

THE UNIVERSITY OF MANITOBA

THE EFFECTS OF REWARD AND PUNISHMENT ON
CHILDREN'S VISUAL OBSERVING BEHAVIOR
DURING DISCRIMINATION LEARNING

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF ARTS

DEPARTMENT OF PSYCHOLOGY

WINNIPEG, MANITOBA

October 1974

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Acknowledgements

The author is indebted to Dr. John H. Whiteley for his excellent supervision of the research and writing of this report. In addition, the author is indebted to Dr. Lois Brockman, Dr. Thomas Duffy and Dr. Joseph Pear for their valuable criticisms of the research proposal. Special thanks are due to the principal and teachers of General Byng Public School for their interest and co-operation during the collection of the data. The helpful comments of Garry Hawryluk, the assistance of Gary Glavin in the construction of the apparatus and the aid of Barbara McEwen in typing this report are also greatly appreciated.

Abstract

Observing and nonobserving behaviors of second- and third-grade children were studied during the learning of a two-alternative visual discrimination task. Ss received either reward following correct responses and nothing following incorrect responses, reward following correct responses and punishment following incorrect responses or nothing following correct responses and punishment following incorrect responses. On each discrimination trial, the following data were obtained: the correctness of the choice response, the number and duration of the observing responses made to each of the stimuli, the total nonobserving trial time, the choice response latency (the time between the last observing response and the choice response).

Punishment-only Ss exhibited discrimination performance which was superior to that of the reward-only Ss. Ss receiving the combination of reward and punishment performed at a level which was not significantly different from that of either the punishment-only or the reward-only Ss. No significant correlations were found between learning rate and either the observing behaviors or the nonobserving trial times exhibited during the learning of the task. For all groups, more observing behavior and longer nonobserving trial times were found following incorrect choice responses than following correct choice responses. Learners (Ss who

reached criterion performance in less than 60 trials), but not nonlearners (Ss whose criterion trial was 60), looked longer and more frequently at the correct stimulus than at the incorrect stimulus. The contingency group differences in discrimination performance may have been due to either group differences in the quality of observing behavior or an interaction of contingency combination effectiveness and distractibility. The preference for looking at the correct stimulus was attributed to changes in the affective value of the stimuli which may have occurred as the task was learned.

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Introduction

During the past decade, investigators have shown increasing interest in studying the effects of various reinforcement combinations on children's discrimination learning. It typically has been shown that groups receiving punishment for incorrect responses and nothing for correct responses and groups receiving punishment for incorrect responses and reward for correct responses demonstrate discrimination performance which is superior to that of groups receiving reward for correct responses and nothing for incorrect responses. Recently, there has been some evidence (Penney, 1967; Witte and Grossman, 1971) to suggest that when nonverbal contingencies and a haptic discrimination task are employed, performance differences between contingency groups are related to group differences in the tactile observing behavior (touching responses) exhibited while the discrimination is being learned. The present experiment was designed to investigate the effects of reward and punishment of children's visual observing behavior during the learning of a visual discrimination task.

Visual observing responses in discrimination learning

Premack and Collier (1966) are two of the few investigators who have studied the visual observing responses of Ss engaged in learning a discrimination problem. They employed undergraduate Ss who could control either the number of times the stimulus display was projected onto

a screen for the duration of .2 seconds or the duration of time that the stimulus display was presented on each trial. The results showed that Ss looked longer at displays containing complex stimuli than at displays containing simple stimuli and that there was a gradual decline in looking time over trials. A discrimination reversal which increased the number of errors was accompanied by a similar increase in looking times. In addition, the type of reinforcement schedule used was found to have an effect on the duration of observing responses -- random reinforcement (both stimuli randomly designated correct 50% of the time with neither stimulus correct more than twice in a row) yielding the longest looking times with standard differential (one stimulus always designated correct) and nondifferential (both stimuli always designated correct) yielding the intermediate and shortest looking times, respectively.

Recently, Oscar-Berman et al. (1971) filmed the eye movements of monkeys as they learned a simultaneous two-choice pattern discrimination. They found that all Ss developed a preference for looking at the correct stimulus as learning progressed. A subsequent study (Oscar-Berman and Bakoplus-Banos, 1971) employing the same apparatus and same basic procedure found similar results for human adults and children.

Wright and Smothergill (1967) studied the observing behavior of children learning a simultaneous discrimination.

problem. The Ss could observe the stimuli one at a time by manipulating a lever either to the left or to the right. On each trial, the length of the observing responses made to each of the stimuli was recorded. Groups received reinforcement that was either immediate or delayed 20 seconds with the stimuli available during the delay period for one half of the delay-group Ss. Although the overall effect was not statistically significant, Ss tended to look longer at the correct stimulus than at the incorrect stimulus. In general, the effect was strongest for those groups showing superior task performance suggesting that nonlearners may not exhibit a preference for observing the correct stimulus. The data also showed a tendency for the duration of the observing responses to both stimuli to decline over trials, this decline being larger for the superior groups. Indications that the decrease in observing behavior over trials becomes more rapid as more Ss reach criterion suggest that a decrease may not be as pronounced for Ss who do not learn the task. Acquisition was best for Ss who had the stimuli available during the delay, intermediate for those who received immediate reinforcement and most retarded for those who had no stimuli present during delay. The superiority of the stimulus-available delay groups was attributed to these groups engaging in significantly more information-getting preresponse observing behavior.

Group differences similar to those found by Wright

and Smothergill were obtained in a subsequent study by Goldstein and Siegel (1971). They suggested that the superiority of the stimulus-available delay group over the empty delay group was due to the transfer of relevant observing responses from the delay interval to the preresponse interval for the former group.

In an exploratory study, White and Plum (1964) photographed the eye movements of nursery school children learning a series of eight simultaneous discrimination problems. Groups learning easy discriminations were superior in task performance to groups learning more difficult discriminations. Easy groups showed more eye movements per trial than Hard groups suggesting that there may be a positive association between amount of stimulus scanning and rate of discrimination learning. However, since the stimuli presented for the easy discriminations seemed to be more interesting and distinctive than those presented for the hard discriminations, this suggestion must be viewed with extreme caution. The data also indicated that the number of eye movements per trial tends to increase as Ss approach criterion performance and to decrease after criterion is reached.

Although the above-mentioned studies utilized very diverse experimental designs, subjects, and methods of measuring observing behavior, there appears to be some consistency in the data obtained. For example, there is a

tendency for the number and/or duration of observing responses to decline over trials (Premack and Collier, 1966; Wright and Smothergill, 1967). The data obtained by Wright and Smothergill (1967) suggests that this decline may be greater for Ss who learn the task and is consistent with evidence that the decline in observing behavior begins only after criterion performance has been reached (White and Plum, 1964). Oscar-Berman et al. (1971) and Oscar-Berman and Bakoplus-Banos (1971) found that, as learning progresses, the correct stimulus is looked at more than the incorrect stimulus. Finally, but most important, there may be a positive relationship between rate of discrimination learning and the number (White and Plum, 1964), duration (Wright and Smothergill, 1967) and/or quality (amount of information-getting observing behavior of the relevance of the observing behavior to the solution of the task) (Wright and Smothergill, 1967; Goldstein and Siegel, 1971) of the observing responses made to the stimuli during the learning of the task.

The present experiment measured the visual observing behavior of children learning a two-alternative discrimination problem. On each trial, the number and duration of the looking responses made to each of the stimuli were recorded. It was expected that observing responses would decrease in number and duration over trials and that this decrease would be more pronounced for Ss who learn

the task than for nonlearners. It was also expected that Ss who were successful in learning the discrimination would look longer and more frequently at the correct stimulus than at the incorrect stimulus and that nonlearners would not exhibit this preference. A positive correlation between the number and duration of the observing responses and the rate of discrimination learning was predicted.

Verbal contingencies and discrimination learning

Early studies (Buchwald, 1959a; Buss et al., 1956; Buss and Buss, 1956) of the effects of contingency combinations on discrimination learning employed adult Ss, the verbal contingencies "right" and "wrong", and nonoutcome or "blank" trials. "Right" and "wrong" were considered positive reinforcement and punishment, respectively, and Ss were not instructed about the meaning of the blank trials. These studies reported that "right" for correct responses and nothing for incorrect responses (RN) leads to acquisition of a two-alternative discrimination problem that is slower than either "wrong" for incorrect responses and nothing for correct responses (PN) or "right" for correct responses and "wrong" for incorrect responses (RP).

Buss and his associates accounted for their results in terms of a theoretical verbal reinforcement continuum where N has no reinforcement value and "right" is a much less powerful contingency than "wrong". Subsequent research, however, has shown that the assumptions of Buss's

theoretical reinforcement continuum are erroneous. Buchwald (1959b) demonstrated that in conditions RN and PN, N acquires a reinforcement value opposite in direction to that of the event with which it is combined. His data further suggested that "right" and "wrong" are equally potent reinforcers. A study by Spence (1964) yielded results similar to those obtained by Buchwald. She concluded that differences in performance between uninformed RN, RP and PN groups are due to "blank" acquiring reinforcement (information) value less rapidly or to a lesser degree when combined with R than when combined with P.

Studies employing the verbal contingencies "right" and "wrong" and normal children (Curry, 1960; Hamilton, 1969a; Hamilton, 1969b; Meyer and Offenbach, 1962; Schroth, 1970; Spence, 1966) or retarded children (Talkington et al., 1971) as Ss uninformed as to the meaning of "blank" have also reported PN and RP superiority over RN. However, in investigations in which child Ss were fully informed (Spence, 1966; Spence and Segner, 1967) or purposely confused (Hamilton, 1969a; Hamilton, 1969b) about the meaning of the blank trials, differences between PN, RP and RN groups have not been obtained.

