
Thomas Daniel Kennedy
Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses

Recommended Citation
https://digitalcommons.lsu.edu/gradschool_disstheses/1344

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.
This dissertation has been microfilmed exactly as received 67-17,327

KENNEDY, Thomas Daniel, 1931-
PERFORMANCE AND AWARENESS IN VERBAL CONDITIONING: "FORCED" REINFORCEMENT AND RECURRING ASSESSMENT OF AWARENESS DURING CONDITIONING.

Louisiana State University and Agricultural and Mechanical College, Ph.D., 1967
Psychology, general

University Microfilms, Inc., Ann Arbor, Michigan
PERFORMANCE AND AWARENESS IN VERBAL CONDITIONING:
"FORCED" REINFORCEMENT AND RECURRING ASSESSMENT
OF AWARENESS DURING CONDITIONING

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by

Thomas Daniel Kennedy
B.A., Tulane University, 1953
M.A., Louisiana State University, 1963
August, 1967
ACKNOWLEDGMENTS

The writer is especially grateful to his advisor, Dr. Edwin O. Timmons, for his aid and encouragement throughout the project, to Dr. A. Clinton Pereboom for his perspicacious suggestions with respect to the design of the study and to Dr. John R. Stabler, Dr. Felicia A. Pryor and Dr. William G. Haag for serving on the examining committee. The assistance of Mrs. Suzanne P. Goodell and Mr. Francis M. Crinella, who served as interviewer and judge, respectively, is gratefully acknowledged. The author also wishes to express his deep appreciation to his wife, Sue, for helpful reading of the manuscript, to Mrs. Mary C. Mevers for typing the manuscript and to Mr. David H. Hovey, Jr. for preparation of the graphs.

Thanks are also due to the faculty of the Department of Psychology, Louisiana State University, whose cooperation greatly facilitated the collection of data for this study.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vi</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>vii</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHOD</td>
<td>10</td>
</tr>
<tr>
<td>Subjects</td>
<td>10</td>
</tr>
<tr>
<td>Materials and Experimental Design</td>
<td>10</td>
</tr>
<tr>
<td>Conditioning Procedure</td>
<td>15</td>
</tr>
<tr>
<td>Postconditioning Awareness Interview</td>
<td>19</td>
</tr>
<tr>
<td>Method for Assessing Awareness</td>
<td>20</td>
</tr>
<tr>
<td>RESULTS</td>
<td>22</td>
</tr>
<tr>
<td>Ratings of Awareness</td>
<td>22</td>
</tr>
<tr>
<td>Other Factors Related to Incidence of Awareness</td>
<td>27</td>
</tr>
<tr>
<td>Analysis of Performance Data</td>
<td>28</td>
</tr>
<tr>
<td>Comparisons of Experimental Groups with Control Group</td>
<td>30</td>
</tr>
<tr>
<td>Experimental Groups Compared with One Another</td>
<td>33</td>
</tr>
<tr>
<td>Performance of Aware Ss prior to and after Reports of Awareness</td>
<td>34</td>
</tr>
<tr>
<td>Reanalysis of Performance Data of Aware Ss.</td>
<td>39</td>
</tr>
<tr>
<td>Other Factors Related to Performance</td>
<td>44</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>46</td>
</tr>
</tbody>
</table>

iii
<table>
<thead>
<tr>
<th>Hypothesis 1</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Hypothesis 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Hypothesis 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Hypothesis 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
</tr>
<tr>
<td>Ratings Made from Notes and Awareness Interview</td>
<td>54</td>
</tr>
<tr>
<td>Correlated Hypotheses</td>
<td>57</td>
</tr>
<tr>
<td>CONCLUSIONS</td>
<td>62</td>
</tr>
<tr>
<td>Implications and Suggestions for Future Research</td>
<td>64</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>67</td>
</tr>
<tr>
<td>APPENDIX A: Postconditioning Awareness Interview</td>
<td>70</td>
</tr>
<tr>
<td>VITA</td>
<td>75</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Predetermined Frequency of Experience with the &quot;Correct&quot; Response Class out of Every Twenty Training Trials on each of the Four Acquisition Blocks</td>
<td>13</td>
</tr>
<tr>
<td>II. Awareness Ratings Assigned to the 18 Ss in Each of the Experimental Groups</td>
<td>23</td>
</tr>
<tr>
<td>III. Summary of Ideas Recorded by Aware Ss on the Aware and Preaware Trial Blocks and Performance on the Preaware Blocks (Raw Data)</td>
<td>40</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Performance Curves of Aware (AW), Correlated Aware (CA), Unaware (NI, GI, AI) and Control (C) Groups</td>
<td>31</td>
</tr>
<tr>
<td>2. Vincentized Performance Curve for Nine Aware Ss. Trial Block 5 Represents the Point at which Aware Ss First Recorded Correct Hypotheses with a High Degree of Certainty (Confirmed)</td>
<td>37</td>
</tr>
<tr>
<td>3. Vincentized Performance Curve for Nine Aware Ss. Trial Block 4 Represents the Point at which Aware Ss First Recorded Correct or Correlated Hypotheses with a Lower Degree of Certainty (Fairly Certain or Less)</td>
<td>42</td>
</tr>
</tbody>
</table>
ABSTRACT

An experimental analysis of two alternative theoretical positions concerning the role of awareness and the role of reinforcement in verbal conditioning was conducted. Reinforcement interpretations of verbal conditioning contend that performance gains initially result from the direct and "automatic" effects of reinforcement, and that gains occur prior to the time that the S becomes aware of the response-reinforcement contingency. Cognitive explanations maintain that awareness precedes, and is a necessary condition for, improvement in performance.

These alternative positions were tested by investigating the temporal relationship between the learning of awareness and the inception of performance gains as a function of reinforced practice. The premise underlying the study was that Ss respond differentially to social reinforcement and that it is the S's reinforcement history on the verbal conditioning task that is crucial for performance gains and the learning of awareness. To test this assumption an experimental design in which reinforcement histories could be equated was employed.

Seventy-two undergraduate college students served as Ss. A modified Taffel procedure was used as the conditioning vehicle. During acquisition Ss received Training trials which permitted E to control the frequency of experience with the response class designated as "correct." In this way the Ss' reinforcement histories were equated by "forced" reinforcement "programmed" according to predetermined rates.
Frequency of selection of the "correct" response class on non-reinforced test trials was the performance measure. Awareness was assessed by notes written by Ss after each Test trial and by a detailed postconditioning awareness interview.

Results supported the over-all prediction that significant performance gains can occur prior to or in the absence of the learning of awareness as a function of reinforced practice. The following conclusions appeared justified by the results:

1. Reinforcement exerts a differential effect upon performance and awareness.

2. Social reinforcers do not have the same strengthening effect upon all Ss.

3. The temporal relationship between performance and awareness posited by Spielberger and DeNike (1966) is an artifact of an insensitive methodology for obtaining reports of awareness during the conditioning task.

4. Notes written by Ss during the conditioning task can be reliably used for assigning ratings of awareness and unawareness.

5. Correlated hypotheses appear to be particularly susceptible to erroneous ratings of awareness.

Implications of the present findings and suggestions for further research were discussed.
INTRODUCTION

The results of the early investigations of verbal operant-conditioning were interpreted as demonstrating that verbal behavior, already available to the S, may be modified by social reinforcement without the S being aware of the principle (contingency) by which reinforcement was administered. Reinforcement theorists (Krasner, 1962; Postman and Sassenrath, 1961; Verplanck, 1962) contend that the effect of the reinforcer is direct, and not necessarily mediated by cognitive processes (i.e., awareness, operationally defined as the ability to verbalize the correct response-reinforcement contingency). According to the reinforcement position, awareness, if and when it occurs, is a consequence of improvement (performance gains) rather than its cause.

Recently, however, this interpretation has been questioned by investigators favoring a cognitive explanation (Dulany, 1962; Spielberger, 1962). They have suggested, instead, that increases in the rate of emission of the reinforced response class (performance gains) in verbal conditioning experiments are mediated by conscious cognitive processes. That is, awareness precedes, and is a necessary condition for, performance gains.

Dulany (1962) and Spielberger (1962) have contended that the early reported findings of conditioning without awareness were an artifact of the method for assessing awareness. In particular, the early interviews or questionnaires were considered to be too brief and general, so that when an S obtained what seemed to be conditioning
without the $S$ being able to verbalize the response-reinforcement (r-r) contingency, it was due, according to Dulany and Spielberger, to the insensitive questionnaires utilized in the postexperimental interviews. Levin (1961), using a detailed questionnaire containing 16 questions, tested this assumption. The first four questions were similar to those used to assess awareness in the early studies. Evidence for conditioning without awareness was found when $S$'s responses to the first four questions were used as the basis for inferring awareness. When the full interview was used "... the evidence for conditioning without awareness was found to have been largely accounted for by $S$s who had been aware but whose awareness was not revealed by the brief interview" (Levin, 1961, p. 74).

The Dulany-Spielberger explanation that performance gains in verbal conditioning are cognitively mediated is based, in part, upon repeated findings of a positive relationship between degree of awareness and amount of verbal conditioning when more sensitive and detailed interviewing procedures are employed in assessing awareness. Other evidence cited in support of the cognitive position comes from studies which have investigated the temporal relationship between awareness and the inception of performance gains (DeNike, 1964; Spielberger, Bernstein, and Ratliff, 1966). To investigate this relationship DeNike had $S$s write down their "thoughts about the experiment" (notes) after each block of conditioning trials. Upon completion of the conditioning task (emission of human nouns) $S$s were interviewed according to a detailed schedule of questions similar to Spielberger (1962). It
was found that for 58 of the 61 Ss in the experimental group awareness ratings made on the basis of the notes agreed with those independently made on the basis of the interview. Further, DeNike found that only aware Ss showed performance gains and that increments in performance first occurred on the trial block on which aware Ss first recorded that they had become aware of the r-r contingency. Statistical analysis indicated that there was no tendency for performance to increase during the preawareness trial blocks. It was concluded that "... the results support the hypothesis that a cognitive learning process mediates performance gains in verbal conditioning" (DeNike, 1964, p. 527).

Although the evidence presented by the cognitive researchers in support of their theory appears compelling, their two main approaches to investigating the events occurring in verbal conditioning (i.e., interview procedures and temporal relationships) are not without methodological shortcomings. With respect to interview procedures, Farber (1963) recognized the possibility that the correct r-r contingency may be suggested during the awareness interview by detailed questions of increasing specificity and, according to Greenspoon (1963), each successive question may provide S with some information about the contingency. Krasner and Ullmann (1963) maintained that the content of the interview itself may influence S to view the conditioning task in retrospect and then formulate the contingency, thus verbalizing an awareness that did not previously exist.

