SHOULD CORRECTIVE FEEDBACK COME BEFORE OR AFTER RESPONDING TO ESTABLISH A "NEW" BEHAVIOR?

THESIS

Presented to the Graduate Council of the University of North Texas in Partial Fulfillment of the Requirements For the Degree of

MASTER OF SCIENCE

Pamela Roberts, B.S.
Denton, TX

December, 1997
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The purpose of this study was to determine the optimal form and timing of feedback to establish a "new" behavior. It examined the relative effectiveness of delivering a corrective feedback immediately before the learner responds to a previously incorrect trial as compared to delivering a corrective feedback immediately after the incorrect response is made. Corrective feedback delivered immediately before the next opportunity to respond produced better learning than corrective feedback delivered immediately after a response. The Feedback Before condition decreased errors during training and increased acquisition rates. Results also indicated an interaction between time of feedback delivery and the complexity of the task. As the task complexity increased, the results were more dramatic in favor of the Feedback Before condition.
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CHAPTER 1

INTRODUCTION

Feedback has long been recognized as an essential element in the teaching and improvement of performance. For example, feedback is often cited as the most frequently used intervention for modifying employee behavior (Balcazar, Hopkins, Suarez, 1986; Duncan & Bruwelheide, 1986; Larson, 1984). Its popularity in organizations is due in part to its effectiveness but also because of its low cost, programmatic simplicity, and flexibility (Prue & Fairbanks, 1981). However, in a review of 126 feedback applications, Balcazar et al. (1986) concluded that feedback does not uniformly improve performance. They found that less than 50% of those studies had consistent effects (i.e. there were desired mean increases or decreases of performance as compared to the mean baseline levels). Perhaps this inconsistency in results is due to a lack of agreement within the literature as to the definition and function of feedback.

Feedback has been defined in many ways (Duncan & Bruwelheide, 1986; Prue & Fairbanks, 1981). Weiner (1948) presented one of the first definitions of feedback as information about the present state or functioning of a system which is used to control the future state or functioning of that system. This definition seems to correspond to the one given by Brethower (1972) which defined feedback as information about past performance which is used to guide future performance.
The latter definition seems to encompass many of the those given in the literature to date. However, this definition suggests that feedback is a distinctive procedure or even a principle. In reality, feedback can serve several behavioral functions and represent different procedures (Peterson, 1982).

One of the most prolonged debates over feedback is whether its function is directional or reinforcing in nature or both. Many consider feedback to primarily serve a reinforcing function (Brethower, 1972; Michael, 1982; Rogers, Brethower, Dillon, Malott, & Sallwey, 1982) because performance improves as a result of the stimulus change that followed the performance. Thus, like reinforcers, it is emphasized that feedback be delivered immediately following the behavior in order to be effective (Miller, 1975). However, there is evidence that delayed feedback is as effective as immediate feedback (Andrasik & McNamara, 1977; Bilodeau & Bilodeau, 1958; Bilodeau & Ryan, 1960; Rolland & Clark, 1987). Because the delay between the response and the delivery of feedback is far too great in some of the studies, the reinforcing nature of feedback was questioned. Even when the temporal relation of reinforcement is satisfied, Skinner (1969) noted that in some cases the term feedback was closer to guidance than to reinforcement.

This ambiguity of definition and function has created problems for research and application. First, the term feedback has become a multipurpose label, synonymous to whatever behavioral function is at issue in research and applications (e.g. instructions, discriminative stimuli, reinforcement, etc.) Second, no matter what behavioral function feedback serves, feedback is always delivered after the occurrence of a
response. With respect to the temporal requirements of feedback, Annett (1969) made the case that feedback comes between responses, suggesting that the fact that it comes before one response may be as important, if not more important, than the fact that it comes after the previous response. Similarly, Tosti (1978) recommended that if the objective is to maintain or increase an already occurring response then feedback should be delivered immediately after the response occurred. On the other hand, if the objective is to teach a new response, then feedback should be delivered immediately prior to the next opportunity to respond to a previously incorrect trial.

Given this recommendation, the actual form of feedback becomes relevant. Feedback is divided into at least two different forms: (a) confirming/disconfirming or reinforcing/punishing responses, and/or (b) correcting incorrect responses. The confirmation form of feedback is contingent on performance and is often presented in the form of "yes/no" or "correct/incorrect." It confirms correct or incorrect performance. It primarily affects the quantity of performance by increasing, decreasing, or maintaining performance, and is delivered following the response. Thus, if the objective is to maintain/increase an already occurring response, this is the form of feedback that should be used. The "no" form does lack sufficient information or guidance to efficiently teach the student the right answer, unless the student is hesitating between two answers and gives the wrong one.