Differences between informed and uninformed contingency groups were investigated by Spence (1966) who concluded that "blank" for uninformed RN groups is relatively ineffective as a punishing stimulus. Data were obtained from normal

children learning a verbal-discrimination list consisting of eight pairs of familiar three or four letter words. An analysis of two-trial sequences revealed that for both instructed and uninstructed Ss, "blank" in the PN group was equally as effective as "right" in the RP and RN groups in producing repetition of correct responses on the second trial. However, whereas "blank" in the RN group was equally as effective as "wrong" in the RP and PN groups in producing a switch from incorrect to correct responses for fully informed Ss, "blank" in the RN group was less effective than "wrong" in the RP and PN groups in producing a switch from incorrect to correct responses for uninstructed Ss. Further analysis showed that there was a fairly high percentage of Ss in the uninformed RN group who misinterpreted "blank" reacting as if it meant "right" and, therefore, repeating all previous choices regardless of whether they were followed by "blank" or "right". These results are in accord with the Blank Trials Law proposed by Levine et al., (1964). They maintain that, in a situation where no instructions are given, the S perceives the blank trial (N) as functionally equivalent to "right".

The Blank Trials Law nicely predicts PN and RP superiority over RN. Since N is perceived as equivalent to "right" when groups are uninformed about N's meaning, both punishment and reward are inherent in the contingencies for RP and PN groups. However, Ss in the uninformed RN

condition do not perceive N as an aversive stimulus. Hence, one might expect the differential effectiveness of PN and RN when no instructions are given and their equivalence when Ss are fully instructed.

In summary, there seems to be fairly conclusive evidence that the differences found between uninstructed verbal contingency groups are the result of the misinterpretation of the blank trial by RN Ss. Differences between verbal contingency groups given full instructions have not been found.

Nonverbal contingencies and discrimination learning

A number of studies have investigated the differential effectiveness of nonverbal rewards and punishments on children's discrimination learning. Penney and Lupton (1961) used candy as a reinforcer and a noxious sound (a 98 db, 2,000 cps tone) as a punishing stimulus in a two-alternative visual discrimination task. On task acquisition, group PN demonstrated superiority over group RN which performed at chance level throughout. Group RP showed a learning rate which was intermediate to that of the other two groups. It was reasoned that the discrimination could not be learned in 60 trials under reward conditions alone. The performance of group RP, therefore, was attributed to an increase in motivational level resulting from the administration of the punishing stimulus. Frustration resulting from the nonreward of an expectancy to receive candy was said to have produced

a drive increment in group PN accounting for the superiority of PN over RP. A close replication of Penney and Lupton's study (Ratliff and Tindall, 1970) yielded similar results for group PN but, in this case, both the RP and RN groups performed at chance level throughout. An explanation of this discrepancy was not offered.

Two early studies (Brackbill and O'Hara, 1958; Harter and Zigler, 1962) comparing the effectiveness of nonverbal contingencies employed a "cost" procedure of punishment (the removal of one reinforcer contingent upon each incorrect response). In these studies, children received or received and forfeited candy and marbles, respectively. PN groups were not tested. In general, RP groups outperformed RN groups and, as in the Penney and Lupton (1961) study, differences were attributed to an increase in motivation produced by the punishing stimulus. However, since Ss participating in the nonverbal contingency studies cited thus far were apparently uninformed as to the meaning of the nonoutcome trial, it is impossible to determine whether or not the results obtained were due wholly or in part to the misinterpretation of "blank".

Spence and Segner (1967) also used candy and a noxious sound as rewarding and punishing stimuli, respectively. Even though Ss received full instructions as to the meaning of all contingencies including "blank", groups PN and RP displayed discrimination performance which was superior to

that of the RN group. Spence and Segner did a probability analysis like that described previously in the discussion of the Spence (1966) paper and concluded that the inferiority of the RN group in this and in previous studies using nonverbal contingencies was due not to the misinterpretation of "blank" by RN Ss, but rather to some kind of distractibility phenomenon. They maintained that candy reinforcement served to distract Ss from the task to a greater degree than the presentation of a noxious sound.

The distracting effects of nonverbal reinforcers were further investigated by Spence (1970). Fully informed RN groups received rewards which differed in their distractibility. The results lent support to Spence and Segner's (1967) hypothesis -- groups receiving reinforcers rated as distracting were inferior in performance to groups receiving less distracting reinforcers.

Whitehurst (1969) attempted to control for the effects of distractibility through the equation of rewarding and punishing events. Prior to the performance of a two-choice visual discrimination task, children received 30 tokens in a clear plastic dish. Following all correct responses, Ss in groups RN and RP received one token which the experimenter placed in the dish by hand. A cost procedure of punishment (the removal by hand of one token from the dish contingent upon each incorrect response) was employed for groups PN and RP. Subjects were fully informed

as to the meaning of all contingencies including "blank" and were told that they could exchange their tokens for a small toy at the conclusion of the experiment. The results, discrepant with those reported in previous reward-punishment studies, showed that group RP was superior in discrimination performance to groups RN and PN. According to Whitehurst's interpretation, N is essentially a non-reinforcer with R and P equal in reinforcing effectiveness. The superiority of RP, therefore, was attributed to the strength of the combination of reward and punishment for that group. In view of the results of previous studies, however, it seems unlikely that N carries no reinforcing properties for fully instructed Ss.

A study by Penney (1967) which has rarely been cited in the subsequent reward-punishment literature yielded yet another explanation of contingency group differences. The experimental design was very similar to that utilized by Penney and Lupton (1961) except that, in this case, a two-alternative haptic discrimination task was employed and reward expectancy was controlled. The typical PN and RP superiority over RN was demonstrated but the results failed to support Penney and Lupton's (1961) frustrative nonreward interpretation. Instead, the superiority of the PN and RP groups was related to the number of orienting (touching) responses made to the stimuli. The PN group made significantly more orienting responses to the stimuli than the RN

group. Group RP was intermediate with nonsignificant PN-RP and RN-RP differences. Moreover, correlations between trials to criterion and the mean number of orienting responses made per trial up to the criterion trial were $-.41$, $-.42$ and $-.61$ for the PN, RP and RN groups, respectively, suggesting a positive association between learning rate and number of orienting responses. Penney hypothesized that fear of noxious stimulation may slow down responding and increase observing behavior or that high reward incentive may lead to faster responding and fewer orienting responses. To date, the response latencies of Ss receiving various contingency combinations during the learning of a discrimination problem have not been measured. Measurement of the choice response latencies (time between the end of the last observing response and the choice response) and the nonobserving trial times of RN, RP and PN subjects would provide valuable data by which to evaluate Penney's response latency hypothesis.

A recent study (Witte and Grossman, 1971) employed a procedure very similar to Penney's but added a response force measure of motivational changes. They replicated Penney's contingency group and orienting response results but found no differences in motivation between contingency groups. Witte and Grossman, like Penney, suggested that group differences were due not to motivational but to

attentional differences. They further suggested the possibility that since rewarding and punishing events may have been differentially distracting, the presentation of reward may have served to distract RN Ss thereby interfering with their attentional responses and resulting in a performance decrement for this group.

The interpretations of contingency group differences given by Stevenson et al. (1959) and Harter et al. (1971) are consistent with the hypothesis that these differences are related to the attentional levels exhibited by the Ss in each group. Employing a cost procedure of punishment, Stevenson et al. used stickers and Harter et al. used marbles as reinforcements. In general, RP groups performed significantly better than RN groups on task acquisition (PN groups were not tested). Stevenson et al. attributed this difference to the facilitative effect of punishment in increasing a subject's attention to relevant cues; Harter et al. attributed the difference to a possible combination of motivational and attentional effects which may result from the presentation of the punishing stimulus.

The studies hypothesizing attentional differences between contingency groups apparently did not employ Ss who were instructed as to the meaning of the blank trial. The point can be made, therefore, that the group differences demonstrated in these studies may have been due, at least in part, to the misinterpretation of the nonoutcome trial

by some Ss. For example, if "blank" typically has the effect of increasing subsequent attentional behavior for fully informed RN Ss, its misinterpretation would likely alter this effect, perhaps causing an attentional decrement for uninformed RN groups.

The present experiment, a continuation of Penney's (1967) work and hypotheses, was designed to investigate the effects of reward and punishment on children's observing behavior during the learning of a two-choice visual discrimination problem. To eliminate the misinterpretation of contingencies, Ss were fully instructed about the meaning of all rewarding and punishing events including "blank". The differential distractibility of contingencies was controlled to a greater extent than in previous experiments by making rewarding and punishing events highly similar. In addition, the choice response latency and the nonobserving trial time was obtained on each trial for each S. These measures were not entirely independent but provided a test of Penney's response latency hypothesis. It was hypothesized that, on task performance (trials to criterion), groups PN and RP would show superiority over group RN and that this superiority would be related to observing behavior and response latency. It was expected that, while learning the problem, Ss in groups PN and RP would make more and longer observing responses and would exhibit longer nonobserving trial times

and choice response latencies than Ss in group RN.

Method

Subjects. Thirty male and 30 female second- and third-grade children attending a predominantly middle-class elementary school in Winnipeg, Manitoba served as Ss.

Apparatus. The stimuli were presented in two light-proof boxes similar to those described by Cantor et al. (1963). Each stimulus box measured 12 in. wide, 13 in. high and 23 in. deep and was painted flat black inside and out. Centered on the front face of each box, 4 3/8 in. from the top, was an oval-shaped viewing aperture 5 1/8 in. long and 1 5/8 in. high. A black, cloth-covered response panel, 7 in. long and 3 in. high was hung directly above each viewing aperture. Located behind each response panel was a microswitch which was connected by electrical switching equipment to a 60W, 120V bulb inside the box. A groove at the rear of each box allowed the insertion of stimulus cards.