The investigation of the temporal relationship between
awareness and the inception of performance gains has been highly informative in that the problem has been narrowed down to a single trial block. Nonetheless, the findings of DeNike (1964) and Spielberger et al. (1966) are far from being unquestionable demonstrations of the priority of a learned response (awareness) which then cognitively mediates an increased output of the reinforced response. The S's "thoughts about the experiment" were written down only at the end of each block of 25 trials. Assuming that the Ss were appropriately motivated to receive reinforcement, an unequivocal demonstration that the performance gains first noted on the "aware" trial block were mediated by cognitive processes would have required the report of a confirmed hypothesis (Spielberger and DeNike, 1966, p. 320) at the end of the preceding trial block or early in the "aware" trial block. Since the "aware" trial block data do not permit this type of determination, the argument that awareness of the contingency was a consequence of the performance gains is equally plausible.

It was with these two cognitive approaches to the experimental analysis of awareness in verbal conditioning that the present paper was concerned. The primary purpose was to investigate the temporal relationship between the learning of awareness and performance gains on a verbal conditioning task as a function of reinforcement. A major premise of the cognitive theory of verbal conditioning posited by Spielberger and DeNike (1966, pp. 314 and 320) is that performance gains (increases in the reinforced response) do not occur prior to verbalization of a correct or correlated r-r contingency (confirmed
hypothesis). A necessary prediction from this cognitive theory is that Ss who are motivated to receive reinforcement can learn the r-r contingency when reinforced at a level consistent with their rate of emission during the operant period. That is, some Ss are apparently able to make use of the information provided by reinforcement at this level in forming correct or correlated hypotheses which, in turn, mediate an increased output in the reinforced response. Others are not.

Within the framework of reinforcement theory it has been postulated that social reinforcers do not have the same strengthening effect on all Ss (Baron, 1966; Kanfer and McBrearty, 1961). According to Philbrick and Postman (1955) the systematic application of social reinforcement in a verbal conditioning situation should lead to differential rates of emission of the reinforced response so that some Ss do not show an increase of the rate of emission above their operant level, whereas others do so at varying rates. An alternative explanation in reinforcement terms for the learning of awareness is that it is a function of the differential effects of social reinforcement upon the rates of emission of the designated response class. That is, it is the S's learning history (i.e., frequency of experience with the reinforcing stimulus) on the verbal conditioning task itself that is crucial for the subsequent development of awareness. A possible explanation, in these terms, for the typical finding that some Ss learn awareness and others do not is that the two groups have had unequal histories of reinforced practice on the conditioning trials. Those Ss whose rate of emission increases in response to social reinforcement will, in
turn, experience reinforcement more frequently and will be more likely to learn the relationship between their response and the reinforcement given by E.

The temporal relationship between awareness and performance gains was investigated in the present study under conditions of "programmed" reinforcement, and in the absence of the usual reciprocal interaction between S's response on performance trials and reinforcement given by E. This was accomplished by employing a modified Taffel (1955) procedure. The reciprocal interaction between S and E on performance trials was eliminated by divorcing the conditioning (Training) trials from the performance (Test) trials and by reinforcing only on the Training trials. "Programmed" reinforcement was effected during Training by using "forced" trials. The stimulus materials (3x5-inch cards) used contained five personal pronouns; on each Training trial one of the pronouns was underlined. The S was instructed to select the underlined pronoun in constructing his sentence. In this manner, frequency of experience with the reinforced response class (and hence reinforcement) could be programmed according to predetermined rates. Each time the S was "forced" to use one of the pronouns designated as "correct," reinforcement was given. This design, then, treated both the learning of awareness and the inception of performance gains as dependent variables subject to the same Training conditions.

The second purpose of the present study was to evaluate the extent which awareness of the r-r contingency may be suggested or influenced by a detailed post-conditioning interview. The development
or onset of awareness was assessed by having Ss write down during the Test trials their ideas concerning the rule or principle for constructing sentences in the experiment. A postconditioning awareness interview adapted from Dulany (1962) and Spielberger (1962) was also employed. Ratings of awareness from these two sources were compared and judgments as to whether awareness was learned during the trials or suggested by the interview were made.

The questions investigated and the methods of inquiry were as follows:

1. Does reinforcement have a direct and "automatic" strengthening effect upon performance? That is, can there be a significant increase in response selection on the Test trials as a function of reinforced practice prior to or in the absence of the learning of awareness? For Ss reporting awareness of a correct or correlated hypothesis in their notes during acquisition, this was determined by comparing their performance on the Test trials up to the point of the report.

2. Can the learning of awareness (as assessed by S's notes) occur in the absence of an increase in reinforced practice on the Training trials as Spielberger and DeNike (1966) have contended? This was tested by "programming" one Experimental group to receive reinforcement on each acquisition trial block at operant (chance) level.

3. Or, on the other hand, is an increment in reinforced practice necessary for the learning of awareness to occur? This was tested in two ways during acquisition:
a. One Experimental group received "programmed" reinforcement initially at the operant level, which then gradually increased beginning with trial block two.

b. Another Experimental group received "programmed" reinforcement at the operant level on each of the first two trial blocks with an abrupt increase in "programmed" reinforcement on trial block three.

4. Can the notes written by Ss during acquisition be reliably used for rating awareness and for determining whether or not extended and detailed interviews suggest awareness. This determination was made by initially asking each S during the postconditioning awareness interview to state his idea of the correct principle for constructing sentences in the experiment. It was expected that this statement would show close correspondence to the principle or principles written during acquisition. One of the last questions asked the S on the awareness interview was to again state his idea of the correct principle. If the S changed his opinion from his initial interview statement, further questioning attempted to determine whether the changed opinion was a function of interview suggestion or whether the S simply had difficulty in conceptualizing his ideas.

The over-all prediction tested was that significant performance gains (increases in the "correct" response class) can occur prior to or in the absence of the learning of awareness as a function of reinforced practice. The following five hypotheses were formulated to test this prediction.
1. When the verbal responses of Ss on the Training trials are followed by "programmed" reinforcement which does not increase above operant (chance) level, the frequency of "correct" pronoun responses of unaware Ss will not be significantly altered on the Test trials.

2. When the verbal responses of Ss on the Training trials are followed by "programmed" reinforcement which increases above operant (chance) level, the frequency of "correct" pronoun responses of unaware Ss will be significantly raised on the Test trials.

3. The learning of awareness, if it occurs at all, will occur subsequent to performance gains on the Test trials and as a consequence of the increase in "programmed" reinforcement on the Training trials.

4. The learning of awareness, if it occurs at all, will occur more often among Ss receiving an increase in "programmed" reinforcement during Training than among Ss receiving no increase in "programmed" reinforcement during Training.

5. Notes written by Ss during acquisition concerning the principle or rule for constructing sentences in the experiment can be reliably used for rating awareness of a correct or correlated r-r contingency.
METHOD

Subjects

The Ss were 72 volunteers from lower division undergraduate Psychology courses. Each S received four experimental points or credits toward his course grade based upon time actually spent in the experiment. To induce motivation, however, the students were told, when contacted regarding participation, that they could earn from one to four points depending upon how actively they participated in the experiment. They were asked not to volunteer if they were not willing to come under these conditions.

The Ss were randomly assigned to one of four groups. The three Experimental groups and the Control group each contained 18 Ss. Males and females were equally represented in all groups. None of the Ss professed any prior knowledge of the experiment, nor had any previously participated in a verbal-conditioning study.

Materials and Experimental Design

A sentence construction task described by Taffel (1955) was employed as the operant-conditioning vehicle. Each sentence was designated as a trial; there were a total of 140 trials. The first 20 trials constituted the operant (non-reinforced) period. This was followed by 120 acquisition trials consisting of four blocks of 30 trials each. There were 20 Training trials and 10 Test trials within each block of acquisition trials. The trials within each acquisition block were presented in an alternating sequence of two Training
trials and one Test trial (i.e., 2 Training, 1 Test--2 Training, 1 Test--etc.).

All four groups received the same instructions, and all groups were treated alike (i.e., no reinforcement) during the operant and Test trials. The groups differed only during the Training trials with respect to frequency of experience with the pronouns and, hence, reinforcement.

The stimulus materials consisted of 140 3x5-inch plain white cards. Typing on each card were two different neutral past tense verbs taken from the list used by Binder and Salop (1961), plus the five pronouns (I, WE, YOU, HE, THEY). The order of appearance of the pronouns was randomized over all cards within the operant period and over all cards within the acquisition period.

During the operant period S's task was to construct a sentence, using either verb, and to begin the sentence with any one of the pronouns. No response was reinforced on these 20 trials in order to establish each S's operant rate for selecting the various pronouns.

On each of the 80 Training cards one of the five pronouns was underlined. The S's task was to construct a sentence using either of the verbs and beginning with the underlined pronoun. This procedure of using "forced" Training trials enabled E to control or "program" the frequency of experience with each pronoun and, hence, the

---

1 The stimulus materials used on the 40 Test trials actually consisted of 2 3/4 x 8 1/2-inch plain white strips of paper. However, these materials are referred to as cards for simplicity of discussion.
occurrence of reinforcement. That is, each time an S in an Experimental group was "forced" to use one of the underlined pronouns designated as "correct" in constructing a sentence, he was reinforced with a mild affirmatory word ("Good," "Fine," or "Mmm-hmm") at the end of the sentence. Each S was reinforced for sentences beginning with I and WE or HE and THEY. Since all Experimental groups were initially reinforced at chance level (40%) on the early Training trials, it was important that the operant rate and the initial rate of "programmed" reinforcement be matched as closely as possible. In order to facilitate this matching the "correct" pronoun class (I and WE or HE and THEY) reinforced for any given S on the Training trials was the one selected by the S during the operant period which most closely approached chance level.

The learning (reinforcement) history was "programmed" by using different sets of cards for each Experimental group on the Training trials. One group, designated as No Increase (NI), was reinforced at chance level (40%) over all 80 Training trials. This was accomplished by underlining the "correct" pronoun on eight cards (four each of the response class reinforced) out of every 20 Training cards within each acquisition block (see Table I). The other three non-reinforced pronouns were each underlined on four of the remaining 12 Training cards. Thus, Ss in Group NI were forced to use a "correct" pronoun eight times out of each 20 Training trials and, consequently, received eight social reinforcements. In this way, frequency of selection of the "correct" pronoun class could be "programmed"
TABLE I

PREDETERMINED FREQUENCY OF EXPERIENCE WITH THE "CORRECT" RESPONSE CLASS OUT OF EVERY TWENTY TRAINING TRIALS ON EACH OF THE FOUR ACQUISITION BLOCKS

(Each Block Subdivided for Trend Illustration)

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Acquisition Blocks</th>
<th>Reinforcement over trials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 FH&lt;sup&gt;a&lt;/sup&gt; SH&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2 FH SH</td>
</tr>
<tr>
<td>NI</td>
<td>4 4 4 4 4 4 4 4 32 40</td>
<td></td>
</tr>
<tr>
<td>GI</td>
<td>4 4 5 6 7 7 7 8 48 60</td>
<td></td>
</tr>
<tr>
<td>AI</td>
<td>4 4 4 4 7 8 8 8 47 59</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>First half of each acquisition block consisting of 10 Training trials.

