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THE EFFECT OF RESPONSE CLASS AND INTER-TRIAL ACTIVITY ON VERBAL OPERANT CONDITIONING AND THEIR RELATIONSHIP WITH A POST-CONDITIONING INTERVIEW

A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PSYCHOLOGY JANUARY 1966

By

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# Table of Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td>iii</td>
</tr>
<tr>
<td>List of Figures</td>
<td>iv</td>
</tr>
<tr>
<td>I Introduction</td>
<td>1</td>
</tr>
<tr>
<td>II Statement of Hypotheses</td>
<td>17</td>
</tr>
<tr>
<td>III Subjects and Apparatus</td>
<td>20</td>
</tr>
<tr>
<td>Subjects</td>
<td>20</td>
</tr>
<tr>
<td>Apparatus</td>
<td>20</td>
</tr>
<tr>
<td>IV Procedure</td>
<td>24</td>
</tr>
<tr>
<td>Instructions and task</td>
<td>24</td>
</tr>
<tr>
<td>Experimental groups</td>
<td>26</td>
</tr>
<tr>
<td>Scoring procedure</td>
<td>27</td>
</tr>
<tr>
<td>V Results</td>
<td>34</td>
</tr>
<tr>
<td>Analysis of covariance of conditioning scores</td>
<td>34</td>
</tr>
<tr>
<td>Secondary analysis of covariance of color-naming groups</td>
<td>35</td>
</tr>
<tr>
<td>Analysis of covariance of &quot;d&quot; endings</td>
<td>42</td>
</tr>
<tr>
<td>Least Squares solution to the analysis of covariance using RH scores as one variable</td>
<td>42</td>
</tr>
<tr>
<td>VI Discussion</td>
<td>51</td>
</tr>
<tr>
<td>Results as they relate to hypotheses</td>
<td>51</td>
</tr>
<tr>
<td>Relation of findings to position I, Dulany and Spielberger's</td>
<td>58</td>
</tr>
<tr>
<td>Relation of findings to second position, Verplanck and Krasner's</td>
<td>59</td>
</tr>
<tr>
<td>Relation of findings to third position, Kanfer and McBrearty's</td>
<td>60</td>
</tr>
<tr>
<td>Generalization of results to operant and classical conditioning</td>
<td>64</td>
</tr>
<tr>
<td>VII Summary and Conclusions</td>
<td>66</td>
</tr>
<tr>
<td>References Cited</td>
<td>71</td>
</tr>
</tbody>
</table>
List of Tables

Table                                      Page  
1 Post-Conditioning Interview.             16  
2 Verbs as Presented to S.                 21  
3 Reports of Behavioral Hypotheses, Reinforce-  
   ment Hypotheses, and Behavioral Intentions.  28  
4 Instructions to Judges                   32  
5 Summary Table of the Analysis of Covariance  
   of Blocks of Trials of All Groups Using  
   the Operant Trials as Covariate with Four  
   Variables: A (Response Class), B (Reinforce-  
   ment), C (Inter-Trial Activity), D (Blocks of Trials).  36  
6 Analysis of Covariance of Blocks of Trials  
   with Covariate of Operant Trials of Color-  
   Naming Groups with Three Variables: A  
   (Response Class), B (Reinforcement), D  
   (Blocks of Trials).  39  
7 Analysis of Covariance of Blocks of Trials  
   Using Operant Trials as Covariate of  
   Color-Naming Groups' Scores for /D/ End-  
   ings in Both Response Classes with Two  
   Variables: B (Reinforcement), D (Trials)  43  
8 Least Squares Solution to the Analysis of  
   Covariance of Blocks of Trials with Oper-  
   ant Trials as Covariate with Three Varia-  
   bles: A (Response Class), B (RH, "Aware-  
   ness"), D (Blocks of Trials).  45  
9 Complete Correlational Analysis of RH, BH,  
   BI with Adjusted Fifth Block of Trials  
   Scores of All Ss in All Groups: R (Reinforce-  
   ment), C (Control), N (Naming),  
   U (Not Naming), A (Changing), B (Unchang-  
   ing).  48  
10 Complete Analysis of Variance of RH, BH,  
    and BI, the Summed Ratings of Two Judges,  
    in All Groups with Four Variables: A  
    (Response Class), B (Reinforcement), C  
    (Color-Naming), D (RH, BH, BI).  49
List of Figures

<table>
<thead>
<tr>
<th>Figures</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The comparison of unchanging response class groups BNR, NC2, BUR, UC2 on adjusted mean number of correct responses emitted over five blocks of fifteen trials each. The operant rate for each group was used for the covariance adjustment.</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>The comparison of changing response class groups ANR, NC1, AUR, UC1 on adjusted mean number of correct responses emitted over five blocks of fifteen trials each. The operant rate for each group was used for the covariance adjustment.</td>
<td>41</td>
</tr>
</tbody>
</table>
Chapter I

Introduction

The original paradigm for the research design presented in this paper is found in Greenspoon's (1955) study of the effect of "mmm-hmm" spoken by the experimenter (E) on the verbal behavior of the subject (S). In Greenspoon's experiment S was instructed to emit words not in any particular order. After the emission of each plural noun, E said "mmm-hmm." Upon examining the number of plural noun emissions of the experimental group which received the reinforcement "mmm-hmm" and a control group which did not, he found a significant increase in plural noun emissions in the experimental group. A short post-experimental interview was given to each S, and those showing an awareness of the contingency between the "mmm-hmm" spoken by E and their own emission of plural nouns were discarded from the analysis. This conditioning procedure follows the Skinnerian model of conditioning in which the organism performs or emits a particular form, or class, of responses for which the organism is rewarded with a particular reinforcer. This emitted response is designated the operant in the Skinnerian lexicon of conditioning. The aware Ss were discarded, since Skinner (1957) states, "A reinforcing connection need not be obvious to the individual reinforced." (p. 75). It is often only in retrospect that one's tendencies to behave in particular ways are seen to be a result of
certain consequences; the relationship may never be seen though it is obvious to others.

An important theoretical issue has been raised by Dulany (1961) questioning the results obtained by means of the Greenspoon studies and those following him: Are the results obtained by the techniques used in this study analogous to bar-pressing or disc-pecking using animals as subjects? When Dulany replicated Greenspoon's experiment, Ss were verbally reinforced for plural nouns in the last four or five blocks of freely emitted words. Analysis of the data showed that 43 experimental Ss increased their frequency of plural noun response without there being a significant trend over the five blocks. Upon examining the post-conditioning interview, it was found that no S could verbalize the correct reinforcement-response contingency, that of being reinforced for the emission of plural nouns. However, 34 Ss stated that E was studying their associations, and of these, 11 stated that the reinforcement occurred for those responses which stayed in the same category. When the interviews were categorized according to type of hypothesis which S had given, it was found that Ss who had an association-reinforcement hypothesis conditioned highly significantly, an association hypothesis alone conditioned moderately, and those Ss who verbalized no hypothesis did not differ significantly from the controls. Dulany posits that verbal operant conditioning may eventually turn out to be
a type of problem-solving with the response given being mediated by hypotheses and transfer. Verbal operant conditioning would thus be no more than another example of cognitive control over voluntary processes.

Three major viewpoints have arisen in the literature concerning the necessity of awareness as a condition for verbal operant conditioning: Does verbal operant conditioning occur with or without awareness of a response-reinforcement contingency? Spielberger (1962) conceives of verbal conditioning as a change in behavior potentiality which may be exhibited either concomitantly or after the learning process has occurred. He finds no evidence, when a long post-conditioning interview is used, for conditioning without awareness. Levin (1961), under Spielberger's direction, found conditioning among those Ss who demonstrated awareness in a larger and more sensitive interview when those same Ss did not report awareness in a shorter interview. Thus, his major point is that conditioning is a cognitively mediated process, and that this awareness may be operationally demonstrated in an interview of sufficient length. Additional experimental evidence supporting this notion of the potency of the extended interview is given in Krasner, Weiss, & Ullman, 1959; Krieghaus & Erickson, 1960; Dulany, 1961; Tatz, 1960.

A more ambitious attempt to account for the findings of experiments in the field of verbal operant conditioning
has been proposed by Dulany (1962). In this theoretical network, Dulany attempts to relate a series of awareness measures of a self-instructional nature to the relationship found between reinforcement and verbal "operant" conditioning. These three constructs are ordered in the direction of the emitted response. The first of these and least related to the emission of the response is RH, awareness, or, as he terms it, reinforcement hypothesis. In an intermediate position is found BH, behavioral hypothesis, or the knowledge of the correctness of the response, or knowledge of the response which R wishes S to emit. Directly controlling the emission of the response is BI, behavioral intention, which may be described as S's intention to emit the correct response. Dulany further postulates that BI should be the single determiner of response selection; RH and BH should affect performance only through BI. This is borne out in his experiment (Dulany, 1962), in which he finds that the correlations between performance and BI, BH, and RH fall off in the expected direction: $0.71 > 0.57 > 0.36$, respectively, each significantly less than the preceding.

The second and third set of positions form another set of coordinates within the context of verbal operant conditioning. These other points relate awareness and conditioning on still other dimensions which admit awareness data, but not as a necessary condition for the increase in an emitted response class. Verplanck (1962) and Krasner (1962)
are the chief proponents of the second approach.