An S was able to view the stimulus card inside a box by pressing his forehead against the response panel on the box. Pressing a response panel closed the microswitch behind it turning on the light inside the box and activating a .01 sec. clock for the duration of the press. A third .01 sec. clock recorded nonobserving trial time (the time on each trial that the S spent engaging in nonobservational

behavior) and electric counters recorded the number of times each response panel was pressed on each trial. The temporal sequence of trial events was registered by a multi-channel pen recorder. It was from these pen recordings that the choice response latency on each trial (time between the last observing response and the choice response) was measured for each S.

The stimulus boxes were placed on a low table beside one another but angled slightly inward. The viewing apertures were located at approximately eye level for an S seated in front of the apparatus. On the table directly in front of the stimulus boxes was a black choice response box 2 1/2 in. wide, 2 in. high and 15 1/2 in. long with two red push-buttons mounted 12 1/2 in. apart on the top of the box. Each push-button was situated directly below one of the viewing apertures.

Rewarding and punishing events occurred on a wooden contingency panel, 36 in. wide and 30 in. high, located above the stimulus boxes. The contingency panel, which was painted flat black, contained two windows 6 in. square surrounded by white frames 1 5/8 in. wide. The windows were centered on the panel side by side 1 in. apart and 1 7/8 in. above the bottom edge. Behind each window was a Z-shaped white plexiglass track along which a penny could roll in full view of the S. A 4W, 28V bulb situated behind each plexiglass track could illuminate each window. A card

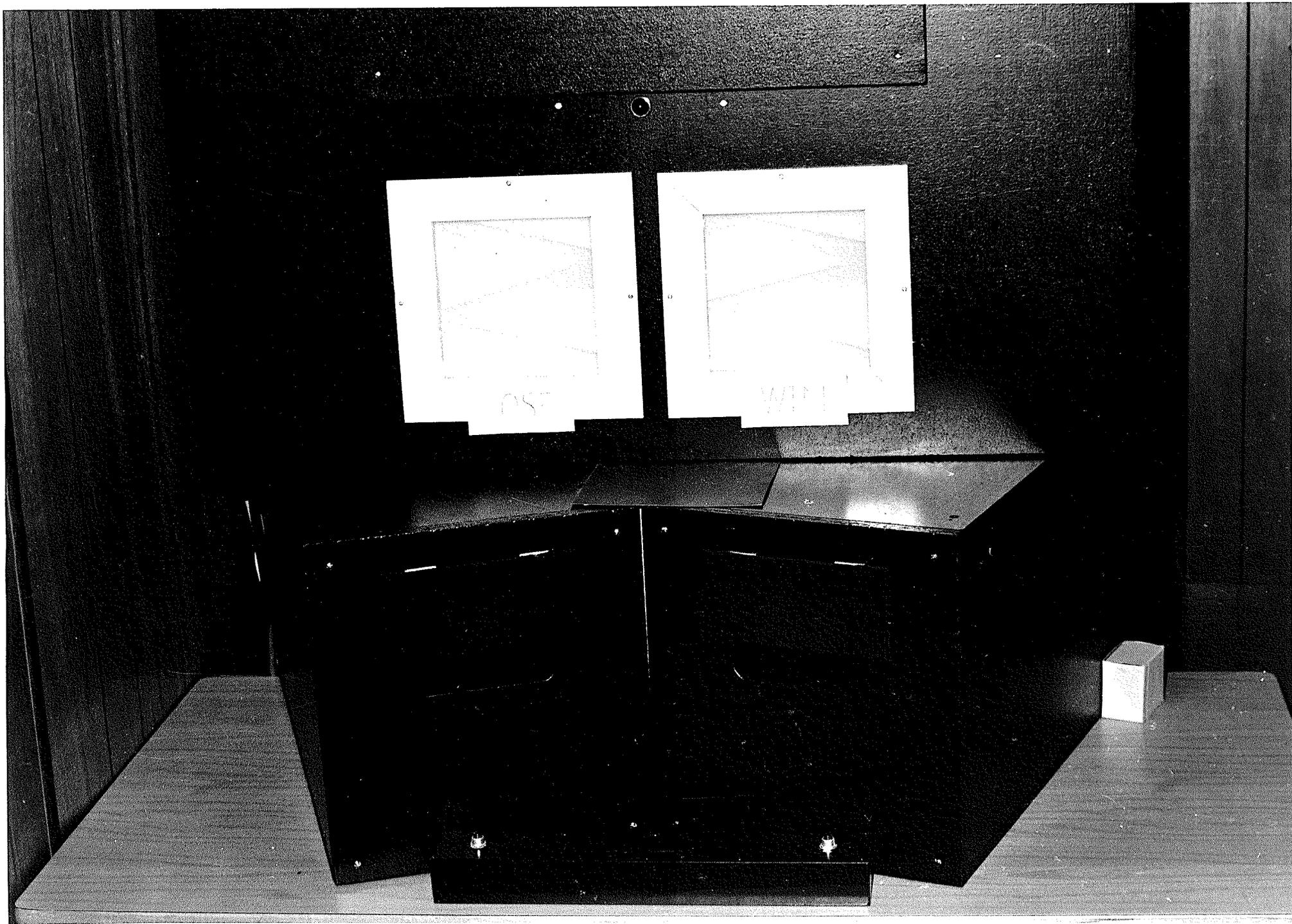
measuring 4 in. long and 2 in. high was affixed below each of the two windows. One card contained the word "WIN"; the other contained the word "LOSE". A 1/2 in. green light was centered on the contingency panel 13 1/2 in. above the bottom edge.

A picture of the apparatus is presented in Figure 1.

The stimuli were like those used by Penney and Lupton (1961). Each stimulus was a 3 1/2 in. square divided into two halves, one red and one white, by a diagonal rising either from the bottom left to the top right or from the bottom right to the top left of the square. The stimuli varied on two dimensions -- colour position (red down or white down) and diagonal orientation (diagonal rising to the right or diagonal rising to the left). They were made from construction paper and were mounted on black cards measuring 10 1/2 in. wide and 14 in. high. Two practice stimuli were employed during the reading of the instructions to the S. One was a picture of a tree; the other was a picture of a horse. Both were mounted on black cards.

Procedure. Ten Ss of each sex were randomly assigned to each of three contingency conditions (RN, RP, PN). Within each contingency condition-sex subgroup, five Ss were randomly assigned to each of the two correct-cue counterbalancing groups (red down, white down). In addition, within each of the 12 correct-cue counterbalancing groups, the five Ss were randomly assigned to one of two

Figure 1. A picture of the apparatus.
The stimulus boxes, response
box and contingency panel
are clearly shown.



feedback-position counterbalancing groups ("WIN" window on the right and "LOSE" window on the left, "LOSE" window on the right and "WIN" window on the left) with the restriction that a maximum of three Ss within each of these subgroups would receive identical feedback-position treatments.

The Ss were brought individually from their classrooms to a testing trailer located beside the school. They were seated in front of the apparatus and read the appropriate instructions.

All Ss received the following instructions:

"We're going to play a game in which you will have a chance to win some pennies as a prize.

"This is how you play the game. These two black boxes (E points to the stimulus boxes) have pictures in them but the only way that you can see the pictures is to press your forehead against this panel like this (E demonstrates). The light inside the box comes on and you can see the picture. Now you try it. Good. Now look at the picture in the other box. Good.

"Now, when you see this green light come on (E points to the green light on the contingency panel), begin to look into the two boxes one at a time. You can look into them as many times as you like and as long as you like. After you have looked at both pictures, decide which box contains the correct picture. If you think this box (E points to the box on the S's left) contains the correct picture, press

this button (E points to the left-hand button on the response box). If you think this box (E points to the box on the S's right) contains the correct picture, press this button (E points to the right-hand button on the response box). Do not press the button until you have stopped looking into the boxes.

"I will give you some pennies at the start of the game. I will give you all the pennies in this box (E holds up a small enclosed box, shakes it a bit and puts it out of sight)."

Ss in the reward-only group (RN) received the following additional instructions:

"Now, every time your choice is wrong, nothing will happen. Just wait for the green light to come on and begin to look into the boxes again.

"Every time your choice is correct, I will put one more penny into the box. When the window that says 'Win' below it lights up and a penny rolls down this track (E points to the 'Win' window), you know that I have added one penny to the box. When the game is over, you may keep all the pennies that are in the box."

Ss in the punishment-only group (PN) received the following additional instructions:

"Now, every time your choice is correct, nothing will happen. Just wait for the green light to come on and begin to look into the boxes again.

"Every time your choice is wrong, I will take one penny from the box. When the window that says 'Lose' below it lights up and a penny rolls down this track (E points to the 'Lose' window), you know that I have taken one penny out of the box. When the game is over, you may keep all the pennies that are in the box."

Ss in the reward-punishment group (RP) received the following additional instructions:

"Now, every time your choice is correct, I will put one more penny into the box. When the window that says 'Win' below it lights up and a penny rolls down this track (E points to the 'Win' window), you know that I have added one penny to the box.

"Every time your choice is wrong, I will take one penny from the box. When the window that says 'Lose' below it lights up and a penny rolls down this track (E points to the 'Lose' window), you know that I have taken one penny out of the box. When the game is over, you may keep all the pennies that are in the box."

After reading the instructions, the E asked each S the following questions:

1. Show me what you will do when the green light comes on.

Answer: S looks into the boxes.

2. How many times can you look into the boxes?

Answer: As many times as I like.

3. How long can you look into the boxes?

Answer: As long as I like.