<sup>b</sup>Second half of each block.
during Training so that Ss in Group NI experienced no increase in frequency above the operant level.

The predetermined frequency of experience with the "correct" pronoun class out of every 20 Training trials for the other two Experimental groups is also shown in Table I. The 20 Training trials are divided in half within each acquisition block to depict more clearly the trend or pattern of reinforcement. Group GI experienced a gradual increase in frequency beginning on Block 2 and continuing through the remaining blocks. The group designated as Abrupt Increase (AI) was similar to Group NI during the first half of acquisition. On Block 3, however, Group AI experienced an abrupt increase in frequency of experience with the "correct" response class. As can be seen in Table I, Groups GI and AI received approximately the same number of reinforcements over the 80 Training trials.

The Ss in the Control group were divided into three sub-groups of six Ss each. On the Training trials each Control sub-group corresponded to one of the Experimental groups. In other words, the same set of Training cards used for Group NI were used for one of the Control sub-groups, Group GI cards for one Control sub-group, and Group AI cards for the third sub-group. This procedure was followed on the Training trials to control for the possibility that an increase in frequency of the "correct" pronoun class alone might lead to an increase in selection of these pronouns on the Test trials. To provide some form of encouragement for the Control Ss, reinforcement was administered randomly for a "correct" response on four of the 80 Training trials.
The S's sentence construction task on the 40 Test cards was the same as during the operant period. Also like the operant trials, no response on the Test trials was reinforced. In addition to the sentence construction task, Ss were instructed to write down on each Test card any ideas they had concerning the rule or principle for constructing sentences in the experiment. They were also instructed to indicate how certain they were of any idea they wrote down.

**Conditioning Procedure**

Each S, seen individually, was seated across a 3x5 ft. table from E in a small room. A cardboard screen, 13 in. high and 15 in. wide, was at one end of the table. The screen was placed between S and E after the instructions had been read to prevent them from seeing each other's writing activity. Since they could see one another's face, E made a concerted effort to minimize visual cues during the conditioning procedure. Initially S was engaged in a few moments of conversation concerning his academic major, hobbies, etc. to establish rapport. Prior to reading the instructions, E asked S if he had any prior knowledge of the experiment. If so, it was explained that he could not be used in the study but that he would receive an experimental point for keeping the appointment. If S had no prior knowledge the following instructions were read:

This is a learning experiment. It is similar to most new experiences that you have had occasion to undertake. For example, when you take a new course here at school you have very little knowledge about it at the outset. If you were tested on the first day of class
you probably would not do very well. But by attending lectures you gain knowledge about the course. This training should then help you when you are later tested on the lecture material.

We are going to follow this same sequence of events today. That is, the experiment is divided into three parts, and your task during each part will be to construct sentences. The first part is a Pre-test in which you will make up sentences prior to any training. You will then receive training on the task and be tested again. This Test score will be compared with your Pre-test score to see how much you improved as a result of the training. The only difference from the classroom situation I described is that your Test will not occur all at once at the end of training. Rather, testing will occur throughout the Training period and your performance will be combined into a total Test score at the end of the experiment.

You will notice that I have three sets of cards. (The sets were placed in a row in front of S. Throughout the instructions E pointed to the respective set each time it was mentioned.) This set will be used for the Pre-test sentences, this set for the Training sentences, and this set for the Test sentences. All of the cards have five pronouns typed on the top line and two simple past tense verbs on the second line (E showed S a sample card). Your task is to make up a sentence using one of the pronouns and one of the verbs and say it aloud. Always begin your sentences with the pronoun; the verb can be placed anywhere in the sentence you like. On the Pre-test and Test cards you may choose any one of the pronouns and either of the verbs
you like. On the Training cards, however, one of the pronouns will be underlined. You are to use the underlined pronoun to begin your sentence and either of the verbs in your sentence. Your sentences need not be lengthy but, at the same time, they should not be unduly short. You will have 5 to 10 seconds to make up each sentence.

I will hand you the cards one at a time. Each card is considered a trial. After you have said your sentence aloud, place the card face down on the table. When you have gone through all of the Pre-test cards we will begin with the Training cards. After every two Training cards I will hand you a Test card. We will repeat this procedure until we have gone through all of the cards. Now, do you have any questions up to this point?

The Training trials are intended to help you on the Test trials. On each Test trial you will have one other thing to do in addition to making up your sentence. After saying each sentence aloud, I would like you to write down, briefly but clearly, on the bottom portion of each Test card any ideas that come to you concerning the way in which you think your sentences should be made up in this experiment. There is a rule or principle for constructing sentences in this experiment and I want to see if you are able to determine it. Both your verbal sentences and your written ideas will be compared with those of other students who have participated in the experiment to see how well you did. Let me caution you not to become discouraged. It is important that you continue to apply yourself throughout the entire experiment.
It may well be that you will not have any ideas on the first few Test trials concerning the way in which you think your sentences should be made up. If so, write the word "none." However, it is very important that as soon as an idea occurs to you that you write it down at the first opportunity you have to do so. Don't hesitate to write your idea down because you think it is irrelevant or foolish, or because you want to wait and try it out. Write it down when it first occurs to you because you can always change it later. Each time you write down an idea I would like for you to indicate how certain you are of the idea. You can do this simply by checking one of the choices (guess, uncertain, fairly certain, or very certain) typed on the bottom left hand side of each Test card.

Once you have written an idea down and it remains unchanged you may write the word "same" on each successive Test card. However, as you are going through the cards, an idea different from the one you have previously written down may occur to you. When this happens it is very important that you write it down as soon as it occurs to you. Again, let me remind you not to hesitate in writing down any ideas that you may have. Do you have any questions up to this point?

Now let me review. On all the cards you are to make up sentences and say them aloud. Always begin your sentences with a pronoun. On the Test cards you are also to write down your ideas concerning the rule or principle for constructing sentences in this experiment as soon as they occur to you; do not say your ideas aloud to me. Remember, the Training trials are intended to provide you with information to
help you perform your two tasks on the Test cards. You will get no information about your Test performance until the experiment is over.2 Apply yourself throughout the experiment so that you will compare favorably with, or better than, other students. Once you begin, I do not want you to ask any questions unless you are puzzled about the procedure, or to make any comments until you have finished. Do you have any questions? (Where necessary, instructions were repeated. Questions concerning the purpose of the experiment were answered with the assurance that it would be explained afterwards.)

I am going to place this cardboard screen between us. We will be able to see one another but I do not want to see what you are writing and, likewise, I do not want you to see what I am recording. Okay, let's begin.

Postconditioning Awareness Interview

Upon completion of the conditioning task, each S was directed to another room where he was interviewed by a second E (hereafter referred to as the Interviewer) who had no knowledge of the group to which S had been assigned nor of his performance on the conditioning task. The only information provided to the interviewer was the pronoun class reinforced for each S. The S's responses were recorded verbatim by the interviewer. The questions used on the awareness interview were adapted from those used by Dulany (1962), Levin (1961)

---

2This point was emphasized to minimize the possibility of extinction occurring on the Test trials.
and Spielberger (1962), and were modified for the present experimental design on the basis of a pilot study. The awareness interview is presented in Appendix A.

Upon completion of the interview the S was told to return to the room where the experiment had been conducted for an explanation. The E then briefly explained the purpose of the experiment, and answered any questions S posed. The S was asked not to discuss the experiment with other students.

Method for Assessing Awareness

The criterion of awareness used in the present study was the report of a correct or correlated behavioral hypothesis (Dulany, 1961; Dulany, 1962) which, if acted upon consistently, should lead to a high frequency of selection of the "correct" pronoun class. Following the procedure described by Dulany (1962), Ss who reported a correct hypothesis were classified as aware (AW), and Ss who reported a positive but imperfectly correlated hypothesis were rated as correlated aware (CA). The Ss who reported neither type of hypothesis were considered unaware (UA).

Ratings of awareness were made independently by E and the interviewer. The ratings by E were inferred from the "ideas concerning the rule or principle for constructing sentences" (notes) written by the Ss on the Test trials. The interviewer's ratings were based upon the responses given by Ss during the awareness interview. With respect to any particular S, if the two ratings agreed, no further steps were taken. In cases of disagreement between E and the
interviewer the Ss' verbatim awareness interview protocols were submitted to a judge who had no knowledge of each S's group or performance. In addition, the judge was blind with respect to the ratings assigned by the first two raters. In any particular case, the final classification (i.e., AW, CA, or UA) assigned was that agreed upon by any two of the three raters.
RESULTS

Ratings of Awareness

All Ss in the Control group were rated as UA by both E and the interviewer. The awareness ratings assigned to the 18 Ss in each of the Experimental groups is shown in Table II. Among the 54 Experimental Ss, both raters (E and the interviewer) agreed perfectly in rating nine Ss as AW, and agreed in classifying 33 out of 34 Ss as UA. The one S about whom there was disagreement was rated as UA by E and as CA by the interviewer. The UA classification was based on the fact that this S showed no increase in performance on the Test trials, and her notes revealed mainly position and order hypotheses. The judge's rating agreed with that of E, making a total of 34 UA Ss. Thus, it was concluded that the ratings of AW Ss and UA Ss was highly reliable.

The remaining 11 Experimental Ss were rated as CA. There was agreement about seven of these between E and the interviewer. Of the remaining three out of four Ss, E rated two as UA and one as "probably UA but uncertain" on the basis of the notes written by these Ss. The most predominant idea written by one of the Ss considered UA by E was that he should "... make similar sentences" (unqualified). The other wrote that the rule or principle was to "... try to make a better and wider range of sentences." In all three of these cases the judge and interviewer agreed on ratings of CA, but both also felt that these correlated hypotheses may have been suggested to the Ss by
TABLE II

Awareness Ratings Assigned to the 18 Ss in Each of the Experimental Groups

<table>
<thead>
<tr>
<th>Awareness Classification</th>
<th>Unaware</th>
<th>Correlated Aware</th>
<th>Aware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI</td>
<td>11</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>GI</td>
<td>10</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>AI</td>
<td>13</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>11</td>
<td>9</td>
</tr>
</tbody>
</table>
the awareness questionnaire. The greatest amount of difficulty in assigning a classification of CA, and of disagreement between the raters, was encountered with the remaining S. The E assigned a rating of "possible CA"; the interviewer was "uncertain of a rating of UA or CA"; and the judge felt that this S was "probably UA." Again, both the judge and the interviewer felt that the awareness questionnaire may have exerted a suggestive influence. In summary, reliability of awareness ratings was considered highly satisfactory in that E and the interviewer agreed perfectly on 49 out of the 54 Experimental Ss, and in that two of the three raters agreed on four of the other five Ss. The remaining S was a "toss-up" and was assigned a classification of CA after discussion among the raters.