Countering the cognitively mediated approach, various workers in the field have attempted to demonstrate verbal operant conditioning without a significantly correlated degree of awareness on a post-experimental interview, or they have attempted to condition separately the S's report of awareness apart from the conditioning task, per se. Verplanck (1962) reported a successful attempt at this latter procedure using a card-sorting task. This finding was later shown to be a statistical artifact in Dulany's (1963) tour de force. Krasner, et al., (1962), reports similar findings showing that awareness need not be present in order for conditioning to occur. These investigators found that such variables as the experimental situation, instructional variables, awareness cues, and personality factors would either decrease or increase the degree of awareness separately from the conditioning scores. Awareness is thus an important variable, as Krasner sees it, but it can be manipulated as can any other dependent variable in an experiment.

A third possibility is that awareness may be found to be correlated with the production of one response class while another response class differing in its formation would not have as highly correlated a degree of awareness on a post-conditioning interview. McBrearty, et al., (1963), has given evidence showing how conditioning is related to
the dimension of class belongingness. The results of the conditioning procedure support an intra-dimensional analysis in the finding that response acquisition is greater with focal stimuli having a high semantic "belongingness" as compared to those having low inter-class belongingness. When the words are easily discriminated in a figure-ground relationship, greater conditioning also results (Kanfer, et al., 1961). In this earlier study (Kanfer, et al., 1961) when mildly hostile words were paired with neutral words and the hostile words were reinforced, conditioning occurred without awareness in some Ss. When the neutral words were paired with intensely hostile words, conditioning occurred to a greater degree; however, there was no conditioning without awareness in this instance.

From this discussion it may be inferred that a more easily discriminable response class may be conditioned more readily. It may also be hypothesized that with greater discriminability, it should be possible for S to form correct hypotheses concerning the conditioning task. In the latter experiment (McBrearty, et al., 1963) concerning class belongingness, the animal words with the highest rating of class belongingness should be easier for S to discriminate as opposed to those words of low class belongingness and, therefore, the result would follow, be of greater conditionability.

According to this last viewpoint, it is possible to
re-evaluate the work of Spielberger, et al., (1962) and Dulany (1961) in their replication of Greenspoon's earlier experiments. They find, as reported above, that those Ss who conditioned had formed the correlated hypothesis of reinforcement being given for staying in a particular response class. All of the conditioning which they find could be attributed to this correlated hypothesis in their findings. This, however, cannot be considered a "correct" hypothesis, i.e., the hypothesis that reinforcement is given for the response class of plural nouns. It may therefore be possible that the criticism of Greenspoon (1963) in his reply to Spielberger and DeMare would be a more parsimonious explanation of the correlated hypothesis: "S is demonstrating that certain verbal responses he makes serve as discriminative stimuli \(S_D\)s) for the control of other verbal responses, the responses of the critical response class." The questioning which occurs after the interview may induce S to review his verbal behavior during the conditioning session. Those who describe this discriminative process are conditioned; the others are not. This would be only a verbal self-report of S's verbal behavior during the conditioning session and would thus be of a post-hoc nature and not a predictive variable.

The underlying assumptions of the first two positions may be contained in the last one given. East of discriminability, the use of his own verbal responses as an \(S_D\) by S mediating transfer, which Dulany (1961) notes is commonly
realized to occur without awareness, and the size of the response class may be considered some of the sources for the ambiguities present in the controversy now occurring in this area of experimental psychology.

While the Verplanck-Krasner position opposes that of Dulany and Spielberger, their experimental results could both be contained within the broad theoretical framework of a descriptive behaviorism embodying within its framework the ordinary principles of a learning theory. Awareness could therefore be seen as a product of the interaction between the relevant variables found within the experimental task. Any part of the experimental situation which increases the ambiguity of the conditioning task, while perhaps decreasing over-all "conditioning" of a cognitively mediated nature, will reduce the ability of S to verbalize the experimental contingencies presented to him, while not necessarily reducing the extent of conditioning of the reinforced response class.

The presence of anything which increased the probability for S to form non-correlated hypotheses, such as, an inter-trial color-naming task in the experimental situation in addition to the effect of the response class, would also increase the probability of conditioning without awareness. This would affect the hypothesis-formation of S and would affect conditioning much the same way as increasing the ambiguity of response class selection. Leading S to believe
that the experiment was concerned with a personality variable or the introduction of an inter-trial task of some complexity would be conditions capable of producing this effect (Dixon & Oakes, 1965).

In experiments during the last five years using the sentence construction task originally designed by Taffel (1955), learning has been found to be highly correlated with awareness of the correct reinforcement-response contingency. In this sentence construction task, S is typically presented with a choice of the six personal pronouns "I," "we," "you," "he," "she," "they," and told to construct a sentence beginning with one of the pronouns and containing the verb presented on the same card. One similarity over experiments has been the obviousness of the experimental contingency and the presence of an inter-trial interval during which S may arrive at the correct reinforcement-response contingency. Lanyon (1964) and Goodstein, et al., (1964), are the most recent examples of this approach to this problem. They both find awareness only where conditioning occurs; those unaware of the correct reinforcement-response contingency do not condition.

Other studies may be found in the literature which do not replicate the uncomplicated conditions present in the original Taffel and Greenspoon procedure. In this set of data the results do not clearly support the Dulany-Spielberger position, but follow the second and third positions set
forth in this paper. Krasner, et al., (1961), found this in his conditioning of emotional words in TAT-like stories using "mmm-hmm" as a reinforcer with an accompanying head nod. Incidental awareness cues significantly affected conditioning; hostility in previous E and S interactions significantly decreased conditioning, but awareness was not found to be a significant variable. Hare, et al., (1964), found an interesting result in that Ss, in giving an affective response to photographs, showed a change in performance due to the operant conditioning of the affective response related to an awareness interview, but in later conditioning no awareness was necessary. This was thought to be unusual, since awareness changes were found to be necessary for the initial change in affective response but not for those following the awareness interview. Moss (1963) reported a finding in conflict with the Spielberger (1962) and Levin (1961) results. His results showed that an instructional set which was designed to induce a positive, neutral, or negative awareness set influenced awareness scores without influencing conditioning. Simkins (1963) reports findings similar to Kanfer and McBrearty (1961), in that increased dissimilarity between response alternatives increased conditioning. Simkins also notes that awareness did not predict to conditioning by itself, since with equal amounts of awareness "long" words conditioned better than "medium" or "short" words. His conclusion is that awareness as an
exploratory construct does not permit us to make very accurate predictions. His findings indicate that instructions, response class, and type of reinforcement all interact in their effect on both awareness and conditioning. In a test concerning generalization of the reinforcement of building words to the drawing of pictures depicting buildings, Timmons (1962) found significant generalization without awareness. Also as an added point following up this point of view, Crowne, et al., (1961), in a test of verbal conditioning using the usual Greenspoon technique, found significant conditioning when those reporting awareness of the correct reinforcement contingency were discarded from the analysis. A brief five-question post-conditioning interview was used in this experiment. As can be readily seen, the results do not conform to any single cognitive explanation.

To further clarify this issue, an experiment was performed testing hypotheses derived from Dulany's nomological, or theoretical, network. In this experiment all conditions were maintained similar to those found in the general run of verbal conditioning studies, except that a complex color-naming task was introduced within the 10-second interval between discrete trials. It was hypothesized that this might interfere with the hypothesis-forming and testing which S could perform during the inter-trial interval. In the reinforced control group, the relationship found among BI, BH, and RH was not found as Dulany had previously reported,
but there was a significant correlation (r) between RH and conditioning. However, in the experimental color-naming group, no significant relationship was found between any of the awareness measures, i.e., BI, BH, RH, and conditioning, though both the reinforced experimental and control groups showed equivalent levels of conditioning (Dixon & Oakes, 1965).

Since the above-cited research may not be an experimentum crucis in the Baconian sense, due to the degree of abstraction in the Dulany nomological network, another way of attacking this question is here proposed. This experiment uses a variant of Greenspoon's experimental task. Each S is to be presented with a card on which he finds two verbs. He will be asked to choose one of the present tense verbs presented on the card and verbalize the past tense of this verb. One of the verbs will end in the allomorph /D/, as in "located" or "deceived." The other will change its form in the plural; examples of this would be "catch" to "caught" or "sink" to "sank." During the 8-second inter-trial interval, a complex color-naming task will be introduced in 4 groups in order to interfere with the inter-trial hypothesis-formation and testing activity which may occur in the reinforced groups. A post-conditioning interview (Table 1) patterned after that used by Dulany (1962) will be given to all Ss.