4. If you think the picture in this box (E points to the right-hand box) is correct, show me what you will do.

Answer: S presses the right-hand button.

5. If you think the picture in this box (E points to the left-hand box) is correct, show me what you will do.

Answer: S presses the left-hand button.

6. What happens if your choice is correct?

Answer: Groups RN and RP -- The window with "WIN" below it lights up and a penny rolls down the track. It means that I have won one penny which you have added to the box.

Group PN -- Nothing.

7. What happens if your choice is wrong?

Answer: Groups RP and PN -- The window with "LOSE" below it lights up and a penny rolls down the track. It means that I have lost one penny which you have taken out of the box.

Group RN -- Nothing.

If the S answered any of the above questions incorrectly, the appropriate part of the instructions were reread and the question was repeated. The E then seated himself out of sight of the S behind the apparatus. From here, E changed the stimuli, recorded the data and programmed the equipment on each trial.

Each S received 60 trials with the experimental

stimuli. The onset of the green light on the contingency panel signalled the start of each trial and initiated the S's observing behavior. Termination of the trial and the offset of the green light occurred when the S made a choice response. One restriction was placed on the choice response, however, in that this response could not be made while the S was engaging in observing behavior. Immediately following the S's choice, the appropriate feedback window was lighted for 5 sec. if the assigned contingency condition required the S's gain or loss of a penny. During the 5 sec. period, a penny was rolled down the Z-shaped track behind the illuminated window. Blank trials involved nothing more than the offset of the green light.

The choice response initiated a 40 sec. intertrial interval during which the E recorded the correctness of the choice response, the number and duration of the observing responses made to each of the stimuli and the nonobserving trial time, changed the stimuli and programmed the equipment for the next trial. During the intertrial interval, the S was unable to activate the lights inside the stimulus boxes and, therefore, was unable to make an observing response.

The 60 trials were divided into five blocks of 12 trials each. In each block of 12 trials, the positive stimulus was presented on the S's right six times and on the S's left six times. The sequences found by Fellows (1967) to be most satisfactory for the control of position

preferences in two-alternative discrimination tasks were used to determine the position of the positive stimulus on each trial. The position of the irrelevant diagonal orientation cues were randomized throughout with the restrictions that within each trial block the diagonal rising to the right cue would appear on the left on 50% of the trials and on the right on 50% of the trials and that within each of the six left presentations this particular irrelevant cue would be paired with each relevant colour position cue three times. The position of the positive stimulus on any trial was the same for all Ss and the stimuli presented on any one trial were the same for all Ss. Tables 1 and 2 of Appendix C describe the stimuli that appeared on each of the 60 trials for each of the correct-cue counterbalancing subgroups.

Results

The number of correct responses made in each of the five blocks of twelve trials was tabulated for each S and these data were used to determine the learning criterion scores. The trial preceding the first errorless trial block was selected as the criterion trial. Ss who failed to meet this criterion were assigned a score of 60. The mean number of trials to criterion was 25.80, 32.40 and 43.80 for groups PN, RP and RN, respectively.

Since the criterion data showed a tendency toward

non-normality, a Kruskal-Wallis analysis of variance by ranks was employed to investigate the contingency group differences in learning efficiency. The analysis revealed a significant effect of Contingency Condition ($H=8.78$, $df=2$, $p<.025$). Subsequent comparisons employing the Mann-Whitney U test indicated that, in terms of trials to criterion, group PN was superior to group RN ($U=121.0$, $p<.025$), whereas differences between groups PN and RP and between groups RP and RN were not statistically significant ($p>.05$).

The relationships between learning efficiency and observing behavior and between learning efficiency and response latency were examined by two methods. The mean score per trial up to and including the criterion trial was calculated for each S for each of the following dependent measures: number of observing responses, duration of observing responses, nonobserving trial time, choice response latency. These scores were first submitted to four separate one-way analyses of variance (analyses shown in Appendix A, Tables 1 through 4; means shown in Appendix B, Tables 1 through 4) with Contingency Condition as the between-subjects factor. None of the analyses yielded a significant effect of Contingency Condition ($p>.05$). Secondly, for each of the dependent measures, the mean scores were correlated with the criterion scores within each contingency group. Kendall Tau correlations between

the mean number of observing responses and criterion were .00, -.09 and .03 for groups RN, RP and PN, respectively. Corresponding correlations between the mean duration of observing responses and criterion were -.09, .18 and -.01 and between the mean nonobserving trial time and criterion were .13, .14 and .03. All of these correlations were statistically nonsignificant ($p > .05$). Significant correlations were found between the mean choice response latency and the criterion measure for groups RN ($r = .26$, $p < .05$) and RP ($r = .33$, $p < .05$), however. No relationship was found between choice response latency and criterion for group PN ($r = .01$, $p > .05$).

The mean number and duration of observing responses were calculated separately for the correct and the incorrect stimulus for each of the five trial blocks for each S. In subsequent analyses involving these dependent measures, Learners (Ss who reached criterion performance in less than 60 trials) and Nonlearners (Ss whose criterion trial was 60) were compared. Of the 20 Ss in each contingency condition, there were 14, 13 and 9 Learners in groups PN, RP and RN, respectively.

The observing response measures were entered into two separate unweighted means analyses of variance with Contingency Condition and Learning Efficiency (Learners vs. Nonlearners) as between-subjects variables and Stimulus Correctness (correct stimulus vs. incorrect stimulus) and

Trial Blocks as within-subjects variables. Since the unweighted means analysis of variance assumes that the unequal subclass numbers are due to random loss of subjects and are unrelated to treatment effects, its use may be inappropriate in the present case. A least-squares analysis is more appropriate for cases in which the unequal subclass numbers are correlated with the treatment effects (Meyers, 1973). However, a least-squares analysis of variance program which would take more than one between-subjects factor was not available to the present author. As a consequence, the unweighted means analysis of variance was utilized. To confirm the results of this analysis, the data was subsequently collapsed over Contingency Condition and a least-squares analysis was performed. Multiple comparisons were made using the Scheffé test and an α level of .05.

Significant effects of Stimulus Correctness ($F=.021$, $df=1/54$, $p<.01$), Trial Blocks ($F=14.71$, $df=4/216$, $p<.01$) and Learning Efficiency X Stimulus Correctness ($F=6.32$, $df=1/54$, $p<.05$) were found in the analysis of observing response number (unweighted means analysis shown in Appendix A, Table 5; means shown in Appendix B, Table 5/ least-squares analysis shown in Appendix A, Table 6; means shown in Appendix B, Table 6). Subsequent pairwise comparisons of the mean number of observing responses for the five trial blocks (means equal to 1.51, 1.24, 1.20, 1.20 and 1.15, respectively) showed that the mean number of

observing responses in the first trial block was significantly greater than the mean number of observing responses in subsequent trial blocks. Figure 2 presents the mean number of observing responses for Learners and Nonlearners as a function of stimulus correctness. Comparisons of the means of the within-subjects variable showed that while Learners looked more frequently at the correct stimulus than at the incorrect stimulus, Nonlearners did not exhibit a preference for looking at either stimulus. Comparisons of the between-subject means indicated that Learner-Nonlearner differences did not reach statistical significance ($p < .05$).

The analysis of the observing response duration data (unweighted means analysis shown in Appendix A, Table 7; means shown in Appendix B, Table 7/ least-squares analysis shown in Appendix A, Table 8; means shown in Appendix B, Table 8) yielded significant effects of Stimulus Correctness ($F=10.04$, $df=1/54$, $p < .01$), Trial Blocks ($F=12.70$, $df=4/216$, $p < .01$), Learning Efficiency X Stimulus Correctness ($F=8.75$, $df=1/54$, $p < .01$) and Learning Efficiency X Trial Blocks ($F=3.70$, $df=4/216$, $p < .01$). Figure 3 shows the mean duration of the observing responses of Learners and Nonlearners as a function of stimulus correctness. Comparisons of the means of the within-subjects variable showed that Learners looked at the correct stimulus longer than at the incorrect stimulus and that Nonlearners did not

Figure 2. Mean number of observing responses made per trial as a function of learning efficiency and stimulus correctness.