The preceding discussion attests the relative ease of assigning ratings of AW and UA. Hence, the point at which the AW Ss first recorded a correct hypothesis was readily determined, in most cases, by an examination of their notes. In addition, the AW Ss were quick to verbalize the correct hypothesis during the awareness interview, usually in response to the first question. Conversely, UA Ss typically wrote ideas concerned with sentence structure or grammar, with position preferences, with the use of active or passive verbs, with the ability to make a story out of the two Training cards and one Test card, etc. Like the AW Ss, the UA Ss tended to verbalize readily their incorrect hypotheses during the awareness interview and to adhere to them.

Twenty-two of the 34 UA Ss answered "No" to Question 13 ("confrontation" question) and one S answered incorrectly. Thus, these 23
Ss did not report correct or correlated hypotheses in their notes, in
response to a detailed awareness questionnaire, nor in response to the
confrontation question. The remaining 11 UA Ss answered Question 13
correctly. Three of these 11 Ss were in Group NI (No Increase), three
were in Group AI (Abrupt Increase), and five were in Group GI (Gradual
Increase). One of the three Ss in Group NI demonstrated an increase
in performance on the Test trials. Although answering Question 13
correctly, she stated that she "did not figure that out," but thought
that E was saying "Good" only randomly as "encouragement to make better
and more interesting sentences." The other two Ss in Group NI did not
show performance gains suggesting that a correct answer to the "con­
frontation" question was not indicative of an awareness that existed
during the conditioning task. Of the three Ss in Group AI, one demon­
strated no increase in frequency of selection of the "correct" pronouns
on the Test trials, whereas the other two showed slight increases: one
of these was clearly unaware on the basis of her responses to Questions
1-12, and to the "confrontation" question she responded "... He and
They possibly, in retrospect"; the other S said that he had tried the
idea of pronouns out during the experiment but that "... it didn't
work so two trials later I wrote 'idea went down the drain.'" One of
the five Ss in Group GI responded to Question 13 by saying "... 
maybe He and They." When asked by the interviewer "When did you think
of this?" the S replied "Just now." With the remaining four Ss in
Group GI who answered the "confrontation" question correctly, two pos­
sible alternatives existed: (a) these Ss were aware during the
conditioning task and should have been classified as AW or as CA; (b) an awareness that did not previously exist was suggested to these Ss by Question 13.

On the basis of results reported by Spielberger (1962) it appeared that alternative (b) should be accepted. That is, Spielberger found that out of six Ss who responded correctly to the "confrontation" question, five were judged to have had awareness suggested to them by this question. To test the possibility that awareness was suggested by the confrontation question in the present experiment, the performance of the four Ss in Group GI mentioned above were compared with that of the other Ss in the same group. The performance data of these two sets of Ss, including operant trials, were subjected to a two-factor analysis of variance having repeated measures (Lindquist, 1953, Type I design) in which Groups was the between Ss variable and Trial Blocks was the within Ss variable. This analysis yielded a nonsignificant effect of Groups (F less than unity) and a nonsignificant Groups X Trial Blocks interaction (F = 1.767; df = 5/40; p > .10), indicating that the performance of these two sets of Ss did not differ from each other. These results, when considered together with the findings reported by Spielberger, strongly suggest that a correct response to the confrontation question should not be considered indicative of a previously existing awareness, and that the rating of UA for the Ss who answered Question 13 correctly in the present experiment was proper. In view of this it was concluded that there was no evidence that the detailed awareness interview suggested a correct or correlated
hypothesis to Ss who were rated as UA both on the basis of their notes and on their responses to the detailed questionnaire used in the present study.

The Ss rated as CA were quite different in their note-writing activity from either the aware or unaware Ss. That is, the CA Ss tended, as a whole, to be somewhat confused about the principle for constructing sentences, to record many different ideas, and to change their ideas frequently. Because of this, it was difficult to determine, in several cases, the point at which these Ss could be considered aware of a correlated hypothesis, if at all, during the acquisition trials. It was with these Ss that the awareness questionnaire appeared to provide cues that clarified the Ss' thoughts and channelized their ideas toward a correlated report. This vagueness and obscurity during the conditioning task raised the questions of whether these Ss should be rated as UA and of the extent to which cognitive processes could be considered to have mediated performance gains on the Test trials. Since Adams (1957) has pointed out, however, that one of the recurring limitations in experiments which reputedly have demonstrated conditioning without awareness has been the failure to eliminate the possibility that above-chance performances can be accounted for by correlated hypotheses, these doubtful cases were classified as CA.

Other Factors Related to Incidence of Awareness

Four Ss each from Group GI and Group AI were rated as AW, as opposed to one S in Group NI. This tended to support the hypothesis
that the learning of awareness would occur more frequently among Ss receiving an increase in reinforcement on the Training trials. However, when correlated hypotheses were considered this difference was negated. There were five Ss rated as CA in the two groups which received an increase in reinforcement (Groups GI and AI) and six CA Ss in Group NI alone. Thus, overall, there was no difference between groups with respect to incidence of awareness (See Table II).

The classifications of awareness were compared with respect to the pronoun class reinforced. A total of 29 Ss was reinforced for sentences beginning with I or WE on the Training trials, and 25 Ss were reinforced for HE and THEY sentences. The most striking difference was between the number of Ss rated as CA. That is, reinforcement of I-WE responses resulted in nine Ss being classified CA as opposed to only two Ss reinforced for HE-THEY responses. The UA Ss were evenly distributed between the two pronoun classes, and six of the nine AW Ss had been reinforced for HE-THEY responses.

Analysis of Performance Data

The 20 operant trials and 40 Test trials were divided into six blocks of 10 trials each. Unless otherwise indicated, the data from all six trial blocks were included in the statistical analyses reported below. For graphical presentation, however, the mean number of "correct" pronoun responses emitted by each group on the 20 operant trials was averaged to correspond to the mean number of "correct" responses given by each group on each of the four Test trial blocks.

The three original Experimental groups each yielded Ss
classified as AW, CA, and UA. For purposes of analysis the nine AW Ss were combined into Group AW. Since the Ss in Group GI and Group AI each received the same number of "programmed" reinforcements on the conditioning task, the one S rated as CA in Group AI was combined with the four CA Ss from Group GI. The performance of these five Ss was compared with the six Ss rated as CA from Group NI by means of a two-factor analysis of variance having repeated measures (Lindquist, 1953, Type I design). In this and all subsequent Type I analyses, Groups constituted the between-Ss factor and Trial Blocks was the within-Ss factor. The analysis comparing the two groups of correlated aware Ss yielded a nonsignificant effect of Groups ($F = .222; df = 1/9; p > .20$) and a nonsignificant Groups X Trial Blocks interaction ($F = .160; df = 5/45; p > .20$). Consequently, the two groups of Ss aware of correlated hypotheses were combined into Group CA. The unaware Ss in each of the three Experimental groups retained their original group designations (i.e., Groups NI, GI, and AI).

A separate single-factor analysis of variance having repeated measures (Lindquist, 1953, Treatments X Ss design) for each of the three Control sub-groups resulted in a nonsignificant effect of Trial Blocks for each sub-group (all $F$s less than unity). The performance data of the three sub-groups were then compared by means of a Type I anova. This analysis yielded nonsignificant effects (all $F$s less than unity) for all three factors (i.e., Groups, Trial Blocks, and Groups X Trial Blocks). As a result, the data for all Control Ss were combined into Group C for purposes of subsequent statistical analyses.
The performances of the Control (C), Unaware (NI, GI, and AI), Correlated Aware (CA) and Aware (AW) groups are presented in Fig. 1. As can be seen in Fig. 1, the mean operant rates for all groups were quite comparable and tended to cluster closely around chance level. An analysis of variance (Lindquist, 1953, Simple Randomized design) for the operant trials indicated that the six groups did not differ significantly (F less than unity) during the operant period. Observation of Fig. 1 also indicates that the performances of the six groups diverged over the trial blocks. A Type I anova of the performance data of the six groups resulted in a significant effect of Groups (F = 11.61; df = 5/66; p < .001) and a significant Groups X Trial Blocks interaction (F = 4.03; df = 25/330; p < .001). These results indicated that the groups differed in frequency of selection of the "correct" pronouns on the Test trials, and that the slopes of the curves in Fig. 1 differed. In order to determine the source of the significant effects in this analysis, separate Type I analyses of variance were performed comparing each of the Experimental groups with Group C and comparing the Experimental groups with one another.

Comparisons of Experimental Groups with Control Group. When Group NI was compared with Group C no significant effects were found (all ps > .20). Tests for trend (Winer, 1962) indicated that the linear trend was nonsignificant for Group C (F = 1.95; df = 1/85; p > .10) as well as for Group NI (F = 3.99; df = 1/50; p > .05). All other trends were also nonsignificant. Thus, as predicted, the group performance of unaware Ss who received no increase in "programmed" reinforcement
Fig. 1. Performance Curves of Aware (AW), Correlated Aware (CA), Unaware (NI, GI, AI) and Control (C) Groups.
was not significantly altered and was no different from that of Control Ss.

The anova comparing Group GI with Group C yielded a significant Groups X Trial Blocks interaction ($F = 3.33; df = 5/130; p < .01$) indicating that the performance curves of these two groups diverged over trials. As can be observed in Fig. 1, Group GI showed a gradual increase in performance over trial blocks corresponding to the "programmed" increase in reinforcement. A test for linear trend was significant beyond the .001 level of probability ($F = 14.75; df = 1/45$). When the performance data of the two groups on the final trial block were compared by means of an analysis of variance (Lindquist, 1953, Simple Randomized design), it was found that Group GI Ss constructed significantly more Test sentences beginning with the "correct" pronouns than did the Control Ss ($F = 8.56; df = 1/26; p < .01$). Further evidence that the unaware Ss in Group GI showed significant performance gains came from a test of the difference between the operant and trial block 4 group means ($t = 2.960; df = 9; p < .02$).