This experiment is designed to determine whether two
response classes which differ in their formation require correct or related hypotheses which correlate with conditioning in order for conditioning to occur. The two response classes, past tense verbs ending in the allomorph /D/ (unchanging) and those which change their form in the past tense (changing) may require two types of hypotheses. For the past tense verbs ending in /D/, no hypotheses may be necessary to mediate conditioning. This may be due to the conditioning of the phoneme /d/, in other words, the sound "-ed" at the end of the word. Conditioning in the unchanging form would be due to the emission of a similar topographic response (similar lip and tongue movements) for each response in the conditioning of this response class. Another possibility is that suggested by Dulany, in which an association hypothesis, to stay in the same category, would be sufficient for a shift in performance to occur. The conditioning of the response class which changes its form in the past tense would require, by this type of analysis, a more specific hypothesis-formation, such as, choosing those verbs which show an alternation of form. This would be due to the fact that no single topographic similarity in response emission would be found throughout the changing response class. There would therefore appear to be a possibility that the color-naming task would affect the conditioning of this type of past tense verb if it interfered with hypothesis-formation by \$ more radically
than the unchanging response class if a mediating hypothesis is required for conditioning in this case. Or, conversely, awareness may be necessary for the conditioning of the unchanging form and the inter-trial task of color-naming may, if it interferes with hypothesis-formation on the part of $S$, interfere with conditioning in this response class.

Another possibility, following the Kanfer and McBrearty (1961) findings and also the Dixon & Oakes (1965) results, would be that awareness would result from the ability of $S$ to perceive the contingency between the reinforcement given by $E$ and the experimental response as related to inter-trial task and response class size and complexity. If $S$ did not perceive the contingency, conditioning would still occur, perhaps to a lesser, but still significant, degree. From this discussion it can be seen that the question of the conditionability of two related response classes can be answered and whether correct or correlated hypothesis-formation by $S$ is required in either case.

The eight groups are as follows, each experimental group followed by its control:

1. Group ANR: this group is reinforced for choosing verbs ending in /D/ and performs the color-naming task.
2. Groups NC_{1} and NC_{2}: these groups choose past tense verbs but are not reinforced and perform the color-naming task.
3. Group BNR: this group is reinforced for choosing verbs
which change their form in the past tense and names colors also. (Group NC₂ will serve as a control for this group.)

4. Group AUR: this group is reinforced for choosing verbs ending in /D/ but does not perform the color-naming task.

5. Groups UC₁ and UC₂: these groups choose past tense verbs but are not reinforced, nor do they name colors.

6. Group BUR: this group is reinforced for choosing verbs which change their form in the past tense but does not name colors. (Group UC₂ will serve as a control for this group.)
Table 1
Post-Conditioning Interview

1.a. Did you notice whether or not I said anything during the experiment?
   b. (What?)

2.a. Did you come to think it was random or did it follow anything in particular that you did?
   b. (What?)

3.a. Did you come to think there was or wasn't any purpose or significance to the "Good" in this experiment?
   b. (What?)

4.a. Did you come to think that there was anything you were supposed to say, or not say, on each trial in order to be correct--something the experimenter wanted you to say or not say?
   b. (What?)

5.a. How did you go about choosing a verb?
   b. Did you have a plan or system for choosing a verb?
   c. (Would you say that you did or didn't try to use any particular words?)
   d. (What?)
Chapter II

Statement of Hypotheses

This experiment is designed to test whether two response classes, one response consisting of past tense verbs ending in "-ed," such as, "located" or "deceived," and the other response class consisting of verbs which change their form in the past tense from one form, such as, "sink" in the present tense to "sank" in the past tense, will differ in their conditionability and in the degree of relationship between conditioning scores and written reports on a post-conditioning interview. The effect of an inter-trial color-naming activity on the conditioning of these response classes and on the relationship of conditioning to the post-conditioning interview is also tested.

Statistical tests using analysis of covariance and the Pearson Product Moment Correlation were made on the conditioning scores and the judges' rating of the modified Dulany post-conditioning interview in order to test these hypotheses:

1. There is a significant difference among the eight groups as to whether conditioning occurred.

2. The correlations of BH, BI, RH as demonstrated on the post-experimental interview differ with respect to conditioning between the experimental and control groups.

These are the hypotheses tested by means of these tests of significance if certain experimental results are found:
1. Do the reinforced color-naming groups show significantly different correlations with awareness than the reinforced non-color-naming groups if all reinforced groups show conditioning? This would relate to the Dixon & Oakes findings.

2. Is there a significant degree of conditioning with the orthographically changing verbs:
   a. with significantly correlated measures of awareness in the non-naming groups but with no awareness in the color-naming, both groups conditioning or,
   b. with a significant degree of conditioning in the non-color-naming group and related degree of awareness, but no awareness and no conditioning in the color-naming group.

If 2.a. should arise, this would tend to support a more direct strengthening approach; if 2.b. should occur, a cognitive, mediational approach would be supported.

3. Is there a significant degree of conditioning with the reinforcement of the allomorph /D/:
   a. with significantly correlated measures of awareness in the non-naming group but with no correlated degree of awareness in the color-naming group, both groups conditioning, or
   b. with a significant degree of conditioning in the non-naming groups and related degrees of awareness but no awareness and no conditioning in the color-naming group.
If 2.a. should occur, this would tend to support a direct strengthening approach; if 2.b. arises, a cognitive mediational theory would be supported. If 2.b. occurred and not 2.a. but only 3.a., this would support the notion that one "reinforcement" process was cognitive in nature and the other was not. If, on the other hand, 3.b. occurred and not 2.b. but 2.a., this would reverse the conclusion as to which response class had a cognitively mediated "reinforcement" explanation.

4. If both the color-naming groups and the non-color-naming groups condition to the same degree and both have the same correlations between RH, BH, BI and conditioning, this would indicate that the color-naming variable had no significant effect in this experiment.

5. If the color-naming reinforced groups condition significantly less than the reinforced non-color-naming groups while still conditioning to a significant degree, this will indicate that color-naming per se is a significant variable and the awareness data must be compared within the color-naming groups as well as between color-naming and non-color-naming groups.
Chapter III

Subjects and Apparatus

Subjects

One-hundred and sixty Ss were obtained from introductory psychology courses and from upper division industrial and social psychology courses. The Ss from these upper division courses had usually had introductory and developmental psychology in addition to their present course in psychology. Approximately three quarters of the total N was derived from the latter named sources. Ss were assigned to the eight groups in the order in which they signed a sign-up sheet handed out in the psychology classes. These groups were, in order of assignment of Ss, ANR, NC1, BNR, NC2, AUR, UC1, BUR, and UC2 with twenty Ss in each group.

Apparatus

The stimulus materials for the conditioning task consisted of ninety 3 x 5-inch white index cards on which the two different types of verbs appear; see Table 2. The order of the verbs as to whether unchanged or the change form of the verb appeared was randomized, with 45 presentations of /D/ first and 45 presentations of the change form first. A memory drum presented a series of colors to the S. The colors appeared in the following order: red, grey, grey, black, orange, intermediate green, red, intermediate green, bright green, blue, light brown, red, brown, orange, yellow,
Table 2
Verbs as Presented to S

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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>chain</td>
<td>shake</td>
<td>26.</td>
<td>demand</td>
</tr>
<tr>
<td>2.</td>
<td>act</td>
<td>go</td>
<td>27.</td>
<td>wring</td>
</tr>
<tr>
<td>3.</td>
<td>sting</td>
<td>moisten</td>
<td>28.</td>
<td>burn</td>
</tr>
<tr>
<td>4.</td>
<td>steer</td>
<td>stick</td>
<td>29.</td>
<td>slide</td>
</tr>
<tr>
<td>5.</td>
<td>drink</td>
<td>impose</td>
<td>30.</td>
<td>change</td>
</tr>
<tr>
<td>6.</td>
<td>seek</td>
<td>list</td>
<td>31.</td>
<td>find</td>
</tr>
<tr>
<td>7.</td>
<td>admire</td>
<td>fight</td>
<td>32.</td>
<td>begin</td>
</tr>
<tr>
<td>8.</td>
<td>admire</td>
<td>fight</td>
<td>32.</td>
<td>begin</td>
</tr>
<tr>
<td>9.</td>
<td>hold</td>
<td>fear</td>
<td>34.</td>
<td>howl</td>
</tr>
<tr>
<td>10.</td>
<td>draw</td>
<td>delight</td>
<td>35.</td>
<td>undo</td>
</tr>
<tr>
<td>11.</td>
<td>peer</td>
<td>blow</td>
<td>36.</td>
<td>meet</td>
</tr>
<tr>
<td>12.</td>
<td>care</td>
<td>think</td>
<td>37.</td>
<td>sling</td>
</tr>
<tr>
<td>13.</td>
<td>battle</td>
<td>speak</td>
<td>38.</td>
<td>shoot</td>
</tr>
<tr>
<td>14.</td>
<td>pilot</td>
<td>tear</td>
<td>39.</td>
<td>bite</td>
</tr>
<tr>
<td>15.</td>
<td>throw</td>
<td>engage</td>
<td>40.</td>
<td>shrink</td>
</tr>
<tr>
<td>16.</td>
<td>account</td>
<td>catch</td>
<td>41.</td>
<td>strike</td>
</tr>
<tr>
<td>17.</td>
<td>ride</td>
<td>level</td>
<td>42.</td>
<td>withdraw</td>
</tr>
<tr>
<td>18.</td>
<td>sit</td>
<td>form</td>
<td>43.</td>
<td>rise</td>
</tr>
<tr>
<td>19.</td>
<td>accept</td>
<td>run</td>
<td>44.</td>
<td>loot</td>
</tr>
<tr>
<td>20.</td>
<td>call</td>
<td>feel</td>
<td>45.</td>
<td>carry</td>
</tr>
<tr>
<td>21.</td>
<td>seize</td>
<td>eat</td>
<td>46.</td>
<td>admit</td>
</tr>
<tr>
<td>22.</td>
<td>weep</td>
<td>rent</td>
<td>47.</td>
<td>arise</td>
</tr>
<tr>
<td>23.</td>
<td>make</td>
<td>join</td>
<td>48.</td>
<td>belong</td>
</tr>
<tr>
<td>24.</td>
<td>see</td>
<td>gather</td>
<td>49.</td>
<td>hoot</td>
</tr>
<tr>
<td>25.</td>
<td>date</td>
<td>am</td>
<td>50.</td>
<td>hang</td>
</tr>
</tbody>
</table>
Table 2 (contd.)