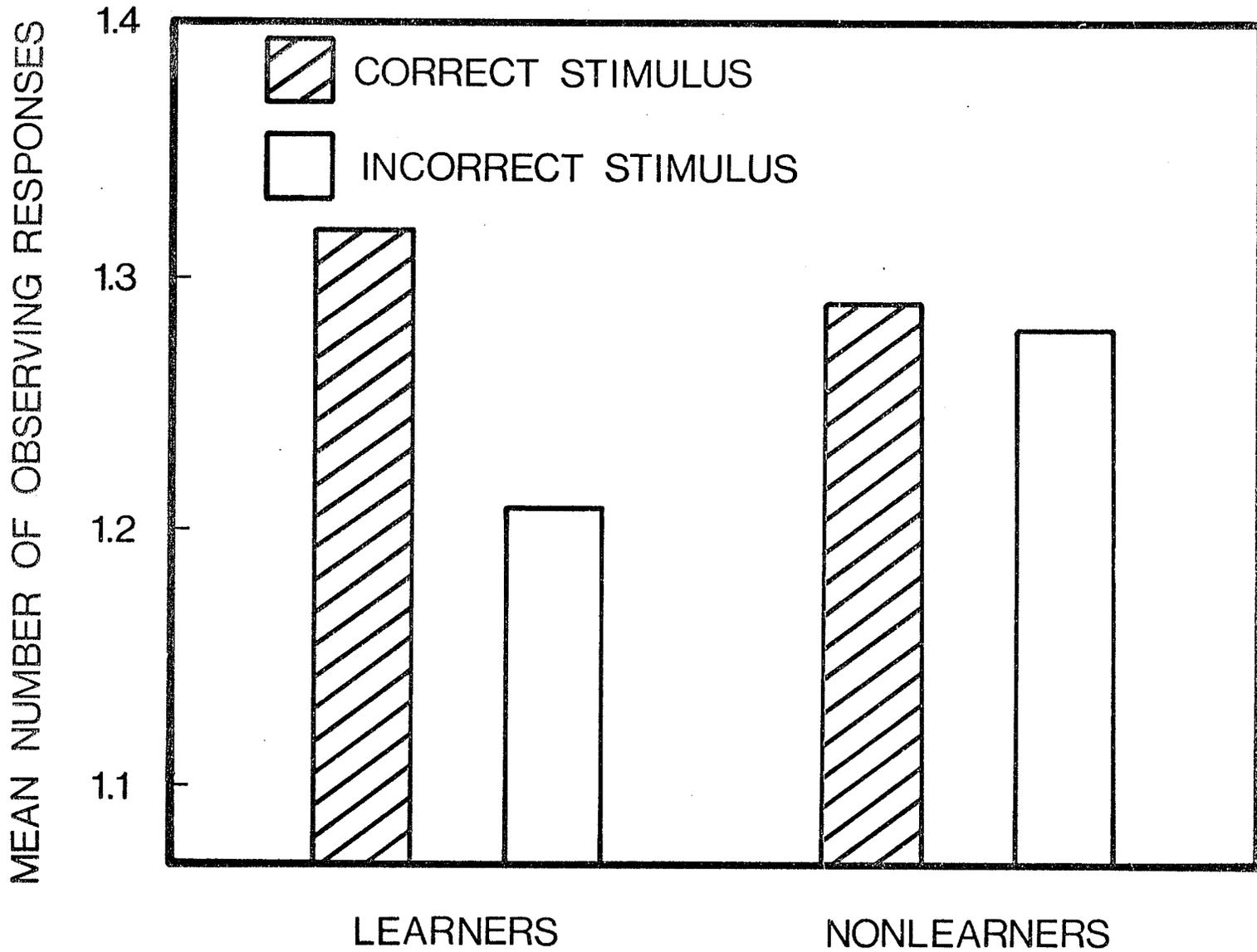


Figure 3. Mean duration of observing responses made per trial as a function of learning efficiency and stimulus correctness.

MEAN DURATION OF OBSERVING RESPONSES (SEC)

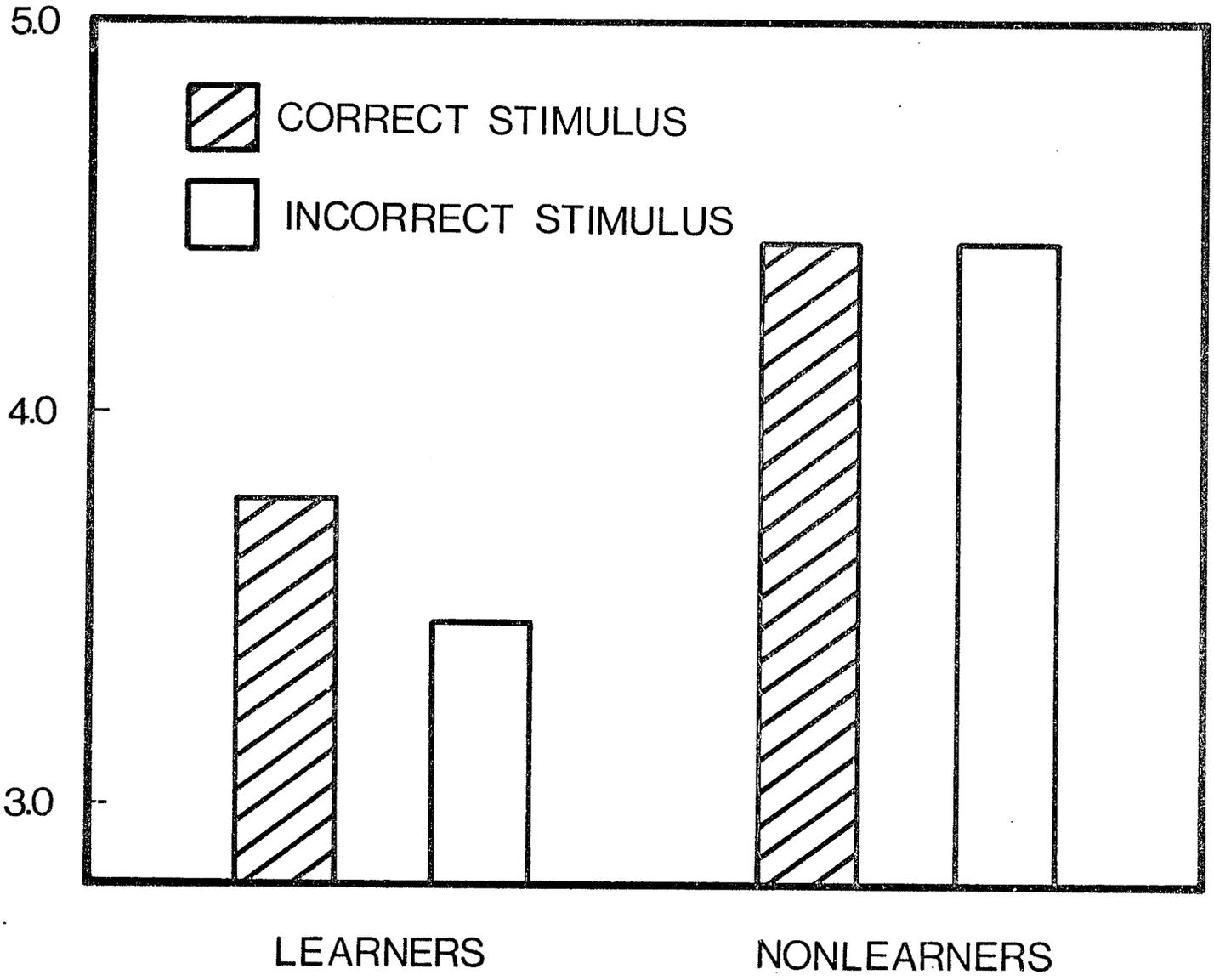
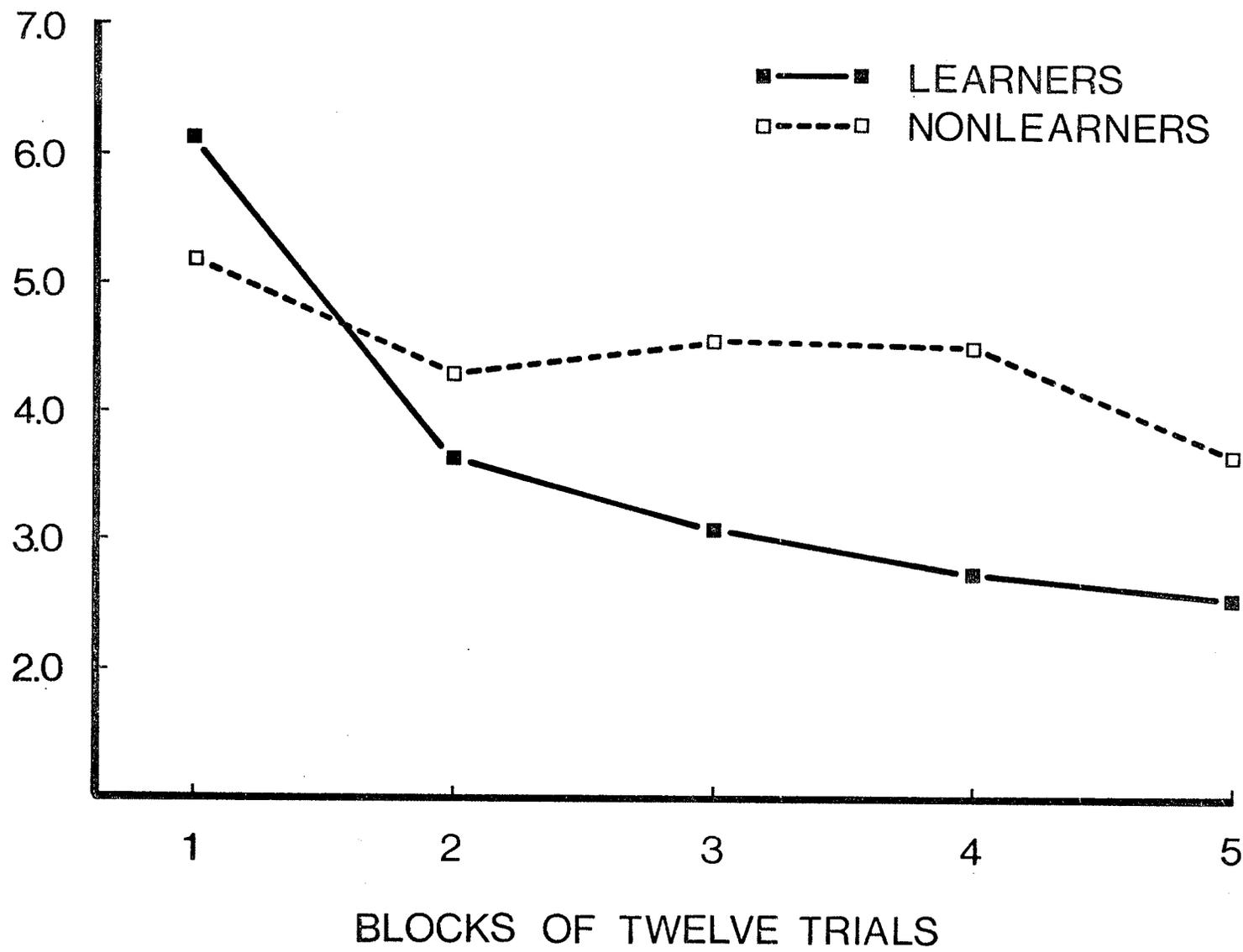


exhibit this preference. Between-subject differences in means were nonsignificant ($p > .05$). The mean duration of the observing responses of Learners and of Nonlearners is presented as a function of trial blocks in Figure 4. Pairwise comparisons of the means of the within-subjects variable showed that for Learners, the mean duration of observing responses in the first trial block was significantly longer than the mean duration in blocks 3 through 5 but for Nonlearners, the mean duration of observing responses did not decrease significantly over trial blocks. Comparisons of the between-subject means indicated that Learner-Nonlearner differences were not statistically significant ($p > .05$).