As may be noted in Fig. 1, Group AI showed a gradual improvement in performance on trial blocks 1 and 2, followed by a greater increase in emission of the "correct" pronouns on trial block 3. A test of the difference between the operant and trial block 1 group means was nonsignificant, but a highly significant difference was found between the operant and trial block 3 means ($t = 3.942; df = 12; p < .01$). It was on trial block 3 that Ss in Group AI first experienced an increase in "programmed" reinforcement, suggesting a rather direct
relationship between reinforcement and performance gains. Tests for
trend yielded a significant linear trend ($F = 19.58; df = 1/60;
p < .001$) and a significant cubic trend ($F = 4.49; df = 1/60; p < .05$)
indicating that both the increase and the changing rate of increase
were significant over all trial blocks. The comparison between Group
AI and Group C by analysis of variance resulted in a significant
effect of Groups ($F = 8.29; df = 1/29; p < .01$) and a significant
Groups X Trial Blocks interaction ($F = 5.04; df = 5/145; p < .005$).
These results, when considered together with Fig. 1, indicate that
Group AI showed a greater increase of "correct" pronoun responses from
its operant rate than did Group C. Similar results were obtained when
Group CA and Group AW were each compared with Group C.

In summary, the preceding analyses indicated that, with the
exception of Ss in Group NI, the group performance of unaware, corre-
lated aware, and aware Ss each differed significantly from the per-
formance of Control Ss. Comparisons were then made between
Experimental groups.

**Experimental Groups Compared with One Another.** As can be ob-
served in Fig. 1, the performance of aware Ss was strikingly different
from that of correlated aware and unaware Ss. This difference was
confirmed by two separate Type I analyses of variance comparing Group
AW with Group CA, and with Groups GI and AI. (That is, Groups AW,
GI, and AI were compared in a single analysis of variance since it was
predicted that unaware Ss in Groups GI and AI would demonstrate perform-
ance gains, and since Group NI was found to be no different from the
Control Group.) The ANOVA between Group AW and Group CA resulted in significant effects on all factors: Groups ($F = 5.53; df = 1/18; p < .05$); Trial Blocks ($F = 21.42; df = 5/90; p < .001$); and Groups $\times$ Trial Blocks ($F = 3.80; df = 5/90; p < .005$). Thus, Ss reporting correlated hypotheses constructed significantly fewer Test sentences beginning with "correct" pronouns than did the aware Ss. Similarly, all effects were significant in the comparison between Group AW and Groups GI and AI.

The difference between aware and unaware Ss was not expected and was in agreement with previous studies. Of considerable interest, however, was the fact that the performance of Ss reporting correlated hypotheses also differed significantly from that of aware Ss. The practice in most previous studies has been to classify Ss who reported correlated hypotheses as aware, to combine their performance data with aware Ss, and to consider them as distinctly different from unaware Ss. Yet, when the performance data of the correlated aware Ss (Group CA) and the unaware Ss (Groups GI and AI) were subjected to a Type I ANOVA, a nonsignificant effect of Groups ($F = 1.32; df = 2/31; p > .20$) and a nonsignificant Groups $\times$ Trial Blocks interaction ($F = 1.27; df = 10/155; p > .20$) were found. Thus, the Test performance of unaware Ss in the present experiment who received an increase in "programmed" reinforcement on the Training trials did not differ from that of Ss aware of correlated hypotheses.

Performance of Aware Ss prior to and after Reports of Awareness

According to the cognitive formulation of Spielberger and
DeNike (1966), performance gains do not occur in verbal operant conditioning in the absence of a "confirmed" (presumably either correct or correlated) hypothesis (p. 320). That is, prior to confirmation an S may be trying out various hypotheses and modifying them based upon information provided by the reinforcer. However, an increased output of the reinforced response class, when it occurs, is the result (italics added) of a confirmed hypothesis. For example, DeNike (1964) found that "... although aware Ss indicated in the interview that they became aware on the average about one trial block before that on which they recorded their correct hypotheses, no performance gains were found prior to the trial block on which these Ss wrote correct hypotheses in their notes" (p. 528).

To investigate the sequence of events posited by Spielberger and DeNike (1966), Ss in the present experiment were asked to indicate, on each Test trial, how certain they were of the idea they had written concerning the rule or principle for constructing sentences. This was done by Ss checking one of four choices (i.e., guess, uncertain, fairly certain or certain) typed on each Test card. The Test trial on which each of the nine aware Ss indicated that he was "certain" of the rule or principle was taken as the point of a confirmed hypothesis. (As mentioned above, this was difficult to determine in many cases with Ss classified as correlated aware. Hence, only Ss rated as AW are analyzed under this heading.)

For purposes of this analysis the performance data of the nine aware Ss on the 40 Test trials were divided into eight blocks of five
trials each. The Ss recorded the correct principle (confirmed hypothesis) in their notes on different Test trials. These reports varied from trial 14 to trial 34, with a mean of 23.7 trials. In terms of trial blocks, this corresponded to a range of 3 to 7 blocks, and a mean of 5.11 trial blocks. Eight of the nine Ss showed a performance gain prior to the trial block on which a confirmed hypothesis was first recorded in their notes. With respect to "programmed" reinforcement, five of the nine Ss first wrote their hypotheses on trial blocks subsequent to an increase in reinforcement, two wrote them on a trial block concomitant with an increase in reinforcement, and two prior to any increase in reinforcement.

The performance data of the aware Ss were Vincentized (Munn, 1950) so that the trial block on which each S first recorded a confirmed hypothesis could be aligned with respect to the same reference point. Since the mean trial block on which the aware Ss first recorded a confirmed hypothesis was 5.11, and the average number of trial blocks prior to these reports was 4.11, trial block 5 was designated as the "aware" trial block in a manner similar to that described by DeNike (1964). Each S's performance data on the "pre-aware" trial blocks (i.e., trial blocks prior to the block on which the confirmed hypothesis was recorded) were Vincentized into Vincent fourths; the data subsequent to the block on which the report occurred were averaged into Vincent thirds.

Figure 2 presents the Vincentized performance curve of the nine aware Ss prior to and after the "aware" trial block designated
Fig. 2. Vincentized Performance Curve for Nine Aware Ss. Trial Block 5 Represents the Point at which Aware Ss First Recorded Correct Hypotheses with a High Degree of Certainty (Confirmed).
as trial block 5. In Fig. 2 the mean number of "correct" pronoun responses emitted on the 20 operant trials was averaged. For purposes of statistical analyses, however, the 20 operant trials were divided into four blocks of 5 trials each, corresponding to the Test trial blocks. This set of group data will henceforth be referred to as Group AW-5. As can be seen in Fig. 2, the performance of this group showed a slight increase in the mean number of "correct" pronouns on trial block 1 over the operant rate, and remained at that level on trial blocks 2 and 3. A rather sharp increase occurred on the final "preaware" trial block (block 4) followed by a decrease on the "aware" trial block.

An analysis of variance (Lindquist, 1953, Treatments X Ss design) of the performance data prior to the "aware" trial block yielded a significant effect of trial blocks ($F = 5.53; df = 7/56; p < .001$), indicating that Group AW-5 selected the "correct" pronouns with a significantly greater frequency on the "preaware" Test trials than during the operant period. This difference was confirmed by a $t$ test between the operant and trial block 4 group means which was significant beyond the .001 level of probability ($t = 4.699; df = 8$). The mean number of "correct" pronouns emitted on trial block 4 was significantly greater than on trial block 3 ($t = 3.105; df = 8; p < .02$). No difference was found between trial blocks 4 and 5, nor between the operant level and trial block 1. The data for the operant and "preaware" trial blocks were subjected to a trend analysis (Winer, 1962) which indicated significant linear ($F = 23.70; df = 1/56; p < .001$)
and quadratic ($F = 9.22; \text{df} = 1/56; p < .001$) components. Thus, both the increase and the changing rate of increase were statistically significant over the "preaware" trial blocks. When considered together with Fig. 2, these results support the overall prediction that significant performance gains can occur prior to, or in the absence of, the learning of awareness as a function of reinforced practice.

**Reanalysis of Performance Data of Aware Ss**

Since it was possible that the significant "preaware" performance gains were mediated by a lesser degree of certainty of correct or correlated hypotheses, the data of the nine aware Ss were reanalyzed using a more liberal criterion of awareness. For this analysis the criterion for the "aware" trial block was set as the block on which each S first indicated in his notes that he was "fairly certain" of a correct or correlated hypothesis. This meant, then, that the ideas recorded by the aware Ss during the "preaware" trial blocks could not be considered indicative of anything more than what Spielberger and DeNike (1966) have referred to as ". . . a tentative formulation of the correct (and presumably correlated) hypothesis" (p. 320). The notes of each aware S were re-examined, and the results are presented in Table III. As the Table indicates, three Ss (Nos. 5, 6, and 9) did not meet the criterion of "fairly certain" on what might be considered to have been their earliest "aware" trial block (based on raw data). Instead, they were conceptualizing at an even lower level of certainty on the "aware" trial block. That is, all three of these Ss recorded correlated hypotheses on the "aware" block, but one indicated that he
TABLE III

SUMMARY OF IDEAS RECORDED BY AWARE Ss ON THE AWARE AND PREAWARE TRIAL BLOCKS AND PERFORMANCE ON THE PREAWARE BLOCKS (RAW DATA)

<table>
<thead>
<tr>
<th>S</th>
<th>Aware Trial Block</th>
<th>Type Hypothesis and Level of Certainty on Aware Trial Block</th>
<th>Type Hypothesis and Level of Certainty on Preaware Blocks</th>
<th>Perf. Gains on Preaware Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>correct - fairly cert.</td>
<td>correct - uncert.</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>&quot;</td>
<td>correl. - uncert. mixed with incorrect ideas</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>&quot;</td>
<td>incorrect</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>&quot;</td>
<td>&quot;</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>correl. - guess</td>
<td>&quot;</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>&quot;</td>
<td>none</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>correct - fairly cert.</td>
<td>correl. - uncert. followed by &quot;now I'm not sure&quot;</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>correl. - fairly cert.</td>
<td>incorrect</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>correl. - uncertain</td>
<td>correl. - guess</td>
<td>No</td>
</tr>
</tbody>
</table>
was "uncertain" of his idea, and the other two indicated that their hypotheses were "guesses." Subsequent to these ideas the three Ss recorded confirmed hypotheses, thus skipping the intermediate steps in formulating the rule or principle. Four of the nine Ss recorded incorrect hypotheses on the "preaware" trial blocks and one S recorded no hypotheses. With respect to performance gains, six of the nine Ss demonstrated an increase in frequency of the "correct" pronouns during the "preaware" trial blocks. The relation between an increase in "programmed" reinforcement and the "aware" trial block was not shown in Table III because of lack of space. Examination of the Ss' notes revealed that the "aware" block was subsequent to an increase in reinforcement for two Ss, concomitant with the reinforcement increase for three Ss, and prior to the "programmed" increase for four Ss.