51. bark\*  win  71. swim  lament
52. blame  fly  72. jolt  foretell
53. sweep  plunge  73. effect  buy
54. declare  stand  74. keep  flow
55. bore  teach  75. undertake  shred
56. feed  register  76. hem  wear
57. spring  lure  77. ring  marvel
58. decide  give  78. break  cheer
59. cling  heave  79. collect  redo
60. hoard  tread  80. add  hear
61. adapt  deal  81. hide  reward
62. believe  spend  82. say  favor
63. take  greet  83. write  end
64. charge  leave  84. dig  mend
65. adopt  come  85. forget  lean
66. joust  spin  86. choose  handle
67. dare  get  87. become  fail
68. cause  know  88. benefit  understand
69. steal  solve  89. seal  sing
70. harken  forgive  90. limit  grind
        discuss  stop*  

Note: \* not reinforced, turned reinforced if omitted with the ending of phoneme /d/.

* pre-conditioning example.
blue, brown, orange, blue, light green, brown, yellow, yellow, light green, red, black, bright green, and red.

A grey screen with its leaves folded in at approximately 120 degrees toward S was used. The central portion of the screen was 26 x 30 inches and the leaves were 12 x 30 inches. A hole for the presentation of the cards 4-1/4 x 1-3/4 inches was located in the center of the screen. A metal holder; also painted grey, was placed at the rear of the card square in order to receive the card for presentation. Beneath the card holder, a slot was cut in the screen 16-1/2 inches long and 7 inches in height, extending for 6 inches, and 6-3/4 inches in height, extending for 10-1/2 inches, in order that the memory drum could face S. The colors on the memory drum appeared directly below the card holder. Sheets of 8-1/2 x 11-inch paper were used for scoring. On each sheet was typed 3 double-spaced columns of verbs with the /D/ form first, and the number of the trial followed by the 2 verbs used in the experiment. Each verb used by S was circled by E during a particular trial.

A large table was placed between S and E on which the screen and memory drum were placed facing S. The room was light beige in color. The dimensions of the room were 8-1/2 x 6-1/2 feet in length by breadth and 7-1/2 feet high. A single enclosed light of 300-watt power was directly above the experimental screen and the room was air conditioned. The door to the room was to the left of S. The interval between trials was timed by the use of a stopwatch.
Chapter IV

Procedure

Instructions and task

A sign-up sheet was passed out to Ss in the psychology classes on which they signed their names at a time they found convenient to them. For each hour that S participated in the experiment, he received credit added to his grade in his psychology course.

When S appeared in the waiting room for psychology experiments, he was escorted to the experimental room by E. During the trip to the experimental room and before the experimental session, E engaged S in a friendly interaction. The questions asked by E to produce a topic of conversation were as follows:

1. "Who is the instructor in your psychology course?"
2. "How do you like psychology?"
3. "How many psychology courses have you had?"
4. "Would you like to take more psychology?"

The answers to these questions were not recorded.

The experimental task consisted of the presentation of two verbs in the present tense to which S then gave the past tense of one of the verbs. If, during the trials, S emitted a response in the response class designated as correct according to the group to which S had been assigned, E recorded his response by circling the appropriate verb. In the reinforced groups E said "good" after the correct response
by S. During the 8-second inter-trial interval in the color-naming groups, colors appeared in the slot in the memory drum at one-second intervals. This 8-second interval was timed by the use of a stopwatch in the non-color-naming groups. The Ss were tested individually in all cases.

The following instructions were read to S after the pre-experimental interview:

"Now if you will move your chair over in front of the square hole that appears in the center of the screen, I will show you a sample card. As you see, there are two verbs in a line in the center of the card. Your task is to say out loud the past tense of one of the verbs on the card that you see before you. As I put the card in the card holder, you are to choose a verb and say its past tense out loud as soon as you have done so. (Read only to color-naming groups:)

In between cards, colors will appear in that brown painted machine beneath the card holder. Your task is to name the colors immediately as they appear in the slot. You have two tasks: to give the past tense of one of the verbs, and to name colors. Be sure not to hesitate. (Read to all groups:)

Now we will begin the experiment. Do you have any questions?"

After the conditioning session all Ss were given the modified Dulany interview; see Table 1. They were read each question separately and told to number and answer each question in order without revising any previous answer. They were required to put their names and psychology course numbers
Experimental groups

In a pilot study the experimental task consisted of words differing in their formation in the past tense but unmatched for their frequency. The fault found in this early pilot study was a greater preference for the irregular verbs by Ss. In the second pilot study the words were matched for frequency by means of the Thorndike-Lorge (1932) word count. However, it was found that with a color-naming task which presented the colors at two-second intervals, there was no difference in degree of awareness between the non-color-naming and the color-naming groups. It was therefore decided to use the matched words and a color-naming task which presented the colors once per second for 8 seconds. Fifty Ss in all were used in the preliminary pilot studies.

The experimental design used was a Lindquist (1953) Type VI design (p. 292) with the between Ss variables of 100% reinforcement versus non-reinforcement, color-naming versus non-color-naming, reinforced unchanging versus reinforced for changing verbs, and the within Ss variable, blocks of trials. The dependent variables were the summed score of blocks of 15 trials each, thus giving 6 blocks of trials the last 5 used as experimental reinforced trials, the first block as operant (unreinforced) for one variable, and the other three dependent variables the summed rankings of the two judges for RH, BH, and BI.
Eight groups were necessary for the complete factorial design. These were, as described above, ANR, NC₁, BNR, NC₂, AUR, UC₁, BUR, and UC₂. In this listing each reinforced group is followed by its appropriate control group.

**Scoring Procedure**

The data sheets were scored by counting the total number of verbs circled by E during the conditioning session. If S had emitted an incorrect response, such as, giving the past tense of "sink" as "sinked," this response was recorded in all groups. In the reinforced groups, however, no reinforcement was given for this response. The sum of the number of "correct" responses emitted during a block of 15 trials was the score for each block of trials. The first block of 15 trials, which occurred without reinforcement in all groups, was used as the operant. In the analysis of covariance there were five blocks of 15 trials each, giving five scores to be used for each S, with operant rate for the first 15 trials used as the covariate. These scores are those used in Figures 1 and 2.

**Judges and judges' instructions**

A graduate student in psychology and an instructor with an M.A. in linguistics were used as the two judges. The criteria used were those given by Dulany (1962) in his treatment of RH, BH, and BI; see Table 3. The judges used question 4, parts (a) and (b) in their rating reports of RH, all parts of questions 1, 2, and 3 for report RH and question 5,
Table 3

Dulany's Categories of RH, BH, and BI

Report of Behavioral Hypotheses: The S

I. Names the correct response class and calls it correct or describes it as what he is supposed to do or as what E wants him to do.

II. Names as correct (or as what he is supposed to do or what E wants him to do) some response class that is positively, but imperfectly, correlated with the correct response class.

III. Does not name the correct response class as correct. He may report that he does not know the correct response, that he does not know whether there is a correct response, that there is not a correct response, or he may report some uncorrelated and irrelevant response class as correct. (An irrelevant response class is one that is uncorrelated but not incompatible with the correct response class.)

IV. Names as correct some response class that is uncorrelated but partially incompatible with the correct response class, e.g., right-left alternation or position preference when the correct response is randomly distributed right and left.

V. Names as correct some incorrect response class that is negatively correlated with the correct response class.
Table 3 (contd.)

Report of Reinforcement Hypotheses: The S

A. Reports the significance of the contingent stimulus --that it signified that the preceding response was correct or what E wanted or would agree with. It is described as having some selective reinforcement or informative value, not as a general encouragement to continue.

B. Reports the distribution but not the significance of the contingent stimulus--that it followed the response class E designates as correct.

C. Reports the occurrence but neither the significance nor the distribution of the contingent stimulus.

D. Does not report occurrence of contingent stimulus.

Report of Behavioral Intentions: The S

1. Reports intention to produce the response class E designates as correct (at any time during the reports*).

2. Reports intention to produce some response class that is positively, but imperfectly, correlated with the correct response class.

3. Reports no particular intention or reports intention to produce some irrelevant response class.

4. Reports intention to produce some response class that is uncorrelated but partially incompatible with the correct response class.
Table 3 (contd.)

5. Reports intention to produce some response class that is negatively correlated with the correct response class.

Note: * added to Dulany's levels of BI in this experiment.
parts (a), (b), (c), and (d) for levels of BI. In the preliminary training the judges were given 8 interviews from the pilot study Ss and rated these 8 interviews in order to achieve a high degree of inter-judge reliability. The instructions given to judges read as indicated in Table 4.

