Experiment II

It was hypothesized that the dice-guessing mean of Group II (Even-Fair) would be significantly higher than the dice-guessing mean of Group I (Odd-Fair). The difference was in the predicted direction and a t-test permitted retention of the hypothesis at the .05 level for trials 201-250, and at the .001 level for trials 251-300, \( t = 2.189, \text{df} = 38, p < .05 \), and for 251-300, \( t = 3.910, \text{df} = 38, p < .001 \). \( t \)

It was also hypothesized that Group III (Fair-Fair-Oral) interval estimates of the population mean of actual guesses would contain the mean sooner than would Group IV (Fair-Fair-Silent) interval estimates. This hypothesis could not be retained, since there were no differences in estimations during any part of the 200 trials.

For Group I (O-F), during condition II, it was hypothesized that numbers 3-5-7-9-11-12 would be guessed significantly fewer times than numbers 2-4-6-8-10. Three Chi-square tests were made, the first on the last 50 trials of condition I, the second on the first 50 trials of condition II, and the third on the second 50 trials of condition II. The results are consistent with the hypothesis. The first Chi-square yielded a p-value of < .02, the difference favoring the odd numbers as would be expected. The second Chi-square was not significant as also would be expected.
The third Chi-square, however, was significant beyond the .01 level favoring the even numbers and tending to confirm the hypothesis.

For Group II (E-F), during condition II, it was hypothesised that numbers 2-3-5-7-9-11 would be guessed significantly fewer times than 4-6-8-10-12. The same testing procedure was employed as for Group I. The first Chi-square was not significant, a finding that was not predicted. The second was not significant, and should not have been. The third was significant beyond the .01 level and in the predicted direction. Both sets of these data are plotted as extinction curves in figure 4.
Figure 4. Actual frequency of guesses of odd numbers during extinction trials. All odd numbers and one even number are combined for each group.
Table 5
Summary of Results and Hypotheses Tested in the Two Experiments

<table>
<thead>
<tr>
<th>Experiment I</th>
</tr>
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<tbody>
<tr>
<td>Hyp. No.</td>
</tr>
<tr>
<td>1</td>
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<td>2</td>
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<tr>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Experiment II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyp. No.</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
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<tr>
<td>3</td>
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<td>4</td>
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</table>

* This outcome is exactly as predicted.
DISCUSSION

The most important of the hypotheses here tested involved the verbal operants for groups E-F and O-F. It was predicted (Hypothesis 3, Experiment I) that the effects of tossing dice, differing in their mean value from other dice, would be strong enough to influence differential operant strength favoring numbers occurring most frequently on the dice. It was shown that different dice produced different guessing habits in this experiment. Subjects who used the 1-3-5 dice had significantly lower mean operant values than did the subjects with 2-4-6 dice. Thus, the learning of "B" interfered with the "recall" of "A," evidence for retroactive inhibition, at least at the conceptual level.

As was indicated in the introduction, it is very important in any situation where verbal behavior is to occur to have both a "speaker" and a "listener." In this situation, the dice are serving as the listeners even though nothing said to the dice will, in any known way, have any effect on the outcome of a particular toss. This observation justifies the "superstitious" part of the term "Superstitious mand." It seems also to be very unparsimonious to suggest any form of "communication" or transfer of "ideas" between the speaker and the listener; yet verbal behavior is occurring and
is being subjected to change. Virtually all subjects modified their
guessing habits without awareness that they were doing so.

Thus far, only the effects of dice-guessing on free operant
numbers have been considered. Experiment II deals with the effects
of dice guessing per se.

According to these results, a free operant situation where
writing is used yields reliably different results from a free oper­
ant situation where speaking is used only after the introduction of
the independent variable. For some reason, the mean for written
responses (group 2FW) decreased following the dice-guessing, while
the mean for the oral group (2F0) was not changed significantly by
the dice guessing.

It may be that the 50 written responses in Test 1 of the
2FW group will not produce "pre-extinction" (Coppock; 1958) in
this group, while, conversely, the responses uttered orally by
group 2F0 served to reduce the effects of the independent variable
for this group. This possibility is suggested on the basis of the
direction of change in the 2FW group. Both groups should have had
significantly lower mean values in Test 2 than they had in Test 1,
since the dice used by both groups would throw only 3-4-5-6-7-8.

Figure 3 shows the free operants for all comparable groups
plotted for Test 1. As can be seen in the figure, numbers 4 and 7
are the most frequently called, and numbers 10 and 12 are the least
frequently used. These results are not consistent with those of Yule (1927) with regard to specific findings. He found that the most frequently estimated numbers in a scale reading task were 0, 2, and 8. However his scale went from 0 to 9 while this one goes from 2 to 12, a difference that limits specific comparisons. However, the results are consistent with Yule's report that subjects and groups show rather large differences in such preferences.

Figures 1 and 2 show the results of tabulating the possible and not-possible numbers for Test 2. It shows that distinct discriminations did occur in both groups, even though these data are based only on 50 responses per group.

In general, all hypotheses, except those based on estimates of the population mean of actual tosses, were supported. This finding indicates that the operant level of group 5FO for numbers 6 through 11 was not effectively changed by the independent variable. It may be that a different method of analysis would detect more subtle differences, however.

Experiment II

The strongest findings of Experiment II are those of groups Fair-Odd (F-O) and Fair-Even (F-E) which are groups I and II respectively in the outline table. These Ss were given 200 trials with the fair dice, then were switched to either the 1-3-5 dice, or to the 2-4-6 dice. This procedure allowed comparisons to be made
between means of guesses during the test period of 100 trials on the odd or even dice. Comparisons were also made between frequencies of numbers possible and not possible for these dice.