The performance data of the nine aware Ss were Vincentized (Munn, 1950) in the manner described above. The mean "aware" trial block of the raw data was 3.89, and the average number of "preaware" blocks was 2.89. Thus, trial block 4 was designated as the "aware" trial block for purposes of weighting each S's performance data. The "preaware" trial blocks were Vincentized into Vincent thirds; the performance data subsequent to trial block 4 were averaged into Vincent fourths. This set of Vincentized group data, shown in Fig. 3, will hereafter be referred to as Group AW-4. Statistical analyses of these data confirmed the following facts which may be observed in Fig. 3: (a) The Vincentized curve shows that performance was
Fig. 3. Vincentized Performance Curve for Nine Aware Ss. Trial Block 4 Represents the Point at which Aware Ss First Recorded Correct or Correlated Hypotheses with a Lower Degree of Certainty (Fairly Certain or Less).
inconsistent on trial blocks 1 and 2 followed by a noticeable rise on trial block 3. On all subsequent trial blocks the curve shows a gradual increase in emission of the mean number of "correct" pronouns. An anova (Treatments X Ss design) of the group data, including operant trials, yielded a significant effect of trials beyond the .001 level of probability ($F = 6.63; \text{df} = 11/88$); (b) When the performance data for the operant trials and the "preaware" trial blocks (1-3) were subjected to an analysis of variance, the effect of trial blocks was found to be significant ($F = 2.78; \text{df} = 6/48; p < .05$), indicating that Group AW-4 selected the "correct" pronouns with a significantly greater frequency on the "preaware" Test trials than during the operant period. Further, the mean number of "correct" pronouns emitted was significantly greater on trial block 3 than during the operant period ($t = 2.918; \text{df} = 8; p < .02$), but no difference was found between the operant period and trial block 1 ($t = 1.583; \text{df} = 8; p > .10$). A trend analysis of the operant and "preaware" trial blocks yielded significant linear ($F = 8.03; \text{df} = 1/48; p < .01$) and quadratic components ($F = 5.20; \text{df} = 1/48; p < .05$) which, when considered together with the other results, indicated that both the increase and the changing rate of increase were significant over the "preaware" trial blocks; (c) The difference between the group means of trial blocks 3 and 8 was significant at the .05 level of probability ($t = 2.325; \text{df} = 8$), indicating that further performance gains occurred subsequent to the "preaware" trial blocks. Thus, even when using a less exacting estimate of awareness, the overall prediction
that significant performance gains can occur prior to the learning of awareness as a function of reinforced practice was supported.

Other Factors Related to Performance

Male and female Ss within each awareness classification (i.e., UA, CA, and AW) were compared to determine whether there was a differential effect of sex on performance. Type I analyses of variance were used for these comparisons. In Group CA and Group AW males performed better than females but the effect of Groups (Sex) as well as the Groups X Trial Blocks interaction were nonsignificant in both analyses. On the other hand, unaware females performed somewhat better than unaware males. The analysis of variance yielded a nonsignificant effect of Groups and a significant Groups X Trial Blocks interaction ($F = 2.82; \text{df} = 5/160; p < .025$) indicating that, while the two sexes responded differentially over trials, the unaware female Ss did not show a greater increase in frequency of "correct" pronouns from the initial operant level than the unaware male Ss. Considering the results of all the groups together, it appeared that sex exerted no differential effect on performance in the present study.

Within each awareness classification, the effect on performance of the pronoun class reinforced was also compared. In each classification Ss reinforced for constructing sentences beginning with HE or THEY performed better than Ss reinforced with the other pronoun class (I or WE). Three separate Type I analyses of variance comparing the two pronoun classes within each awareness classification were
performed. These analyses yielded in each case a nonsignificant effect of Groups (Pronoun Class) and a nonsignificant Groups X Trial Blocks interaction. It was concluded, then, that the pronoun class reinforced had no differential effect on the performance of $S$s in this experiment.
DISCUSSION

In order to obviate the criticism of inadequate methods used for determining awareness directed against early verbal conditioning studies which reported conditioning without awareness, ratings of awareness in the present experiment were carefully assessed independently from the notes written by Ss on the Test trials and from a detailed postconditioning interview. Utilizing such a method, the overall prediction that significant performance gains can occur in a verbal operant conditioning paradigm prior to or in the absence of the learning of awareness was clearly supported by the results. These results were contrary to the findings reported by cognitive investigators (DeNike, 1964; Dulany, 1962; Levin, 1961; Spielberger, 1962; Spielberger, et al., 1966) who assessed awareness from notes and/or detailed questionnaires in essentially the same manner. In general, these cognitive investigators reported that performance gains were found only for aware Ss and that these gains were subsequent to the learning of awareness. On the other hand, the present results were in agreement with those of Dixon and Oakes (1965) who used a detailed questionnaire for inferring awareness. Dixon and Oakes found that when Ss were engaged in a color naming task between verbal conditioning trials, this intertrial activity interfered with the learning of awareness. Yet the unaware Ss demonstrated significant performance gains as a function of reinforced practice and were no different from Ss not engaged in color naming and who were able to verbalize correct hypotheses.
Assuming that the use of similar methods and criteria for assessing awareness led to similar judgments in the present study and in those of the cognitive investigators mentioned above, the contradictory findings would appear to be due to other differences in methodology, to the interpretations of the results which the methodology permitted and to theoretical biases. Interpretations of results have been primarily concerned with the antecedent conditions of behavior change. Cognitive investigators have stressed the learning of awareness as the essential antecedent condition of performance gains. Without awareness conditioning does not occur. While agreeing that the learning of awareness may facilitate behavior change, reinforcement psychologists have denied the unique status assigned to awareness by the cognitive investigators and have maintained, instead, that reinforcement is both a necessary and sufficient condition of performance gains in verbal conditioning. The results of the present experiment will be discussed in terms of these two alternative viewpoints and in terms of the methodological differences which may have accounted for the contradictory findings.

A major premise at the outset of the study was that Ss respond differentially to the same social reinforcement and that it is the Ss' reinforcement history on the verbal conditioning task itself that is crucial for performance gains and the learning of awareness if it occurs at all. Four hypotheses were formulated to test this assumption.
Hypothesis 1

Hypothesis 1, that the frequency of "correct" pronoun responses of unaware Ss would not be significantly altered on the Test trials when "programmed" reinforcement did not increase above operant (chance) level, was confirmed. The performance of Experimental Ss rated as unaware who received reinforcement at a level which corresponded to their operant rate did not differ from Control Ss. This finding was supported by statistical analyses and is clearly shown in Fig. 1 (Group NI). These unaware Ss did show a gradual, albeit slight, increment in emission of the "correct" pronouns over trials. Dulany (1962) has referred to these nonsignificant increases by unaware Ss as "... time-correlated increases ... that would seem to be the manifestations of prior habit" (p. 117), released by situational cues "... in transfer--involuntarily" (p. 109). In the present study the situational cues were the same for Experimental and Control Ss, with the exception of frequency of experience with reinforcement. The fact that unaware Ss in Group NI (reinforced at chance level) showed slight performance gains whereas Control Ss did not suggests that reinforcement is a parameter that must be dealt with when considering performance gains in verbal conditioning situations.

Hypothesis 2

That the amount of reinforcement was related to the performance gains of unaware Ss can be observed in Fig. 1. Only the unaware Ss who received an increase in "programmed" reinforcement (Groups GI and
AI) which rose above operant (chance) level showed significant performance gains, confirming Hypothesis 2. An unexpected finding was the relationship between the trend of performance of unaware Ss and the pattern or trend of "programmed" reinforcement. Subjects who received a gradual increase in reinforcement demonstrated gradual performance gains. A striking relationship between the pattern of reinforcement and performance gains was found in Group AI. That is, significant performance gains first occurred on the trial block in which the Ss in Group AI first received an abrupt increase in "programmed" reinforcement. Thus, the performance gains of Ss who received increases in reinforcement appeared to be a direct function of the Ss' reinforcement histories in terms of the amount of reinforcement and the manner or pattern in which it was experienced. Spielberger and DeNike (1966) have stated that the pattern and amount of reinforcement may facilitate the development of hypotheses leading to awareness. This sequence of events is based on the assumption that the reinforcing stimulus provides information which gives rise to cognitive states (hypotheses) but has no effect upon performance in the absence of a correct or correlated hypothesis. The fact that the performance gains of unaware Ss co-varied with "programmed" reinforcement in the present experiment implies, instead, that the amount and pattern of reinforcement should be considered as performance variables. This finding of a co-varying relationship would appear to be consistent with reinforcement interpretations of verbal conditioning (Krasner, 1962; Postman and Sassenrath, 1961; Verplanck, 1962), which contend that performance
gains initially result from the direct and automatic strengthening effects of reinforcement, and suggests that until a change in reinforcement is experienced by Ss who remain unaware, performance gains are not likely to occur.

**Hypothesis 3**

The group performance gains demonstrated by aware Ss on the "preaware" trial blocks also supported the overall prediction that significant performance increases can occur prior to the learning of awareness as a function of reinforced practice. Hypothesis 3, that the learning of awareness would occur as a consequence of the increase in "programmed" reinforcement, tended to be supported only when a rigorous criterion of awareness was employed. That is, 78% of the Ss first recorded their correct hypotheses subsequent to, or concomitant with, an increase in "programmed" reinforcement. When a less exacting measure of awareness was used, this proportion dropped to 56%, indicating that Hypothesis 3 was less clearly supported. This meant, in turn, that most of the aware Ss demonstrated performance gains prior to an increase in "programmed" reinforcement. The direct relationship between performance gains and "programmed" reinforcement found with unaware Ss was not evident in the performance gains of aware Ss on the "preaware" trial blocks, suggesting that Ss who learned awareness in the present experiment were qualitatively different, in some way, from those who did not. As assessed by the postconditioning awareness interview motivation was probably not a factor. That is, unaware Ss, in general, tried as hard and wanted to
receive reinforcement as much as aware Ss. One thing was certain: the Ss who subsequently learned awareness conditioned more readily in response to lesser amounts of reinforcement than did Ss who remained unaware. This would seem to indicate that individual differences in responsivity to social reinforcement play a significant part in verbal conditioning experiments. Such an interpretation is consistent with the position of Baron (1966) and Kanfer and McBreearty (1961) that social reinforcers do not have the same strengthening effect on all Ss.

The finding of significant performance gains prior to reports of awareness was in agreement with those reported by Philbrick and Postman (1955) and Postman and Sassenrath (1961) but contrary to the results obtained by DeNike (1964) and Spielberger, et al. (1966). These latter investigators found no tendency for the performance of Ss who subsequently learned awareness to increase on the "preaware" trial blocks; performance gains first occurred on the trial block in which Ss first recorded their correct hypotheses in their notes. DeNike and Spielberger, et al. concluded that the close temporal relationship between the learning of awareness and the inception of performance gains supported the hypothesis that the performance gains occurring on the "aware" trial block were mediated by cognitive processes. The Ss in these two experiments, however, recorded their correct hypotheses only at the end of the "aware" block which consisted of 25 and 23 trials respectively. Thus, the conclusion by these cognitive investigators that the performance gains on the
"aware" block occurred only after the Ss became aware requires the additional assumption that awareness was learned relatively early in the "aware" block. DeNite and Spielberger, et al. present, however, no evidence to substantiate this presumed necessary condition.