The number and duration of observing responses, the nonobserving trial times and choice response latencies on trials following correct and on trials following incorrect choice responses were examined to determine if the reward, punishment and "blank" contingencies had differential effects on the behavior exhibited on the subsequent discrimination trial. To maximize the number of Ss who could be included in the analysis, only data from the first trial block were considered. Thirty-five of the 60 Ss had at least one of each of four two-trial sequences (a correct choice response followed by a correct choice response, a correct choice response followed by an incorrect choice response, an incorrect choice response followed by a

Figure 4. Mean duration of observing responses made to each stimulus as a function of learning efficiency and trial blocks.

MEAN DURATION OF OBSERVING RESPONSES (SEC)



correct choice response and an incorrect choice response followed by an incorrect choice response) in the first trial block. Measures obtained on the second trial of the first occurrence of each sequence were submitted to least-squares analyses of variance with Contingency Condition as the between-subjects variable and Correctness 1 (choice response correctness on the first trial in the sequence) and Correctness 2 (choice response correctness on the second trial in the sequence) as the within-subjects variables. By analyzing the data in this manner, behavior shown on trials on which correct or incorrect responses were made by the S could be examined as well as behaviors shown on trials following correct and incorrect responses.

The analyses of variance for number of observing responses, duration of observing responses, nonobserving trial time and choice response latency are presented in Appendix A, Tables 9 through 12; the means for these analyses are presented in Appendix B, Tables 9 through 12. The effect of Correctness 1 reached statistical significance for both number of observing responses ($F=5.73$, $df=1/32$, $p<.05$) and nonobserving trial time ($F=8.94$, $df=1/32$, $p<.01$) and approached significance for duration of observing responses ($F=3.78$, $df=1/32$, $p<.10$). Ss looked at the stimuli more frequently (means equal to 3.30 and 2.78) and longer (means equal to 15.69 and 11.34 sec.) following an incorrect choice response than following a correct choice response.

Similarly, nonobserving times were longer following incorrect responses (mean equal to 10.46 sec.) than following correct responses (mean equal to 7.90 sec.). The numbers of the trials from which the scores for the four types of trial sequences were obtained were submitted to a least-squares analysis of variance with Contingency Condition as the between-subjects variable and Correctness 1 and Correctness 2 as the within-subjects variables. This analysis (analysis shown in Appendix A, Table 13; means shown in Appendix B, Table 13) yielded no significant effects ($p > .05$) indicating that for each contingency group, the scores for each type of trial sequence were obtained at approximately the same stage of training.

Discussion

Consistent with the results of most of the contingency group literature (Penney, 1967; Penney and Lupton, 1961; Spence and Segner, 1967; Witte and Grossman, 1971), Ss who received punishment for incorrect responses and nothing for correct responses exhibited discrimination performance which was superior to Ss who received reward for correct responses and nothing for incorrect responses. The prediction of RP superiority over RN was not supported, however. The learning rates of Ss who received reward for correct responses and punishment for incorrect responses did not differ significantly from those of Ss in the RN

and PN groups.

In the present experiment, there exists the possibility that the effectiveness of the various contingency combinations in changing and maintaining behavior interacted with the differential distractibility of these combinations to produce the PN, RP and RN group ordering of criterion performance. Reinforcement theory would predict that if the contingency combinations were equally distracting for the three treatment groups, the combination of R and P would produce the most efficient learning followed by either the combination of P and N or R and N (Whitehurst, 1969). However, although the physical events of P and R were equated for distractibility in the present study, there was no equation for the total distractibility of the contingencies in combination. Ss in group RP were subjected to the greatest distraction since they received an overt contingency following each choice response. For Ss in group RN, the occurrence of the distracting overt contingencies increased from a mean of 50% as discrimination performance improved. The distractibility of the contingencies was lowest for group PN Ss since overt contingencies decreased from a mean occurrence of 50% as the task was learned. The differential distractibility of these combinations, therefore, would likely produce a criterion performance ordering of PN, RN and RP if it could be assumed that the three

contingency combinations are equally effective in changing and maintaining behavior. However, since the criterion performance ordering obtained in the present experiment is not consistent with either the predictions of reinforcement theory or the predictions of the distractibility hypothesis, this result may have been due to the interaction of contingency combination effectiveness and distractibility. Further study of the reinforcing effectiveness and distractibility of the contingencies in combination is needed. Experiments in which either the reinforcing effectiveness or the distractibility of the contingency combinations is equated across groups would be most valuable for assessing the effects of these variables on contingency group performance.

In contrast to the findings of Penney (1967) who studied tactile rather than visual observing responses, the present experiment provided no evidence to suggest that differences in the learning rates of either individual Ss or contingency groups as a whole are related to the observing behavior exhibited during the learning of the discrimination task. Perhaps the observing response measures employed in the present study were too gross to detect the subtle differences in visual observing behavior which may lead to differences in learning rate. It may be the quality rather than the quantity of observing behavior that is the important factor in determining

the efficiency of discrimination learning. An observing response model accounting for differences in learning rate should, therefore, not be discarded. Future research investigating the role of observing behavior in discrimination learning might examine the eye movement patterns and visual fixations of Ss learning discrimination problems.

The prediction that contingency group differences in criterion performance would be related to response latency as measured by nonobserving trial time and choice response latency was not supported by the present data. No significant contingency group differences on either of these two response latency measures were evident during task acquisition. Moreover, contrary to prediction, small but significant within-group positive correlations were found between criterion performance and choice response latency for groups RN and RP. Perhaps Ss in these groups became more cautious, increasing their choice response latencies slightly over trials when the task was not immediately mastered.

The prediction that observing responses would decrease in number and duration over trials and that this decrease would be more pronounced for Ss who learn the task than for those who did not learn the task received partial support in the present data. As expected, the durations of the observing responses of learners became shorter over

trials whereas those of nonlearners did not decrease significantly. This result provides some indication that observing responses decrease in length only when the task is learned. The observing responses of learners decreased in number over trials but, contrary to prediction, the numbers of the observing responses of nonlearners also tended to decline. From the data, it appears that the number of stimulus comparisons declined sharply for both groups early in training. Both groups may have adopted the strategy of taking few but lengthy looks at each stimulus. If such a strategy was adopted it may have been the result of the task employed where each stimulus comparison involved a bothersome turn of the head.

The finding that learners looked longer and more frequently at the correct stimulus than at the incorrect stimulus is consistent with previous research with monkeys (Oscar-Berman et al., 1971) and humans (Oscar-Berman and Bakoplus-Banos, 1971). As predicted, nonlearners failed to show a preference for looking at the correct stimulus. Oscar-Berman and Bakoplus-Banos (1971) attribute the preference of learners for looking at the correct stimulus to the idea that Ss tend to "look at what they touch" (their study employed a task which required the Ss to respond to the correct stimulus by touching it) but there is an alternative explanation. Numerous reports (Parker and Nunnally, 1966; Nunnally et al., 1967; Nunnally and

Faw, 1968) have shown that children tend to evaluate more positively and to look longer at stimuli that have been associated with rewarding events than at stimuli that have been paired with neutral or negative events. It is possible that during the learning of a two-alternative discrimination problem, the correct stimulus changes in affective value and becomes the preferred stimulus. Non-learners, then, would fail to show a preference for the correct stimulus if such conditioning failed to occur.

Evidence that stimulus feedback can influence subsequent observing and nonobserving behaviors was provided in an analysis of data from the first trial block. A greater number of observing responses and longer non-observing times were exhibited on trials following incorrect responses than on trials following correct responses. In addition, there was a tendency for observing responses following incorrect choice responses to be longer than those following correct choice responses. No effect of Contingency Condition was found and hence there is no evidence that "blank" contingent upon correct or upon incorrect responses had an effect on subsequent behavior that was different from the effects of the overt rewarding and punishing contingencies, respectively. From the data collected in the present experiment, it cannot be determined if the knowledge of a correct response decreases observing behavior and speeds responding from its normal

level on the subsequent trial or if the knowledge of an incorrect response increases observing behavior and slows subsequent responding from its normal level. Further studies employing rewarding, punishing and neutral contingencies would be valuable in assessing more fully the effects of feedback on subsequent behavior.