The judges were given the 80 unchanging and the 80 changing verb post-conditioning interviews as separate sections. These papers were thoroughly randomized with the unchanging and changing verb conditions including the control groups in this shuffling for their appropriate groups. The judges then categorized these interviews into levels of RH, BH, and BI.
Instructions to Judges

I. A. The Ss were told to emit past tense verbs on being presented two verbs which were presented to S in their present tense form.

B. The correct response to be emitted by S is a verb in its past tense.

C. The reinforcement given for this correct response was E saying "Good" each time S emitted this response after the first 15 trials of the experiment.

D. Correct hypotheses for:
   1. irregular verbs: not "-ed" words, words that change, as "sink" to "sank."
   2. regular verbs: those that end in "-ed," not the "sink-sank," or irregular, verbs.

E. Correlated hypotheses for:
   1. irregular verbs: short words, easy or hard words, unusual words.
   2. regular verbs: longer words, easy or hard words, usual words.

F. Neutral hypotheses for all words
   1. colors, patterns
   2. psychological meaning

G. Partially uncorrelated hypotheses
   1. position preference
   2. right-left alternation
Table 4 (contd.)

H. Negatively correlated hypotheses
   1. those opposite of /D/
   2. those that reflect opposition to the experimental conditioning.

II. A. Each written interview is to be categorized into one of the various levels in each of the three categories: Report of Behavioral Hypotheses, Report of Reinforcement Hypotheses, Report of Behavioral Intentions.

   B. In order to reach a level of accuracy in report categorization, each report should be read through before any attempt at categorization is made.

   C. Question 1 answers the question of occurrence of reinforcement hypotheses. Question 2 answers the question of distribution in reinforcement hypotheses. Question 3 answers the question of significance in reinforcement hypotheses. Question 4, parts (a) and (b) give the level of behavioral hypotheses. Question 5, parts (a), (b), (c), and (d) answer the question of level of behavioral intentions.
Chapter V

Results

Analysis of covariance of conditioning scores

A 2x2x2x5 analysis of covariance was made on the scores of all groups. The analysis of covariance had adjusted effects only in the between analysis. In the within analysis, the operant rate which was used as the covariate for each block of trials remained constant; therefore, no adjustment in the within analysis was possible. The distinction could therefore be made that the between analysis was an analysis of covariance and the within analysis was an analysis of variance. The results show that the effect of reinforcement (B) was significant at the .001 level. The difference in scores due to a difference in response class (A) was also significant at the .01 level. There was no interaction between response class and reinforcement (AxB), however, between groups. The effect of inter-trial activity (C) was significant at the .01 level, and there was also a significant inter-trial activity by reinforcement interaction (BxC). This indicates that there was a significant decrease in conditioning due to the effect of inter-trial activity. There was no significant decrease in conditioning due to the interaction of inter-trial activity by response class, nor was the triple interaction of response class, reinforcement, and inter-trial activity significant.
Of the within effects the greatest significance achieved parallels that of the between effects with the interaction between reinforcement and trials (BxD) reaching the .001 level of significance. The effect of blocks of trials (D) alone was also significant at the .01 level, as was the interaction between response class and blocks of trials (AxD). The triple interaction of reinforcement, inter-trial activity, and blocks of trials (BxCxD) reached significance at the .10 level, suggesting that the effects of inter-trial activity can be seen over trials as it interacts with reinforcement. This is more clearly seen in the between F ratio where there is a significant interaction between inter-trial activity and reinforcement.

The within analysis also indicates that there was no significant interaction between blocks of trials and inter-trial activity, and no triple interaction among response class, inter-trial activity, and blocks of trials. Thus, response class does not interact significantly with either reinforcement or inter-trial activity over blocks of trials. There was also no significant quadruple interaction among response class, reinforcement, inter-trial activity, and blocks of trials. The two response classes were not differently affected to a significant extent by any of the experimental variables.

Secondary analysis of covariance of color-naming groups

Analysis of covariance was made using the
Table 5

Summary Table of the Analysis of Covariance of Blocks of Trials of All Groups Using the Operant Trials as Covariate with Four Variables: A (Response Class), B (Reinforcement), C (Inter-Trial Activity), D (Blocks of Trials)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
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<th>df</th>
<th>Source</th>
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</tr>
</thead>
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<tr>
<td>Between Ss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>203.05</td>
<td>10.38**</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>.167</td>
<td>.008</td>
<td>A x B</td>
<td>1</td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A x C</td>
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<td>2.05</td>
<td>.104</td>
<td>A x B x C</td>
<td>1</td>
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<td></td>
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<tr>
<td>Residual (between)</td>
<td>151</td>
<td>19.56</td>
<td></td>
<td>Total (between)</td>
<td>158</td>
</tr>
<tr>
<td>Within Ss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>39.28</td>
<td>4.93*</td>
<td>A x D</td>
<td>4</td>
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<td></td>
</tr>
<tr>
<td>Residual (within)</td>
<td>615</td>
<td>7.97</td>
<td></td>
<td>Total (within)</td>
<td>767</td>
</tr>
<tr>
<td>Total</td>
<td>799</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Note: * significant at the .05 level
** significant at the .01 level
*** significant at the .001 level
conditioning scores of the Ss in the color-naming groups only. The effect of response class (A) produced a significant effect at the .01 level. There was also a reinforcement effect (B) which suggests a moderate level of conditioning significant at the .06 level. There is no interaction in the between analysis, however, between the effect of response class and reinforcement. Here again the independent variable of reinforcement did not affect the changing nor the unchanging response classes to a different degree.

In the between analysis there was a significant effect due to the interaction between trials and response class (AxC), this interaction effect reaches significance at the .01 level.

Figures 1 and 2 give the relative changes that occurred among the groups during the conditioning trials. The reinforced groups in Figure 1, those reinforced for the unchanging response class, significantly increased their emission of this response. The reinforced groups shown in Figure 2, those reinforced for the changing response class, also significantly increased their emission of the reinforced response class. As can be seen in both groups the emission of the correct response class is greatly decreased due to the influence of the color-naming task. Conditioning still occurs, however, significant at the .06 level.
Table 6

Analysis of Covariance of Blocks of Trials with Covariate of Operant Trials of Color-Naming Groups with Three Variables: A (Response Class), B (Reinforcement), D (Blocks of Trials)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Ss</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>102.21</td>
<td>5.26*</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>76.91</td>
<td>3.96**</td>
</tr>
<tr>
<td>A x B</td>
<td>1</td>
<td>.36</td>
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</tr>
<tr>
<td>Residual (between)</td>
<td>75</td>
<td>19.44</td>
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</tr>
<tr>
<td>Total (between)</td>
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<td></td>
</tr>
<tr>
<td>Within Ss</td>
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<td></td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>1.23</td>
<td>.19</td>
</tr>
<tr>
<td>A x D</td>
<td>4</td>
<td>33.89</td>
<td>5.22*</td>
</tr>
<tr>
<td>B x D</td>
<td>4</td>
<td>5.46</td>
<td>.85</td>
</tr>
<tr>
<td>A x B x D</td>
<td>4</td>
<td>1.30</td>
<td>.20</td>
</tr>
<tr>
<td>Residual (within)</td>
<td>307</td>
<td>6.36</td>
<td></td>
</tr>
<tr>
<td>Total (within)</td>
<td>323</td>
<td>8.91</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>399</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * significant at the .01 level
** significant at the .06 level
Fig. 1. The comparison of unchanging response class groups BNR, NC₂, BUR, UC₂ on adjusted mean number of correct responses emitted over five blocks of fifteen trials each. The operant rate for each group was used for the covariance adjustment.
Blocks of Trials

Fig. 2. The comparison of changing response class groups ANR, NC1, AUR, UC1 on adjusted mean number of correct responses emitted over five blocks of fifteen trials each. The operant rate for each group was used for the covariance adjustment.
Analysis of covariance of "d" endings

A separate analysis of covariance was performed on the color-naming reinforced group reinforced for unchanged endings and its control. All words which ended in the sound "d" were scored both in the irregular verbs and in the verbs normally adding "-ed" in their past tense. This analysis was performed in order to observe the effect of "phonemic" conditioning of the /d/ sound if it did occur in this manner. The analysis of covariance showed that the effect of reinforcement (B) did not reach the .05 level of significance. The effect of blocks of trials with reinforcement (DxB) did not reach the .05 level of significance.

Least Squares solution to the analysis of covariance using RH scores as one variable

The effect of response class (A) reached significance at the .01 level. Awareness of "good" as opposed to those aware of the correct reinforcement-response contingency, and also that the "good" spoken by E acted as a reinforcer or incentive, did not act over-all as a significant variable between groups. The interaction between response class and awareness also did not reach significance.