Figure 1 shows the frequency of odd numbers following the change to dice which do not throw odd numbers. These resemble "typical" extinction curves. The Chi-square analysis indicates both of these differences to be statistically significant. Also the mean value of the guesses in the F-E group was significantly higher than the mean value of guesses for group F-0. This finding was predicted since the actual mean value of the dice was higher for the 2-4-6 dice. This finding is in agreement with the most general findings of other experiments. Grant, Hake, and Hornseth (1951) have shown that choices in a two-choice situation will approach as an asymptote the objective probability of success on each of the alternatives.

Group Fair-Fair-Oral (FF-O), which said orally the result of each toss, as well as each guess prior to tossing, was expected to learn more quickly than its control. The rationale was that Ss in this group were required to participate in the task more completely than were Ss in groups which did not have to make a verbal acknowledgement of the number occurring on the dice. The method of analysis used here did not yield results in support of this hypothesis.

It may be, however, that Ss in other groups not required to call out their actual toss were still just as attentive to the roll of the dice as were the Ss required to do so orally. This problem
cannot be solved with the data presented here. It was reasonable
to predict such an outcome at the outset since a pilot study had
indicated that some Ss found the task "boring."

This finding suggested that it would be better to use a
manual "cup" for dice-tossing rather than some kind of mechanical
tossing device. In the present experiment, S was sometimes re-
quired to stretch her arm to pick up a die straying to the other
side of the table, or to pick up a die which had fallen to the
floor after an enthusiastic toss. These events were thought to re-
duce monotony.

The pilot study also indicated that it is much more feasible
to use "re-spotted" dice, rather than "loaded" ones. It is very
difficult to "load" dice in order to get them to throw the de-
sired numbers. Ss used were remarkably naive about the use of
dice. Few of them admitted knowledge of the range of numbers
thrown by dice, and some of them guessed such numbers as "one" or
"fourteen." After the experiment, several Ss suggested jokingly
to E that he should use "loaded" dice in order to make the experi-
ment come out "right," a remark that suggested Ss were not aware
that they were using "unfair" dice.

It can now be argued that verbal behavior may be studied
just as any other form of operant behavior is studied. It need not
be considered as a special class of behavior since it can be
shown to be affected by many of the variables which affect other
forms of behavior [e.g., reinforcement, extinction]. It is not necessary for an appeal to be made to the internal condition of the speaker in order to observe how the behavior of the speaker affects and is affected by the environment.

The purpose of this research was to attempt to study verbal behavior more objectively. By using a situation in which the verbal responses of the Ss could be quantified and the independent variable easily manipulated, the purpose was accomplished. Of course, this method is far from the final answer for a "perfect" method. It is, however, thought to be an improvement over the position which holds that "ideas" must be conveyed in verbal behavior. It is difficult, if not impossible, to quantify "ideas" so that they could be studied. It is a relatively simple matter to quantify verbal responses made by Ss.

Since we cannot study "ideas," it seems that the study of verbal behavior could well follow the same procedures as the study of any other form of complex behavior. We must learn about the simple case first, then attempt to progress to the more complex.
SUMMARY

The purpose of these experiments was to investigate the possibility that verbal behavior could be controlled and manipulated by inanimate objects not under control of the subject. Two separate experiments were conducted to study different aspects of the problem.

Experiment I was concerned with the effects of tossing a pair of re-spotted dice on the verbal behavior of the dice-tosser. It was hypothesized that the operant level of the different numbers throwable by the dice would be modified after the subject had thrown the dice 200 times. It was further suggested that there would be no difference if the operant levels were concerned with speaking or if they were for writing.

It was found that verbal behavior could be manipulated by changing the objective probabilities of certain numbers on the dice. The numbers most frequently said by the subjects were the numbers occurring most frequently on the dice. It was found that there are differences between oral and written responses on this problem. If the operant level is determined by having Ss write "random" numbers, their behavior shows greater changes than if they are asked to recite orally the pre-experiment random numbers.
Experiment II was concerned with the problem of extinction and also served to determine if the Ss were paying attention to the task at hand. It was hypothesized that Ss would gradually stop calling numbers that no longer appeared on the dice, but would continue to call the numbers which did appear on the dice in agreement with the objective probability of these numbers. It was also hypothesized that Ss who were required to call out both the number they thought the dice would throw and the number that the dice actually threw would learn the problem more quickly than the Ss who were not required to say what the dice actually threw.

It was found that the first hypothesis was confirmed. Ss showed extinction to those numbers that no longer appeared on the dice. It was also found that there was no difference between the two major experimental conditions. Actually saying the point the dice threw was of no reliable importance in this experiment.

It was suggested that objective techniques for the study of verbal behavior are essential if progress is to be made in this area. It was also suggested that the method used here might be a step toward finding an objective way of studying verbal behavior since no appeal is necessary to the "communication of ideas" or other non-operational descriptions of verbal behavior.
BIBLIOGRAPHY


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I, Robert Keith Branson, was born in Shawnee, Oklahoma, February 23, 1932. I received my public school education in Shawnee, Oklahoma, where I graduated from high school in 1950. I did my undergraduate work at Oklahoma State University, which granted me the Bachelor of Science degree in 1956. I received the Master of Science degree from Oklahoma State University in 1957, and while in residence there, served as a Graduate Teaching Assistant. In September, 1957, I was appointed a Teaching Assistant at the Ohio State University in the Department of Psychology. During the summer of 1958, I served as Research Assistant to Professor Frederick A. King of the Ohio State University College of Medicine. In October, 1958, I was appointed Assistant Instructor for the 1958-59 academic year. In the summer of 1959, I was appointed Assistant to Professors Sidney L. Pressey and Reed Lawson, the position I held while completing the requirements for the degree Doctor of Philosophy.