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Appendices

Appendix A

Table 1
Least-Squares Analysis of Variance: Mean Number of
Observing Responses (mean per trial up to and
including the criterion trial) of Ss
in the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	.14	.18
Error 1	51	.75	
Total	53	.73	

* $p < .05$

** $p < .01$

Table 2
Least-Squares Analysis of Variance: Mean Duration
of Observing Responses (mean per trial up to
and including the criterion trial) of Ss
in the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	35.38	.45
Error 1	51	77.27	
Total	53	75.69	

* $p < .05$

** $p < .01$

Table 3

Least-Squares Analysis of Variance: Mean Duration
of Nonobserving Trial Time (mean per trial
up to and including the criterion trial)
of Ss in the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	10.63	2.45
Error 1	51	4.33	
Total	53	4.57	

* $p < .05$

** $p < .01$

Table 4
 Least-Squares Analysis of Variance: Mean Choice
 Response Latency (mean per trial up to and
 including the criterion trial) of Ss in
 the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	2.82	2.76
Error 1	51	1.02	
Total	53	1.09	

* $p < .05$

** $p < .01$

Table 5

Unweighted Means Analysis of Variance: Mean Number of
 Observing Responses Made to the Correct and to the
 Incorrect Stimulus Over the Five Blocks of 12
 Trials by Learners and Nonlearners in Each
 of the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	1.07	1.07
Learning Efficiency (L)	1	.10	.10
C x L	2	.38	.38
Error 1	54	1.00	
Stimulus Correctness (S)	1	.55	10.21**
C x S	2	.01	.28
L x S	1	.34	6.32*
C x L x S	2	.03	.64
Error 2	54	.05	

Table 5 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Trial Blocks (T)	4	2.10	14.71**
C x T	8	.10	.72
L x T	4	.25	1.78
C x L x T	8	.07	.49
Error 3	216	.14	
S x T	4	.00	.62
C x S x T	8	.01	1.24
L x S x T	4	.01	1.11
C x L x S x T	8	.01	1.14
Error 4	216	.01	

* $p < .05$

** $p < .01$

Table 6
 Least-Squares Analysis of Variance: Mean Number
 of Observing Responses Made to the Correct and
 to the Incorrect Stimulus Over the Five
 Blocks of 12 Trials by Learners and
 Nonlearners

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Learning Efficiency (L)	1	.20	.21
Error 1	58	.96	
Stimulus Correctness (S)	1	.75	14.24**
L x S	1	.35	6.59
Error 2	58	.05	
Trial Blocks (T)	4	2.53	18.16**
L x T	4	.32	2.32
Error 3	232	.13	

Table 6 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
S x T	4	.01	1.10
L x S x T	4	.00	.78
Error 4	232	.01	

* $p < .05$

** $p < .01$

Table 7

Unweighted Means Analysis of Variance: Mean Duration
of Observing Responses Made to the Correct and to
the Incorrect Stimulus Over the Five Blocks of
12 Trials by Learners and Nonlearners in Each
of the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	63.68	.72
Learning Efficiency (L)	1	94.30	1.07
C x L	2	31.29	.35
Error 1	54	88.11	
Stimulus Correctness (S)	1	3.66	10.04**
C x S	2	.04	.06
L x S	1	3.19	8.75**
C x L x S	2	1.00	2.76
Error 2	54	.36	

Table 7 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Trial Blocks (T)	4	112.61	12.70**
C x T	8	4.12	.46
L x T	4	32.82	3.70**
C x L x T	8	3.28	.37
Error 3	216	8.86	
S x T	4	.40	1.26
L x S x T	8	.22	.69
L x S x T	4	.29	.93
C x L x S x T	8	.34	1.07
Error 4	216	.32	

* $p < .05$

** $p < .01$

Table 8
 Least-Squares Analysis of Variance: Mean Duration
 of Observing Responses Made to the Correct and
 to the Incorrect Stimulus Over the Five
 Blocks of 12 Trials by Learners and
 Nonlearners

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Learning Efficiency (L)	1	139.04	1.63
Error 1	58	85.22	
Stimulus Correctness (S)	1	5.60	15.62**
L x S	1	3.86	10.78**
Error 2	58	.35	
Trial Blocks (T)	4	143.69	17.04**
L x T	4	27.98	3.31*
Error 3	232	8.43	

Table 8 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
S x T	4	.30	.91
L x S x T	4	.13	.40
Error 4	232	.33	

* $\underline{p} < .05$

** $\underline{p} < .01$

Table 9
 Least-Squares Analysis of Variance: Number of
 Observing Responses in Each of the Four
 Two-Trial Sequences for Ss in the
 Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	.24	.03
Error 1	32	7.25	
Correctness 1 (A)	1	9.25	5.73*
C x A	2	.02	.01
Error 2	32	1.61	
Correctness 2 (B)	1	2.31	3.46
C x B	2	.14	.21
Error 3	32	.66	

Table 9 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
A x B	1	.11	.11
C x A x B	2	.18	.19
Error 4	32	.98	

* $p < .05$

** $p < .01$

Table 10
 Least-Squares Analysis of Variance: Duration of
 Observing Responses in Each of the Four
 Two-Trial Sequences for Ss in the
 Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	65.89	.07
Error 1	32	928.30	
Correctness 1 (A)	1	661.88	3.78
C x A	2	89.99	.51
Error 2	32	174.97	
Correctness 2 (B)	1	.00	.00
C x B	2	4.96	.12
Error 3	32	39.19	

Table 10 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
A x B	1	66.55	2.01
C x A x B	2	41.63	1.25
Error 4	32	33.04	

* $\underline{p} < .05$

** $\underline{p} < .01$

Table 11
 Least-Squares Analysis of Variance: Duration of
 Nonobserving Time in Each of the Four
 Two-Trial Sequences for Ss in the
 Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	45.18	1.04
Error 1	32	43.16	
Correctness 1 (A)	1	228.39	8.94**
C x A	2	5.95	.23
Error 2	32	25.51	
Correctness 2 (B)	1	11.83	.74
C x B	2	6.23	.39
Error 3	32	15.78	

Table 11 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
A x B	1	.87	.05
C x A x B	2	41.02	2.74
Error 4	32	14.95	

* $p < .05$

** $p < .01$

Table 12
 Least-Squares Analysis of Variance: Choice Response
 Latency in Each of the Four Two-Trial Sequences
 for Ss in the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	19.59	1.65
Error 1	32	11.82	
Correctness 1 (A)	1	9.00	1.31
C x A	2	.50	.07
Error 2	32	6.83	
Correctness 2 (B)	1	1.94	.45
C x B	2	2.54	.59
Error 3	32	4.24	

Table 12 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
A x B	1	1.30	.38
C x A x B	2	4.74	1.40
Error 4	32	3.36	

* $p < .05$

** $p < .01$

Table 13
 Least-Squares Analysis of Variance: Trial Number
 for Each of the Four Two-Trial Sequences for
Ss in the Three Contingency Groups

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Contingency Condition (C)	2	1.03	.45
Error 1	32	2.26	
Correctness 1 (A)	1	1.02	.17
C x A	2	8.21	1.42
Error 2	32	5.76	
Correctness 2 (B)	1	.45	.10
C x B	2	4.97	1.13
Error 3	32	4.39	

Table 13 (continued)

<u>Source</u>	<u>df</u>	<u>MS</u>	<u>F</u>
A x B	1	11.42	2.66
C x A x B	2	.04	.01
Error 4	32	4.29	

* $p < .05$

** $p < .01$

Appendix B

Table 1

Means Table: Mean Number of Observing Responses (mean per trial up to and including the criterion trial) of Ss in the Three Contingency Groups

Analysis of Variance Factor

Contingency Condition		
RN	RP	PN
2.78	2.61	2.67

Table 2

Means Table: Mean Duration of Observing Responses
(mean per trial up to and including the criterion
trial) of Ss in the Three Contingency Groups

Analysis of Variance Factor

Contingency Condition

RN	RP	PN
11.70	9.53	9.16

Table 3

Means Table: Mean Duration of Nonobserving Trial
Time (mean per trial up to and including the
criterion trial) of Ss in the Three
Contingency Groups

Analysis of Variance Factor

Contingency Condition		
RN	RP	PN
7.30	6.56	8.15

Table 4

Means Table: Mean Choice Response Latency (mean
per trial up to and including the criterion
trial) of Ss in the Three
Contingency Groups

Analysis of Variance Factor

Contingency Condition

RN	RP	PN
2.07	1.73	2.55

Table 5

Means Table: Mean Number of Observing Responses Made
to the Correct and to the Incorrect Stimulus Over
the Five Blocks of 12 Trials by Learners and
Nonlearners in Each of the
Contingency Groups

		Analysis of Variance Factor					
(C)	(L)	(S)	(T)				
		Trial Block					
		1	2	3	4	5	
RN	Learners	Correct	1.61	1.37	1.39	1.43	1.32
		Incorrect	1.49	1.27	1.27	1.26	1.17
	Non-Learners	Correct	1.50	1.29	1.31	1.32	1.20
		Incorrect	1.44	1.27	1.32	1.38	1.19
		Trial Block					
		1	2	3	4	5	
RP	Learners	Correct	1.55	1.28	1.15	1.10	1.07
		Incorrect	1.49	1.22	1.08	1.05	1.01
	Non-Learners	Correct	1.38	1.27	1.15	1.10	1.10
		Incorrect	1.38	1.16	1.14	1.09	1.11

Table 5 (continued)

		Analysis of Variance Factor					
(C)	(L)	(S)	(T)				
		Trial Block					
			1	2	3	4	5
PN	Learners	Correct	1.59	1.27	1.17	1.17	1.22
		Incorrect	1.61	1.06	1.01	0.97	1.05
	Non-Learners	Correct	1.48	1.23	1.33	1.45	1.25
		Incorrect	1.48	1.26	1.34	1.43	1.19

Table 6

Means Table: Mean Number of Observing Responses
 Made to the Correct and to the Incorrect
 Stimulus Over the Five Blocks of 12
 Trials by Learners and Nonlearners

		Analysis of Variance Factor				
(L)	(S)	(T)				
		Trial Block				
		1	2	3	4	5
Learners	Correct	1.58	1.30	1.22	1.21	1.19
	Incorrect	1.54	1.17	1.10	1.07	1.07
Nonlearners	Correct	1.46	1.27	1.27	1.29	1.18
	Incorrect	1.43	1.23	1.27	1.31	1.15