In the within analysis the effect of trials (D) neared significance, being significant only at the .10 level. The triple interaction between blocks of trials,
Table 7
Analysis of Covariance of Blocks of Trials
Using Operant Trials as Covariate of Color-Naming Groups Scores for /D/ Endings in Both Response Classes with Two Variables: B (Reinforcement), D (Trials)

<table>
<thead>
<tr>
<th>Source</th>
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<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between Ss</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>38.89</td>
<td>2.73</td>
</tr>
<tr>
<td>Residual (between)</td>
<td>37</td>
<td>14.23</td>
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</tr>
<tr>
<td>Total (between)</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Within Ss</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>36.61</td>
<td>8.91*</td>
</tr>
<tr>
<td>D x B</td>
<td>4</td>
<td>1.61</td>
<td>.39</td>
</tr>
<tr>
<td>Residual (within)</td>
<td>153</td>
<td>4.11</td>
<td></td>
</tr>
<tr>
<td>Total (within)</td>
<td>161</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * significant at the .01 level
awareness category, and trials (AxBxD) reached significance at the .05 level. This analysis was performed to observe if awareness as measured by RH would predict to greater conditionability in the changing, as opposed to the unchanging, response class. Winer (1962, p. 374) recommends the use of the least squares approach when the group to which $S$ is assigned is a function of the experimental manipulations.

A matrix of Pearson $r$ correlation coefficients was obtained using the adjusted score of the last block of trials for $S$ as one variable and the summed rankings of each judge for the three measures of "awareness": RH, BH, and BI as the other variable. In the color-naming groups the correlations between BH and BI and the last block of trials scores reached the .01 level of significance for those reinforced for the unchanging response class. No other correlations approached significance at the .05 level.

In the groups which did not receive the color-naming task, the correlation between the adjusted scores for the last block of trials and the summed ratings on RH reached significance at the .05 level for the group reinforced for the unchanging response class. The correlation for BI reached the .05 level of significance for those reinforced for the changing response class also. The correlations between BH and BI with the
Table 8
Least Squares Solution to the Analysis of Covariance of Blocks of Trials with Operant Trials as Covariate with Three Variables: A (Response Class), B (RH, "Awareness"), D (Blocks of Trials)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Ss</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>134.65</td>
<td>9.63***</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>5.14</td>
<td>.367</td>
</tr>
<tr>
<td>A x B</td>
<td>1</td>
<td>23.66</td>
<td>1.69</td>
</tr>
<tr>
<td>Residual (between)</td>
<td>35</td>
<td>13.97</td>
<td></td>
</tr>
<tr>
<td>Total (between)</td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Ss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>12.40</td>
<td>2.18*</td>
</tr>
<tr>
<td>A x D</td>
<td>4</td>
<td>15.28</td>
<td>1.68</td>
</tr>
<tr>
<td>B x D</td>
<td>4</td>
<td>7.55</td>
<td>1.32</td>
</tr>
<tr>
<td>A x B x D</td>
<td>4</td>
<td>16.40</td>
<td>2.88**</td>
</tr>
<tr>
<td>Residual (within)</td>
<td>147</td>
<td>5.69</td>
<td></td>
</tr>
<tr>
<td>Total (within)</td>
<td>163</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:  * significant at the .01 level
** significant at the .05 level
*** significant at the .10 level
adjusted scores reached significance at the .01 level in the unchanging reinforced group as did the correlations between RH and BH in the non-reinforced control group for the unchanging response class. This last result is due to one S, who chose the verbs ending in "-ed" and reported reinforcement on the part of E. The other correlations do not reach the .05 level of significance.

In comparing the color-naming reinforced groups with their controls, it was found that the correlations of RH and BH with conditioning differed significantly at the .06 and .02 levels from their controls. In the non-color-naming reinforced groups, the correlation of BI with conditioning differed at the .05 level from its control. In the changing reinforced groups, however, none of the correlations of RH, BH, and BI with conditioning approached the .05 level of significance in the degree to which they differed from their controls.

If the S who reported the reinforcement of "good" in the unreinforced non-color-naming unchanging group is excluded from the analysis, the correlations of RH and BH also differ significantly at the .05 level.

An analysis of variance was made using the summed rankings of the two judges as the dependent variable on the three measures, RH, BH, and BI. The between
analysis demonstrated that the main effects of reinforcement (B) and color-naming (C) influenced the awareness variables at the .001 level of significance. The interaction between reinforcement and the inter-trial activity of color-naming (BxC) also reached the .001 level of significance. The main effect of response class (A), per se, did not affect the dependent variable of RH, BH, or BI. There were also no significant interactions between the two response classes and the other variables, such as, reinforcement and inter-trial activity.

In the within analysis another pattern of findings occurred. The interaction between reinforcement and RH, BH, BI (BxD) was significant at the .001 level. Again, there were no significant interactions between response class, reinforcement, color-naming, and RH, BH, and BI. The main effect of RH, BH, and BI (D) was significant at the .001 level. This effect may be attributed to the different length of the scales used in the ratings of RH, BH, and BI.

The degree of inter-judge reliability for the one-hundred-and-sixty post-conditioning interviews for the experiment is indicated by the following per cents of agreement: 94.38% for RH, 95.63% for BH, and for BI, 78.75%. The sum of the ratings by the two judges on each measure was used to correlate with the conditioning
Table 9

Complete Correlational Analysis of RH, BH, BI with Adjusted Fifth Block of Trials’ Scores of All Ss in All Groups: R (Reinforcement), C (Control), N (Naming), U (Not Naming), A (Changing), B (Unchanging)

<table>
<thead>
<tr>
<th></th>
<th>Changing RNA</th>
<th>CNA</th>
<th>Unchanging RNB</th>
<th>CNB</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH</td>
<td>+.05</td>
<td>.00</td>
<td>-.31</td>
<td>+.22</td>
</tr>
<tr>
<td>BH</td>
<td>+.16</td>
<td>-.27</td>
<td>-.64xx</td>
<td>.00</td>
</tr>
<tr>
<td>BI</td>
<td>-.32</td>
<td>-.01</td>
<td>-.59xx</td>
<td>-.23</td>
</tr>
</tbody>
</table>

Not Color-Naming Groups

<table>
<thead>
<tr>
<th></th>
<th>Changing RUA</th>
<th>CUA</th>
<th>Unchanging RUB</th>
<th>CUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH</td>
<td>-.22</td>
<td>.00</td>
<td>-.52x</td>
<td>-.56xx</td>
</tr>
<tr>
<td>BH</td>
<td>-.15</td>
<td>+.15</td>
<td>-.59xx</td>
<td>-.57xx</td>
</tr>
<tr>
<td>BI</td>
<td>-.50x</td>
<td>-.33</td>
<td>-.67xx</td>
<td>-.23</td>
</tr>
</tbody>
</table>

Note: xx P .01, x .05 level of significance

* Level of significance of difference between correlations of reinforced unchanging and their controls.

None of the changing reinforced groups differ significantly from their controls.
Table 10

Complete Analysis of Variance of RH, BH, and BI, the Summed Ratings of Two Judges in All Groups with Four Variables: A (Response Class), B (Reinforcement), C (Color-Naming), D (RH, BH, BI)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Ss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>1.41</td>
<td>.43</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>496.13</td>
<td>150.34*</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>114.08</td>
<td>34.57*</td>
</tr>
<tr>
<td>A × B</td>
<td>1</td>
<td>.30</td>
<td>.09</td>
</tr>
<tr>
<td>A × C</td>
<td>1</td>
<td>3.67</td>
<td>1.11</td>
</tr>
<tr>
<td>B × C</td>
<td>1</td>
<td>149.63</td>
<td>45.32*</td>
</tr>
<tr>
<td>A × B × C</td>
<td>1</td>
<td>.538</td>
<td>.16</td>
</tr>
<tr>
<td>Residual (between)</td>
<td>152</td>
<td>3.30</td>
<td></td>
</tr>
<tr>
<td>Total (between)</td>
<td>159</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Ss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>47.23</td>
<td>12.81*</td>
</tr>
<tr>
<td>A × D</td>
<td>2</td>
<td>.22</td>
<td>.06</td>
</tr>
<tr>
<td>B × D</td>
<td>2</td>
<td>75.92</td>
<td>20.60*</td>
</tr>
<tr>
<td>C × D</td>
<td>2</td>
<td>.45</td>
<td>.12</td>
</tr>
<tr>
<td>A × B × D</td>
<td>2</td>
<td>1.54</td>
<td>.42</td>
</tr>
<tr>
<td>B × C × D</td>
<td>2</td>
<td>1.65</td>
<td>.45</td>
</tr>
<tr>
<td>A × C × D</td>
<td>2</td>
<td>.045</td>
<td>.01</td>
</tr>
<tr>
<td>A × B × C × D</td>
<td>1</td>
<td>1.62</td>
<td>.44</td>
</tr>
<tr>
<td>Residual (within)</td>
<td>311</td>
<td>3.686</td>
<td></td>
</tr>
<tr>
<td>Total (within)</td>
<td>327</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>479</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * significant at the .001 level
score for $s$. 
Chapter 6

Discussion

The first hypothesis to be tested was whether or not conditioning had occurred. Using an analysis of covariance, it was found that there was a significant conditioning effect. When testing the degree of differences between the reinforced groups and their control conditions, the amount of conditioning was found to be greater between the reinforced groups which did not name colors than those groups which did. This was a significant difference in favor of reinforced non-color-naming groups.

The second hypothesis, whether or not the correlations of RH, BH, and BI differ with respect to conditioning between the experimental groups and control conditions, was partially supported. In three cases the correlations for the reinforced groups differed significantly from the correlations for the control conditions. The correlations for RH and BH differed significantly from their control conditions in the color-naming group reinforced for the unchanging response class. The correlation for BI differed significantly from its control condition in the group for the unchanging response which named colors.