The results of the present study and those of Philbrick and Postman (1955) suggest that the hypothesized temporal relationship of the cognitive psychologist is an artifact of an insensitive methodology for obtaining reports of awareness during the conditioning task. Philbrick and Postman stopped Ss at the end of every block of nine trials in which Ss gave evidence of responding at a significantly better than chance level (four or more "correct" responses), and asked them to state the principle on which they were basing their responses. It was found that, for the entire group, there was an average of 4.25 blocks between correct statement of the principle and the first time the criterion was reached. In addition, the performance curve showed a positive acceleration as the point of verbalization ("aware" trial block) was approached.

In the present study, reports concerning the rule or principle for constructing sentences were obtained on every Test trial. With this method the progressive formulation of hypotheses recorded by Ss and the degree of confidence associated with each one could be readily determined by an examination of the Ss' notes. By plotting the performance data of the aware Ss in blocks of five trials each, a far more precise analysis of the temporal relationship between performance and awareness could be made. Even when the "aware" trial
block was determined on the basis of a less exacting criterion of awareness than a confirmed hypothesis, the Ss who subsequently learned awareness demonstrated significant performance gains prior to reports of awareness. As Fig. 3 indicates, if Ss in Group AW-4 had been asked to record their ideas only after every ten trials, reports of awareness would have first occurred at the end of trial block 4. Such a procedure would have lent itself to the erroneous conclusion that the performance gains that occurred on the immediately preceding 10 trials were cognitively mediated. In view of this, it would appear that the conclusion reached by both DeNike (1964) and Spielberger, et al. (1966) that performance gains in verbal conditioning are mediated by cognitive processes was unwarranted and an artifact of the methodology employed during the conditioning task for determining the temporal relationship between performance gains and awareness.

The position of Krasner and Ullmann (1963) and other behavioral psychologists that performance and awareness are both dependent variables which can be modified directly by reinforcement was supported by the results of the present study. These results, when considered together with those of Philbrick and Postman (1955), Postman and Sassenrath (1961) and Dixon and Oakes (1965), suggest that reinforcement exerts a differential effect upon these two dependent variables. It would appear that reinforcement predominantly influences performance, so that performance gains may be expected to precede in time the learning of awareness. This interpretation is consistent with that of Postman and Sassenrath (1961) who have stated that "...
since verbalization often occurs after a period of systematic improvement, verbalization of a principle may be considered at the same time a result of past improvement and a condition of further improvement" (p. 124). This is not to say that verbalization can occur only after an improvement in performance but that this is the most probable sequence of events. Such was the case in the present experiment; as can be seen in Table III, two-thirds of the aware Ss demonstrated performance gains prior to reports of awareness whereas one-third did not. Thus, while awareness may precede performance gains in verbal conditioning in some instances, present evidence supports the position of Postman and Sassenrath that the opposite is most likely to occur.

Hypothesis 4

This hypothesis, that the learning of awareness would occur more often among Ss receiving an increase in "programmed" reinforcement than among Ss receiving no increase, was not accepted. Considering only Ss rated as aware, the hypothesis was supported. But when Ss rated as correlated aware were considered, it was found that more Ss in the group receiving no increase in reinforcement reported awareness than Ss in the groups receiving the "programmed" increase. In any event, the finding that aware Ss learned awareness prior to an increase in "programmed" reinforcement rendered Hypothesis 4 vapid.

Ratings made from Notes and Awareness Interview

It was concluded that the notes written by Ss during the conditioning task concerning the rule or principle for constructing
sentences in the present experiment could reliably be used for assigning ratings of aware or unaware. This was generally true for Ss rated as correlated aware, although in some cases a determination could not be made from the notes alone. Thus, Hypothesis 5 was confirmed. This finding was in agreement with DeNike (1964) who concluded that note writing and interview techniques appeared to "... yield essentially comparable results in distinguishing between aware and unaware Ss, and that the biasing effects introduced by interviewing Ss after the conditioning period are not large" (p. 528).

The fact that there was no difficulty in rating Ss as unaware on the basis of their notes or responses to the detailed postconditioning questionnaire in the present study, and the finding of no tendency for the questionnaire to suggest a correct or correlated hypothesis to unaware Ss would appear to have important implications for an unexpected finding reported by Levin (1961). Levin found that 13 Ss classified as unaware of a correct contingency had also been unaware of the reinforcer. They did not spontaneously mention during the interview that E had said "Good" during the conditioning trials, yet these Ss showed as much conditioning as the aware group. Levin attempted to explain this discrepancy as possibly due to an artifact in his interviewing procedure. Questions 8 through 10 were designed to investigate the S's awareness of the reinforcer, and, when S still had not mentioned at the end of Question 10 that the E had said "Good" during the trials, the interview was terminated since all the remaining questions included wording to the effect that E had
in fact said "Good." Levin concluded: "It is possible that these Ss misunderstood question 10 and might have realized a correct contingency had they been interviewed further" (1961, p. 73).

Such a conclusion seems to be highly speculative since both questions 9 and 10 used by Levin were quite pointed as to E's activity during the conditioning trials. That is, Question 10 asked "Were you aware that I said anything?" (Levin, 1961, p. 68). In the present experiment only one S could not answer this question correctly; she remembered that E had said something but not sure what it was. It was pointed out to her by the interviewer that E had said "Good," and the interview continued; she was unable to answer the confrontation question. On the basis of both her notes and the entire questionnaire she was clearly unaware. Yet this S, like the ones in the Levin (1961) study, demonstrated performance gains. Admittedly an N of one is a rather small sample from which to generalize. But since this type of S--i.e., one who was unaware of the reinforcer--has been encountered so infrequently in studies where Ss have been carefully interviewed, a sample of one may be representative. This case, when considered with the findings of DeNike (1964) and of the present study (that Ss who were unaware during the conditioning task remained unaware during the postconditioning interview, and that Ss rated as correlated aware were not lacking in ideas and, at bottom, knew that E had said "Good"), implies that the 13 Ss in Levin's study were, in fact, unaware. There should be no need for the interviewer to have to make a supposedly aware S aware that E had occasionally
said "Good." To argue otherwise is to beg the question.

**Correlated Hypotheses**

Farber (1963) has suggested that cognitively oriented investigators, in their eagerness to attribute behavior to conscious mediating processes, might sometimes inadvertently suggest, or erroneously infer, awareness in questioning Ss who demonstrated performance gains. Results of the present experiment indicated that a detailed questionnaire increased the probability of correlated hypotheses being suggested to Ss. In some cases, the previous existence of such hypotheses could have been seriously challenged on the basis of notes written by the Ss during the conditioning task, irrespective of their performance. However, Spielberger and Levin (1962) have argued that performance gains in verbal conditioning are presumptive evidence for awareness. While granting that the use of a detailed postconditioning interview undoubtedly increased the probability of awareness having been suggested to some of their Ss, Spielberger and Levin maintained, nevertheless, that

... only Ss who verbalized a correct response-reinforcement contingency showed acquisition of the reinforced response. Therefore, an inescapable implication of the findings of the present study is that verbalization of awareness is an important empirical variable in verbal conditioning irrespective of whether the Ss' verbal reports are interpreted as indicating awareness during the conditioning trials or awareness suggested by the cues of the postconditioning interview [italics added] (1962, pp. 130-131).

That there may often be a correlation between performance gains and awareness has not been denied and, in fact, evidence for such a relationship has been reported by behaviorally oriented investigators
(e.g., Krasner and Ullmann, 1963; Matarazzo, Saslow, and Pareis, 1960). Nonetheless, "... a positive correlation between the two does not necessarily imply that awareness mediates conditionability" (Krasner and Ullmann, 1963, p. 201). If, on the other hand, Spielberger and Levin (1962) are saying that, regardless of how the reports of awareness are obtained (i.e., whether they are suggested or not), the presence of performance gains means that these gains had to be cognitively mediated, then such a statement would appear to be circular reasoning. By rigidly adhering to a theoretical bias which maintains that awareness must precede conditioning, Spielberger and Levin have been forced to present the consequent condition (performance) as evidence for its presumed antecedent condition (awareness).

Dulany (1961) has maintained that, in an experiment where the "correct" response class has been designated as plural nouns, a report by an S of "I am supposed to associate in a series when you say 'Umhmmm'" should be considered as a correlated hypothesis for "I am supposed to say plural nouns" (p. 260). Evidence obtained from the data of Ss classified as correlated aware in the present experiment suggests, however, that Dulany's assumption may sometimes be an overstatement leading to erroneous judgments of awareness for Ss who demonstrated performance gains. For example, an S who was reinforced for I-WE sentences in the present experiment wrote in her notes that the rule for constructing sentences was "... whether we relate the sentences to our own experiences." This type of verbal report is considered by cognitive investigators (as well as in the
present experiment) as *prima facie* evidence of a correlated hypothesis meaning "I was supposed to begin my sentences with 'I'" because Ss who report such hypotheses typically demonstrate performance gains. Ironically, the S in the present experiment, although appropriately motivated, did not show a performance gain. This S identified the "correct" pronoun class in response to Question 12a (after which pronouns did E say "Good?") but said she had not written that in her notes because "I didn't think of it in that way--I thought about sentences relating to self." Obviously for this S the hypothesis of relating sentences "to myself" had an entirely different meaning from that of beginning sentences with "I." Although correlated theoretically, it was, in fact, incorrect. Otherwise, according to cognitive theory this S would have shown acquisition of the "correct" pronoun.

But what if this S had demonstrated performance gains? Would it then be valid to infer that the increase was cognitively mediated? To do so, it seems, would necessitate the assumption that the S was trying to tell us what we wanted to hear but couldn't get the idea across since, logically and statistically, such reports should be correlated with the "correct" response class. On the other hand, could the (hypothesized) increase have been the result of the direct and automatic strengthening effect of reinforcement? The results of the present experiment would support such an interpretation. That is, Ss reporting incorrect hypotheses who received an increase in "programmed" reinforcement demonstrated significant performance gains. Conversely, Ss who did not receive an increase did not differ
from Control Ss. Interestingly enough, the S under discussion was in the group which received no increase in "programmed" reinforcement, confirming the impression that her apparent correlated hypothesis was deceptive.