Table 7

Means Table: Mean Duration of Observing Responses Made
to the Correct and to the Incorrect Stimulus Over
the Five Blocks of 12 Trials by Learners and
Nonlearners in Each of the
Contingency Groups

Analysis of Variance Factor

(C)	(L)	(S)	(T)				
			Trial Block				
			1	2	3	4	5
RN	Learners	Correct	6.79	4.50	3.87	3.69	3.37
		Incorrect	6.73	4.30	3.38	3.30	3.07
	Non-Learners	Correct	6.41	4.99	5.01	4.73	3.83
		Incorrect	6.53	4.98	4.84	4.67	4.08
			Trial Block				
			1	2	3	4	5
RP	Learners	Correct	6.84	3.74	2.93	2.44	2.15
		Incorrect	6.36	3.70	2.89	2.38	1.96
	Non-Learners	Correct	3.93	3.99	3.59	3.84	2.94
		Incorrect	3.75	3.70	3.77	3.09	3.14

Table 7 (continued)

		Analysis of Variance Factor					
(C)	(L)	(S)	(T)				
		Trial Block					
		1	2	3	4	5	
PN	Learners	Correct	5.31	3.16	2.95	2.56	2.36
		Incorrect	4.76	2.45	2.51	2.03	2.26
	Non-Learners	Correct	5.05	3.89	4.83	5.51	4.01
		Incorrect	5.42	4.20	5.16	5.22	3.91

Table 8

Means Table: Mean Number of Observing Responses
 Made to the Correct and to the Incorrect
 Stimulus Over the Five Blocks of 12
 Trials by Learners and Nonlearners

		Analysis of Variance Factor				
(L)	(S)	(T)				
		Trial Block				
		1	2	3	4	5
Learners	Correct	6.25	3.70	3.17	2.80	2.54
	Incorrect	5.83	3.36	2.86	2.46	2.35
Nonlearners	Correct	5.34	4.43	4.55	4.67	3.63
	Incorrect	5.45	4.41	4.61	4.34	3.76

Table 9

Means Table: Number of Observing Responses in Each
of the Four Two-Trial Sequences for Ss in the
Three Contingency Groups

Analysis of Variance Factor			
(C)	(A)	(B)	
RN	Correct	Correct	2.69
		Incorrect	3.00
	Incorrect	Correct	3.30
		Incorrect	3.46
RP	Correct	Correct	2.66
		Incorrect	2.91
	Incorrect	Correct	3.00
		Incorrect	3.50
PN	Correct	Correct	2.70
		Incorrect	2.70
	Incorrect	Correct	3.10
		Incorrect	3.40

Table 10

Means Table: Duration of Observing Responses in Each
of the Four Two-Trial Sequences for Ss in the
Three Contingency Groups

Analysis of Variance Factor			
(C)	(A)	(B)	
RN	Correct	Correct	9.59
		Incorrect	12.86
	Incorrect	Correct	19.15
		Incorrect	17.09
RP	Correct	Correct	11.63
		Incorrect	10.75
	Incorrect	Correct	15.05
		Incorrect	15.65
PN	Correct	Correct	10.88
		Incorrect	12.44
	Incorrect	Correct	14.39
		Incorrect	11.46

Table 11

Means Table: Duration of Nonobserving Time in Each
of the Four Two-Trial Sequences for Ss in the
Three Contingency Groups

Analysis of Variance Factor			
(C)	(A)	(B)	
RN	Correct	Correct	6.82
		Incorrect	9.04
	Incorrect	Correct	11.27
		Incorrect	10.26
RP	Correct	Correct	6.23
		Incorrect	7.09
	Incorrect	Correct	8.85
		Incorrect	10.49
PN	Correct	Correct	10.57
		Incorrect	8.14
	Incorrect	Correct	10.04
		Incorrect	11.96

Table 12

Means Table: Choice Response Latency in Each of
the Four Two-Trial Sequences for Ss in the
Three Contingency Groups

Analysis of Variance Factor			
(C)	(A)	(B)	
RN	Correct	Correct	2.50
		Incorrect	2.76
	Incorrect	Correct	3.57
		Incorrect	2.30
RP	Correct	Correct	1.66
		Incorrect	2.12
	Incorrect	Correct	2.54
		Incorrect	2.66
PN	Correct	Correct	3.85
		Incorrect	2.80
	Incorrect	Correct	3.85
		Incorrect	3.85

Table 13

Means Table: Trial Number for Each of the
Four Two-Trial Sequences for Ss in the
Three Contingency Groups

Analysis of Variance Factor			
(C)	(A)	(B)	
RN	Correct	Correct	3.76
		Incorrect	4.00
	Incorrect	Correct	3.76
		Incorrect	5.15
RP	Correct	Correct	5.33
		Incorrect	4.41
	Incorrect	Correct	3.66
		Incorrect	4.00
PN	Correct	Correct	4.50
		Incorrect	3.70
	Incorrect	Correct	3.90
		Incorrect	4.10

Appendix C

Table 1

The pairs of stimuli presented on each trial when red triangle down was the correct cue. Red triangle down and white triangle down are represented by rd and wd, respectively. The irrelevant cues diagonal rising right and diagonal rising left are represented by drr and drl, respectively. The capitalized letters indicate the correct stimulus.

1	DRR-RD drl-wd	13 DRL-RD drr-wd	25 drl-wd DRR-RD
2	drr-wd DRL-RD	14 DRR-RD drl-wd	26 DRL-RD drr-wd
3	DRR-RD drl-wd	15 drl-wd DRR-RD	27 drr-wd DRL-RD
4	DRL-RD drr-wd	16 drl-wd DRR-RD	28 drr-wd DRL-RD
5	drl-wd DRR-RD	17 drr-wd DRL-RD	29 DRL-RD drr-wd
6	drl-wd DRR-RD	18 DRL-RD drr-wd	30 DRR-RD drl-wd
7	drr-wd DRL-RD	19 DRL-RD drr-wd	31 DRL-RD drr-wd
8	DRR-RD drl-wd	20 DRR-RD drl-wd	32 drl-wd DRR-RD
9	DRL-RD drr-wd	21 drr-wd DRL-RD	33 drl-wd DRR-RD
10	DRL-RD drr-wd	22 drl-wd DRR-RD	34 drr-wd DRL-RD
11	drr-wd DRL-RD	23 DRR-RD drl-wd	35 DRR-RD drl-wd
12	drl-wd DRR-RD	24 drr-wd DRL-RD	36 DRR-RD drl-wd

Table 1 cont'd

37 drr-wd DRL-RD	49 DRR-RD drl-wd
38 drl-wd DRR-RD	50 drr-wd DRL-RD
39 DRR-RD drl-wd	51 drl-wd DRR-RD
40 DRL-RD drr-wd	52 DRR-RD drl-wd
41 DRL-RD drr-wd	53 DRR-RD drl-wd
42 drr-wd DRL-RD	54 DRL-RD drr-wd
43 drr-wd DRL-RD	55 drr-wd DRL-RD
44 drl-wd DRR-RD	56 drl-wd DRR-RD
45 DRL-RD drr-wd	57 drr-wd DRL-RD
46 DRR-RD drl-wd	58 DRL-RD drr-wd
47 drl-wd DRR-RD	59 DRL-RD drr-wd
48 DRR-RD drl-wd	60 drl-wd DRR-RD

Table 2

The pairs of stimuli presented on each trial when white triangle down was the correct cue. Red triangle down and white triangle down are represented by rd and wd, respectively. The irrelevant cues diagonal rising right and diagonal rising left are represented by drr and drl, respectively. The capitalized letters indicate the correct stimulus.

1	DRL-WD drr-rd	13	DRR-WD drl-rd	25	drr-rd DRL-WD
2	drl-rd DRR-WD	14	DRL-WD drr-rd	26	DRR-WD drl-rd
3	DRL-WD drr-rd	15	drr-rd DRL-WD	27	drl-rd DRR-WD
4	DRR-WD drl-rd	16	drr-rd DRL-WD	28	drl-rd DRR-WD
5	drr-rd DRL-WD	17	drl-rd DRR-WD	29	DRR-WD drl-rd
6	drr-rd DRL-WD	18	DRR-WD drl-rd	30	DRL-WD drr-rd
7	drl-rd DRR-WD	19	DRR-WD drl-rd	31	DRR-WD drl-rd
8	DRL-WD drr-rd	20	DRL-WD drr-rd	32	drr-rd DRL-WD
9	DRR-WD drl-rd	21	drl-rd DRR-WD	33	drr-rd DRL-WD
10	DRR-WD drl-rd	22	drr-rd DRL-WD	34	drl-rd DRR-WD
11	drl-rd DRR-WD	23	DRL-WD drr-rd	35	DRL-WD drr-rd
12	drr-rd DRL-WD	24	drl-rd DRR-WD	36	DRL-WD drr-rd

Table 2 cont'd

37 drl-rd DRR-WD	49 DRL-WD drr-rd
38 drr-rd DRL-WD	50 drl-rd DRR-WD
39 DRL-WD drr-rd	51 drr-rd DRL-WD
40 DRR-WD drl-rd	52 DRL-WD drr-rd
41 DRR-WD drl-rd	53 DRL-WD drr-rd
42 drl-rd DRR-WD	54 DRR-WD drl-rd
43 drl-rd DRR-WD	55 drl-rd DRR-WD
44 drr-rd DRL-WD	56 drr-rd DRL-WD
45 DRR-WD drl-rd	57 drl-rd DRR-WD
46 DRL-WD drr-rd	58 DRR-WD drl-rd
47 drr-rd DRL-WD	59 DRR-WD drl-rd
48 DRL-WD drr-rd	60 drr-rd DRL-WD