Upon further examination it was found that two of the significant correlations in the control conditions for the group reinforced for the unchanging response class were caused by an anomalous S in this group. This S demonstrated
an awareness of the correct reinforcement-response contingency when no reinforcement had been given in her group. Whether or not a clerical error was made in assigning S to this group as compared to another, or whether the awareness expressed by S was due to prior communication between Ss, is not known. This S and many of the other Ss in this experiment were members of upper-division psychology courses and could therefore have had some knowledge of experiments in verbal operant conditioning.

When the scores for this S, both for conditioning and RH, BH, and BI were removed from the analysis, the correlations of RH and BH for those reinforced for the unchanging response class differed significantly from the control groups' correlations for these two measures.

For those groups reinforced for the changing response class, however, none of the correlations in either the color-naming or the non-color-naming groups differed from their control groups' correlations for RH, BH, or BI. The hypothesis that the correlations between conditioning and the measures of RH, BH, and BI would differ from their control conditions was thus supported only for the unchanging response class but not for the changing response class. This suggests the conclusion that the degree of correlation between RH, BH, and BI was related to the effect of response class and not to the color-naming task.

The first hypothesis of the second set, which is concerned
with the Dixon and Oakes finding of the decrease in correlation between awareness and conditioning due to the color-naming task, is answered in the negative by the data. The color-naming task does not decrease the correlation between conditioning and the measures of RH, BH, and BI even though it does decrease the total amount of conditioning in the groups reinforced for the unchanging response class. In the changing response class, none of the correlations differ significantly from their control's correlations in either the color-naming or non-color-naming groups.

The only evidence bearing on the effect of color-naming as it relates to conditioning and awareness is provided by analyzing the amount of variance accounted for in the analysis of the awareness scores as compared to the conditioning scores. Color-naming accounts for 5.1 per cent of the variance in the conditioning scores, and 11.8 per cent of the variance in the awareness scores. This finding suggests that awareness is decreased to twice the extent of conditioning, thus suggesting that a decrease in awareness may occur without an equal decrease in conditioning scores. This may also indicate that decreases in amount of awareness are related to conditioning in a proportional manner with greater decreases in awareness relating to partial decreases in conditioning, or vice versa, greater decreases in conditioning relating to
partial decreases in awareness. The Dixon and Oakes findings are therefore only supported by this latter finding which suggests that the color-naming task is affecting the measures of RH, BH, and BI and conditioning to a different extent, i.e., awareness is decreased to twice the extent of conditioning. Awareness and conditioning are thus, to this degree, independent in their functioning.

The results indicate that hypothesis 2.a. is closest to the results of this experiment. Hypothesis 2.a. states that there would be a direct-strengthening interpretation of the results if conditioning occurred in the color-naming groups without correlated awareness measures and conditioning occurred in the non-color-naming groups with significantly correlated degrees of awareness. In this experiment, however, while conditioning occurred to a significant degree in the non-color-naming groups, it occurred to a significantly less degree in the color-naming group, although to a still significant extent. Only the correlation between BH and conditioning reaches significance in the non-color-naming reinforced group, and none of the reinforced groups' correlations differ significantly from their controls for the changing response class.

These results would appear to lend support to a direct-strengthening approach for the changing response class independently of the effect of color-naming. The correlations relate to the response class being reinforced and
not to the effect of color-naming.

Neither of the hypotheses concerning the reinforced unchanging groups (3.a.) or that conditioning would occur without awareness in the color-naming group, nor (3.b.) that conditioning would not occur without awareness in the color-naming group, were supported. It was found, instead, that the color-naming task reduced conditioning and awareness to a significant degree but did not reduce the correlation between the measures of RH, BH, and BI and conditioning. This finding suggests that with the unchanging response class, the relationship between awareness and conditioning is similar to that found by Dulany where awareness is predictive to conditioning, or it may also suggest that awareness arises out of the ease of discriminability of this response class. This result would tend to support a more cognitive type of mediational process for this response class as compared to the more direct-strengthening approach for the changing response class.

Hypothesis 4 is concerned with whether the color-naming variable influenced the correlation between conditioning and awareness and whether it influenced conditioning to any extent. Though the effect of color-naming, as seen in the preceding discussion, did not reduce the correlation between awareness and conditioning in the unchanging, nor to any great extent in the changing, response class, it did reduce the total amount of awareness
to a highly significant degree and reduced conditioning, but to only one-half the extent as it did "awareness." The proportionately greater change in awareness scores suggests that a change in awareness need not predict to a change in conditioning. The decrease in conditioning may be due only to the fatiguing effect of the color-naming task and not to the interference with conditioning. The correlations with awareness found in the groups reinforced for the unchanging response class would thus be only a post-hoc phenomenon.

Hypothesis 5 is concerned with the question of to what degree the dependent variable of conditioning is influenced by color-naming and to what extent this influences the relationship between conditioning and the measures of RH, BH, and BI. Color-naming was found to decrease the total amount of "awareness" by twice the degree of the conditioning. This would seem to indicate that awareness and conditioning may vary independently. Upon examining the correlations, however, it can be seen that the higher correlations, those that achieve significant difference from their controls, are those in the changing group. Thus, the effect of color-naming, though it did have an effect on the relationship between awareness and conditioning as far as total amount is concerned, did not influence the correlations to a noticeable degree. If the degree of awareness in the color-naming group reinforced for the
unchanging response class occurred after the conditioning session and not during it, the correlation would still be high in this group but not produce any greater degree of conditioning. Since the color-naming group reinforced for the changing response class achieved the same degree of conditioning without significantly correlated measures of RH, BH, and BI, the hypothesis that awareness of the reinforcement-response contingency occurred after the termination of the conditioning may be advanced.
Relation of findings to position I, Dulany and Spielberger's

The results of conditioning and the effect of the color-naming task as it influences conditioning and awareness scores agree well with Dulany's theoretical network in the unchanging reinforced, control, color-naming, and non-color-naming groups. Even though the color-naming task interacts significantly with conditioning, the order of $BI > BH > RH$ is followed to some degree, and is followed exactly in the unchanging non-color-naming reinforced group. The agreement of these results with Dulany's is therefore close to 100% perfect in the verbs which end simply in "-ed." In the verbs which change their form in the past tense, the results tend to follow a more random pattern of variation. None of the correlations for RH, BH, and BI in the reinforced changed groups differ to a significant degree from the same correlations for their control conditions; also, the only order found in the order of significance, i.e., $BI > BH > RH$, is that BI alone reaches the .05 level of significance.

The chief underlying assumption that the proponents of the first position uphold, that awareness in its various categories is a necessary condition for the occurrence of a reinforcement effect in verbal operant conditioning, is not upheld in the more complex response (changing) class. There is instead evidence for the notion that the degree of RH, BH, and BI account for a very minor part of the variance
in predicting to conditioning scores in this response class. If Dulany's "awareness" measures are of a self-instructional nature, then they should be predictive to conditioning and thus correlate with the conditioning data. That they do not do so with any great degree of success is evident from these data, and the total amount of awareness, it could be argued, is a product of the interviewing procedure and other demand characteristics and is not of a predictive nature.

Relation of findings to second position, Verplanck and Krasner's

These findings suggest that the action of the awareness variable is independent of that of the conditioning scores. In this experiment extraneous cues were added to the experiment to induce in $S$ the formation of incorrect hypotheses. This, it was hoped, would be the result of the inter-trial task of color-naming and also possibly the effect of the complexity of the changing response class. The effect of the inter-trial activity, though it slightly decreased the degree of relationship of the unchanging reinforced color-naming group scores with conditioning, was not to change them to any great extent. In the changing reinforced groups, the effect was again to reduce the degree of relationship of the awareness measures to the conditioning scores. It did not affect them to any great extent, however, since awareness did not relate to conditioning except for the significant BI correlation coefficient in the non-color-naming, changing
reinforced group.

Verplanck and Krasner would probably accept this finding as being congruent with their present positions. Awareness could be considered in this case to be an independent, separately manipulable variable. The investigation of response class variables has not been, however, their major concern, and therefore these results may be considered to be aligned more closely with the third position next presented.

Relation of findings to third position, Kanfer and McBrearty's

Kanfer and McBrearty (1961 & 1963) have investigated the conditioning of various response classes and the production of awareness due to the action of response class, the degree of intraclass "belongingness" of the response of a semantic nature, and the focal and contextual cues given to S when two response classes are presented to S simultaneously. In general their results indicate that awareness increases the "conditioning" effect but is not necessary for conditioning to occur. If the reinforcement-response contingency is of a subtle nature, conditioning will occur to a lesser degree, but without concomitant awareness.

These relationships between conditioning, "awareness," and response class are also found in the present experiment. In this experiment the unchanging response class had a more readily discernible form change in its past tense,
that is, adding an "-ed" in every case. On the other hand, the changing response class was often defined by its opposite, that is, those verbs which did not add "-ed" to form their past tense. The size of the response class was smaller in the changing response class; however, generalization would be difficult since the repeating of topographically identical responses would not suffice for conditioning to occur. In comparing Figures 1 and 2 it can be seen that conditioning is approximately equal for both the reinforced color-naming groups despite the greater difficulty that one would expect for conditioning to occur in the changing groups. This may be hypothesized to be due to two causes. In the first place the emission of the changing response class was the one favored by all Ss, and its greater frequency of emission would increase the probability of this response being reinforced. In the second place, its greater frequency of emission suggests that the changing form of the verb may constitute a "natural" response class, and because of its extremely high frequency of usage form, a more automatic one.