Although correlated hypotheses have long been recognized as a likely source of contamination in studies reporting conditioning without awareness (Adams, 1957), surprisingly little attention has been devoted to them in the literature. The findings of the present study, that: (a) notes can be reliably used for rating awareness of correct and incorrect hypotheses but not correlated hypotheses; (b) Ss who develop correct hypotheses during the conditioning task readily verbalize them early in the postconditioning interview whereas S presumably aware of correlated hypotheses often are perplexed in their note writing and in the interview; (c) correlated hypotheses are likely to be suggested to these Ss by extensive postconditioning interviews; and, (d) reports of apparent correlated hypotheses do not always mean what the interviewer interprets them to mean, indicate that the range of behaviors encompassed by correlated hypotheses is broad and ambiguous. Of greatest interest was the unexpected finding that the performance of Ss reporting correlated hypotheses did not differ from that of unaware Ss. The fact that the performance of the former was more like that of unaware Ss than like Ss reporting correct hypotheses strongly suggests that correlated hypotheses may often not be indicative of an awareness that existed during the conditioning task. In other words, since correlated hypotheses appear to encompass a wide
range of behaviors, it is possible that correlated hypotheses may approximate incorrect hypotheses as frequently as correct ones.

In view of this, the criticism directed against the early verbal conditioning studies for failing to deal with the problem of correlated hypotheses seems less conclusive. Granted that some Ss who were aware of correlated hypotheses were overlooked, it would appear highly improbable that the conditioning demonstrated in all the early studies could have been accounted for only by Ss aware of correlated hypotheses. Conversely, it is not surprising that studies which have employed detailed postconditioning interviews, which readily accepted correlated hypotheses as indicative of awareness and which considered performance gains as proof of this should, with one exception, never find evidence of conditioning without awareness. This is not to say that postconditioning interviews have no part in verbal conditioning research. On the other hand, there does seem to be a limit as the unexpected findings of Levin (1961) disclosed. Nor does it mean that correlated hypotheses are not frequently indicative of an awareness that existed during the conditioning task. It does suggest that correlated hypotheses appear to lend themselves readily to misinterpretation and should, therefore, be evaluated cautiously.
Cognitive investigators of verbal operant conditioning have questioned the extension of principles of learning developed in the animal laboratory to account for the events occurring in verbal conditioning situations. In particular they have challenged the concept of reinforcement by maintaining that the reinforcement given by E has no reinforcing properties but, instead, possesses only information and incentive value. Thus, the reinforcing stimulus can have no effect upon overt behavior (performance) unless mediated by a cognitive process labeled as awareness. As might be expected, the research strategy of the cognitive investigators has been primarily directed toward developing techniques to obtain evidence for the role of awareness in verbal conditioning rather than investigating the parameters of reinforcement.

The present study was designed to do both. To evaluate the role of awareness, the techniques (viz., "notes" and extensive interviews) developed by cognitive researches were employed. The role of reinforcement was investigated by controlling for frequency of experience with reinforcement through the use of "forced" Training trials. The results obtained appear to justify the following conclusions concerning the relation between reinforcement, performance gains, and the learning of awareness in verbal conditioning.

First, performance gains (acquisition of the reinforced response class) can occur in verbal conditioning prior to, or in the absence of,
awareness as a function of reinforced practice. This suggests that performance and awareness are both dependent variables subject to the same antecedent conditions (reinforcement) and that reinforcement exerts a differential effect upon the two.

Second, social reinforcers do not have the same strengthening effect upon all Ss. Individual differences in response to social reinforcement appear to be related more to performance than awareness. For some Ss small amounts of reinforcement seem to be sufficient to produce noticeable changes in performance. In turn, these Ss are more apt to learn awareness. For other Ss, presumably those who are less responsive to social reinforcement, it appears that performance gains are not likely to occur in the typical verbal conditioning situation in the absence of more favorable conditions, such as a rather sudden shift in the pattern of response selection. Awareness does not necessarily appear to be a consequence of this type conditioning.

Third, although the learning of awareness may precede performance gains in some cases, the conclusion by Spielberger and DeNike (1966) that acquisition of the reinforced response cannot occur in the absence of awareness appears to be an artifact of an insensitive methodology for determining the temporal relationship between performance gains and awareness.

Fourth, hypotheses (notes) written by Ss during the conditioning task can be reliably used for assigning ratings of awareness or unawareness.

Fifth, correlated hypotheses are the "twilight zone" of verbal
conditioning. Assigning ratings from notes is less reliable than for the other classifications and correlated hypotheses are likely to be suggested by detailed postconditioning interviews. In addition, they are often deceptive and may be easily misinterpreted, and they may not always be indicative of an awareness that existed during the conditioning task. They appear to be particularly susceptible to erroneous ratings of awareness.

**Implications and Suggestions for Future Research**

The psychotherapeutic analogue of the problem of behavior modification without awareness is whether a patient's behavior can change without having first achieved "insight" (Kanfer, 1965). Rather than "insight" being necessary for behavior to change, the question has been raised as to whether changed behavior in therapy increases the likelihood of the patient emitting the verbal behavior labeled as "insight" by the therapist (Saslow, 1965). Results of the present study suggest that such may be the case. That is, behavior change (performance gains) more frequently preceded reports of awareness than was true of the opposite sequence of events. Further, present findings supported the position of Krasner and Ullmann (1963) that reported awareness is a verbal behavior influenced by the same variables that influence other kinds of verbal operants. This, in turn, implies that reports of awareness or "insight" can be controlled or produced by therapists employing the social reinforcement model (see, e.g., Krasner and Ullmann, 1965).
Present findings indicate that individual differences in response to social reinforcement play a prominent part in verbal conditioning studies and, by implication, in therapies employing the reinforcement model. Research in this area has primarily attempted to establish a relationship between a given personality, intellectual or socially desirable variable, and the conditioning of some verbal operant as well as reports of awareness. Yet, most of these efforts have yielded contradictory and ambiguous results (see, e.g., Farber, 1963; Matarazzo et al., 1960; Williams, 1964). One of the few clear-cut demonstrations of such a relationship was reported by Timmons and Noblin (1963). These investigators found that Freudian oral and anal character types responded differentially to positive verbal reinforcement in a verbal conditioning paradigm. A later study (Noblin, Timmons and Kael, 1966) found that oral and anal character types responded differentially to negative as well as to positive reinforcement.

Baron (1966) has recently suggested that less emphasis be placed on personality characteristics and more weight be given to the characteristics of the social reinforcement history of the individual. It is Baron's thesis that the individual's past reinforcement history produces an internal norm or frame of reference which influences his present receptivity to social reinforcement (cf., Helson, 1964). Such an assumption has apparently not been tested in the verbal conditioning situation using, as predictors, techniques which have been developed for assessing Ss' past histories of social reinforcement (see, e.g., Crandall, 1963; Zigler, 1961).
The most obvious suggestion for future research growing out of the present experiment is that repeated assessments of awareness should be employed in the typical verbal conditioning paradigm to see if the precedence of performance gains does in fact obtain in the absence of "forced" reinforcement. Such a study is presently being planned.
REFERENCES


APPENDIX
APPENDIX A

Postconditioning Awareness Interview

1. What is your main idea about the rule or principle for constructing sentences in this experiment? What is your basis for this conclusion?

2. How did you go about making up your sentences?

3. How did you go about deciding which of the words to use on the card? (If S did not differentiate between Training and Test cards he was asked to do so.)
   a. Did you think you were using some of the words on the cards more often than others? Which words? Why?

4. Did you think you were supposed to make your Test sentences up in any particular way?
   a. Did you come to think that there was anything you were supposed to say, or not say, on each Test sentence in order to be correct?
   b. Did you think there was, or wasn't, any kind of correct way for making up the Test sentences?
   c. Did you think there was anything the experimenter wanted you to say or not say on the Test sentences?

(If, in answering Questions 1-4, S mentioned the fact that E had said "Good," "Fine," or "Mmm-hmm," Questions 5-7 were not asked.)

5. During the experiment did you notice the experimenter doing anything in particular?
6. Did you notice that he said anything?

7. Actually he did occasionally say something. Thinking back now, do you remember him saying anything while you were going through the cards?

(If S still did not verbalize "Good," etc. this was pointed out to him and the interview continued.)

8. Did you try to figure out what made the experimenter say "Good?"

   a. Did you come to think that there was any purpose or significance to the experimenter saying "Good," etc.
   b. Do you think it was random or did it follow anything in particular that you did?

9. Do you think that his saying "Good," etc. on the Training trials had anything to do with the words you chose to begin your Test sentences?

   a. Did you think that you were supposed to change the way in which you made up your Test sentences as the experiment went along?
   b. Do you think you actually changed the way in which you made up your Test sentences as the experiment went along?
   c. How hard would you say you tried to improve your performance on the Test sentences?
   d. How did you go about trying to improve your Test sentences?
e. Did you usually construct your Test sentences according to the ideas you wrote down during the experiment?

f. How helpful did you find the Training trials?

10. What was your reaction or attitude toward the experimenter saying "Good," etc.?
   a. How hard would you say you tried to figure out what was making him say "Good?" Very hard? Fairly hard? Not hard at all?
   b. Would you say you wanted the experimenter to say "Good" very much, some, or didn't care one way or the other?

11. I would like for you to state again your main idea about the rule or principle for constructing sentences in this experiment. (If S added anything new, the following two questions were asked.)
   a. Is that something you were actually aware of while going through the cards or is it something you thought of since the interview began?
   b. Did you write that in your notes?

12. At any time while going through the cards did you have the idea that the experimenter was saying "Good" after sentences beginning with certain pronouns? If yes:
   a. Which pronouns?
   b. Did you write that in your notes? (If no, S was asked "Why not?")
   c. Did the fact that you realized this have any effect on the way in which you made up your Test sentences?
13. Did you ever have the idea that the experimenter was saying "Good" after sentences beginning with I and We? He and They?
   a. Why did he do that?

14. Have you ever participated in an experiment like this before?
VITA

Thomas Daniel Kennedy was born in Emporia, Kansas, on July 15, 1931. After graduating from Samuel J. Peters High School, New Orleans, Louisiana, he entered Tulane University. He received the degree of Bachelor of Arts from that institution in 1953 with a major in public administration. He served for a spell in the United States Marine Corps after which he worked for a living. Having tired of this, he entered Louisiana State University in 1961 as a probationer, received the degree of Master of Arts in 1963 and became a postulant for the degree of Doctor of Philosophy in the Department of Psychology. Upon receipt of his degree he will join the faculty of the Department of Psychology, Arizona State University, Tempe, Arizona. He is a candidate for the Ph.D. degree at the Summer Commencement.
EXAMINATION AND THESIS REPORT

Candidate: Thomas Daniel Kennedy

Major Field: Psychology

Title of Thesis: Performance and Awareness in Verbal Conditioning: "Forced" Reinforcement and Recurring Assessment of Awareness During Conditioning

Approved:

[Signatures and titles]

EXAMINING COMMITTEE:

[Signatures]

Date of Examination: 12 June 1967