The topographic similarity of response class emission, i.e., adding "-ed" to the end of each verb, while it enabled conditioning to occur to a significant degree equaling the changing response class, plus the fact that the contingency was readily perceivable by S during the conditioning session, probably produced the high correlation between the awareness data and the adjusted scores for the fifth block of trials. The question of whether the awareness is a
product of conditioning, is concurrent with conditioning, or whether awareness mediates "conditioning" is not answered by the significant correlations in the unchanging response class. Since equal amounts of awareness occurred in the changing reinforced groups, yet the high number of significant correlations did not occur in these groups, it may be hypothesized that awareness did not occur during or before conditioning in the changing response class but afterward, possibly as an effect of the post-conditioning interview. The high correlations in the unchanging groups may be due to ease of discrimination during the conditioning trials, but if conditioning was effected by the conditioning of topographically similar responses, awareness could still be a post-hoc phenomenon.

The inference could be made that the correlations with awareness are a product of three variables here given in their approximate order of importance:

1. the discriminability of the response class, i.e., the easier the discrimination, the greater the intraclass "belongingness"; its size, i.e., the smaller the response class, the greater the intraclass relationships if topographically similar in their response characteristics.

2. the opportunity for $S$ to hypothesize during the experiment, i.e., fewer hypothesis-inducing tasks, such as, color-naming, adding numbers backwards, etc.

3. the instructions given to $S$, i.e., whether they induce
in S a set for problem-solving or ask S to spend as little time as possible examining the experimental situation. In this latter case instructions of this nature may induce more awareness than giving S more neutral instruction if they increase S's wariness of the experiment as a whole.

Ease of conditioning, apart from awareness, when S variables such as anxiety have been randomly distributed in all groups, is probably a result of natural habit family hierarchies in language behavior. A way to determine a verbal habit family would be to sample S's natural language behavior on a period of free emission and count the number of times, when S is talking about "I," he emits words such as "me," "we," "us," etc. This might give an accurate picture of the actual response contingencies and probabilities which occur throughout any given population. It could be inferred from the data obtained from this experiment that irregular verbs have a higher rate of emission in the verbal behavior of the population of the University of Hawaii Ss than is indicated by the Thorndike-Lorge frequency count. Thus, RH, BH, and BI correlations with conditioning in the unchanging reinforced and control groups were a product of the first three mentioned variables, and "conditioning" was probably increased by cognitive problem-solving behavior. In the changing groups, however, conditioning occurred without significantly correlated measures of RH, BH, and BI and this conditioning
may be attributed to the effect of a generalized reinforcer, a la Skinner (1957), acting on a response class which was already a part of Ss' past history of verbal behavior.

Generalization of results to operant and classical conditioning

The relationship found between conditioning and awareness scores, i.e., awareness bears no necessary correlation with operant conditioning, is an interesting finding in that it produces two categories of hypotheses concerning human operant conditioning. Returning to the original argument as to whether human verbal behavior is related to animal-training studies involving bar-pressing or disc-pecking behavior as contrasted with problem-solving behavior, it would appear that a more direct strengthening approach could be upheld. In this further study of Dulany's nomological network, his theory accounts for only one-half the data, i.e., the findings in the unchanging groups. This is similar to the Dixon and Oakes (1965) findings, where Dulany's nomological network could account for the findings in the reinforced non-color-naming group, but not in the reinforced color-naming group. Here the differences, with this particular experimental task, are found between response classes and not between color-naming groups; this still supports, however, the original findings of these investigators.

If verbal behavior can be conceived of in terms of
conditioning processes, operant conditioning of motor responses, which lack the close association with cognitive processes that verbal behavior is presumed to have, can easily be conceived of as a direct strengthening process. Reinforcement as a process would thus still follow the Skinnerian (1957) and Thorndikian (1932) notions of a non-cognitive, peripheral organization and chaining of probabilities.

It is interesting to note that a similar report of the relationship between awareness and classical conditioning of autonomic responses is reported by Grings (1965, p. 81). He reports that awareness of the CS-UCS contingency may increase the acquisition of a particular response such as GSR. He also states "(a) that appropriate verbal association may provide conditioning-like behavior modification in the absence of paired stimulation and (b) that conditioning will occur in the absence of verbalized awareness of stimulus relations."

The relationship between classical and operant conditioning is evident since increased acquisition occurs with verbal mediation of stimulus-stimulus or stimulus-response association, but the effect of conditioning in either case may be observed separately with no necessary relationship between conditioning and verbal reports.
Chapter 7
Summary and Conclusions

One-hundred-and-sixty Ss from psychology courses at the University of Hawaii were used for this experiment. Using a variant of Greenspoon's (1955) procedure for conditioning plural nouns, the allomorph /D/ (unchanging response class) and verbs which change their form in the past tense (changing response class) were conditioned by E's saying "good" after S had verbalized a member of the correct response class in the reinforced groups. A memory drum presented a color-naming task to four groups, two reinforced and two controls. From the previous study by Dixon and Oakes (1965), it was hypothesized that this inter-trial task would interfere with the report of "awareness" on a post-conditioning interview patterned after that used by Dulany; see Table 1. All groups received the post-conditioning interview. There were eight groups in all: two experimental color-naming reinforced changing and unchanging groups; two reinforced groups, one for changing and one for unchanging which did not name colors; two groups, one scored for changing and one for unchanging responses, which named colors and were not reinforced; and two groups, one scored for changing and one for unchanging, which chose past tense verbs only.

The results of the analysis of covariance of the scores of all groups indicated that conditioning had occurred
equally in the reinforced non-color-naming groups both for changing and unchanging, and also equally in the changing and unchanging color-naming groups. In this latter case, however, the effect of the color-naming task was to significantly decrease conditioning and awareness scores, but to the same degree in both the changing and unchanging reinforced color-naming groups.

Using the Pearson $r$ correlation coefficient to determine the degree of relationship between the measures of RH (reinforcement hypothesis), BH (behavioral hypothesis), and BI (behavioral intentions) and the adjusted scores on the fifth block of trials for all groups, it was found that the measures of BI reached a significant correlation at the .05 level with conditioning in the changing reinforced non-color-naming group. In the unchanging reinforced groups, only the correlation of RH and conditioning failed to reach the .05 level of significance. All other correlations between the measures of "awareness" and conditioning reached either the .05 or .01 level of significance; also, two of the correlations between RH and BH in the unchanging non-reinforced non-color-naming group reached significance at the .01 level. This was found to be due to an $S$ who reported the awareness of a reinforcer given by $E$ and was probably due to a clerical error in the labeling of $S$'s scoring sheet during the experiment or could also be due to the sophisticated nature of $S$s used in this
experiment. When the data for this S are excluded from the analysis, all of the correlations for RH, BH, and BI for the unchanging reinforced group differ at the .05 level of significance from their controls. In the color-naming groups for the reinforced unchanging groups, the correlations for RH and BH differ significantly from their control conditions. None of the changing reinforced groups differed from their control groups.

The conclusions drawn from the correlations between awareness and the adjusted fifth block of trials' scores are vitiated by the data from this anomalous S. The correlations may therefore only be considered to suggest a tentative conclusion. In general terms the effect of the color-naming task was to decrease the amount of awareness to twice as much as it decreased conditioning. This finding, when coupled with the data from the correlational analysis, supports the hypothesis that verbal operant conditioning may occur without awareness.

The results suggest the conclusion that ease of discriminability of the response class, focal and contextual cues between response classes, and the size of the response class as it relates to the hierarchies of response emission accounted for the degree to which the measures of awareness related to conditioning in the changing and unchanging response classes. It could also be inferred that the unchanging response class was more
clearly discriminable and therefore had highly correlated measures of awareness because of the repetition of "-ed" endings, and was also easily conditioned because of topographically similar or nearly identical response for each past tense verb. The changing response class, it may be posited, however, was readily conditionable because of its high frequency of emission and smaller size. Its greater complexity of formation, i.e., a new topographic response for almost every verb and the difficulty S had in describing the type of response reinforced, led to lower correlations between RH, BH, and BI and adjusted fifth block of trials' scores as compared to the more readily discriminable unchanging form of response.

The theoretical implications of the findings suggest that with some verbal responses, a Skinnerian model of the operant conditioning of human verbal behavior presents an adequate paradigm. These findings do not concur with the Dulany (1961) and Spielberger (1961) position of the interposition of cognitive rules between stimulus and response as the mediators of verbal operant conditioning in all cases. The findings lend support to the positions of Verplanck (1962) and Krasner, et al., (1962), which follow the more traditional conceptions of Skinner (1957), Dollard and Miller (1950), and Thorndike (1933) in their view of verbal conditioning as having as its basis a direct strengthening or non-cognitive change in probabilities.
of response emission. The works of Kanfer, et al., (1961), and McBrearty, et al., (1963), also show similar findings as those which occurred in this experiment in the relationship found between awareness measures and the operant conditioning of different verbal response classes.
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