Corrective feedback, on the other hand, is often presented in a form that does provide sufficient information or guidance to enable the student to perform the right answer on the next occasion for a response to occur. It may tell a person what, when,
and how to respond. It instructs by pointing out errors or deficiencies and cueing some action the performer can take to correct his/her performance. Corrective feedback primarily affects the topography of performance, or the stimulus control of responses. Thus, if the objective is to teach a new response, this is the form of feedback to use. Corrective feedback is usually delivered following an incorrect response.

Interestingly, if corrective feedback is presented before a response it is not called corrective feedback, it is considered to be a prompt. Prompts consist of physical guidance, models, demonstrations, or verbal descriptions (Whitman, Zakaras, & Chardos, 1971; Zane, Walls, & Thvedt, 1981) designed to tell the learner what, when, and how to respond. Apparently, corrective feedback and prompts are similar in their instructional function. That is, they both instruct a behavior that has never been emitted by a person or evoke a behavior that exists in a person's behavioral repertoire but is currently not occurring. However, prompting and corrective feedback procedures have been commonly cited as two different unrelated independent variables (PsychLit search between 1974 and 1996). The main difference seems to be the time at which they are delivered relative to the target behavior. Tosti (1978) pointed out another distinctive characteristic of corrective feedback that differentiates it from prompts, which is that corrective feedback (a) provides information about the present level of performance and (b) provides direction for future performance (e.g. "Last time you went west on I-96, this time go east"). Prompts only tell the performer what to do next (e.g. "Go east").
There are only two published articles that compare corrective feedback delivered immediately before the next opportunity to respond and corrective feedback delivered immediately after the response. Cook and Kendler (1956) used a 2 X 2 analysis of variance to compare two conditions: prompting (presenting the stimulus before the next opportunity to respond) and confirmation (presenting the stimulus after the response). They showed the prompting yielded significantly more correct paired associations than confirmation.

Similarly Day (1987) who used a single subject, concurrent-schedule design to compare the effects of a prompt given prior to the subject's response with the same prompt delivered after an incorrect response, concluded that delivering feedback before the opportunity to respond was more effective than delivering feedback after the response in facilitating skill acquisition. The before condition was characterized by initial large step gains, more rapid progress, minimal errors, and higher overall levels of acquisition. However, this study does not tell us about the performance in the absence of the prompts.

These two research reports suggests that corrective feedback delivered before the next opportunity to respond is more effective than delivering corrective feedback following the response in producing skill acquisition. This superiority may be due to a couple of factors. First, antecedent events can increase efficiency of training because the exclusive use of consequences to shape behavior can be a slow process (Day, 1987). That is, the teacher must wait for the student to engage in the behavior or an approximation before consequences can be delivered. This is often referred to as trial
and error learning. Second, when corrective feedback is delivered following a response during skill acquisition, the learner may practice the error several times before making a reinforceable response. This repeated practice can make it more difficult for the person to learn the correct response (Van Houten, 1980), or as Day (1987) suggested, the fewer errors the learner makes, the shorter the time required to acquire a task.

The purpose of this study was to determine the optimal form and timing of feedback to establish a "new" behavior. It examined the relative effectiveness of delivering a corrective feedback immediately before the learner responds to a previously incorrect trial as compared to delivering a corrective feedback immediately after the incorrect response is made.
CHAPTER 2

METHOD

Experiment 1

Subjects. The subjects were six undergraduate students enrolled in an introductory course in Behavior Analysis at the University of North Texas. Their ages ranged from 20 to 32 years. Their participation was voluntary, and they were told at the outset that they could withdraw from the study at any time. Subjects who completed the study received bonus points toward their grade in the course. The bonus points were not contingent on subjects' performance in the experiment.

Setting and apparatus. Experimental sessions were conducted in the human operant laboratory of the Department of Behavior Analysis. The subject sat in a small room in front of an IBM-compatible computer. No other persons were present in the room during these sessions. Subjects responded via the computer's keyboard. The stimuli, instructions, and feedback were presented on the computer screen.

Stimuli and responses. A stimulus consisted of a Japanese word displayed in the center of the computer screen, and a response consisted of typing an English word via the computer keyboard. Each response was displayed on the computer screen inside an answer box as the subject typed it. There were a total of 30 stimulus-response pairs. Of the stimulus-response pairs, 15 were assigned to one of the experimental conditions and the remaining 15 stimulus-response pairs to the other
condition (see Figure 1 in Appendix B). The subjects did not know the correct English word for any of the Japanese words used in this experiment.

Independent variable. The independent variable was the point in time at which incorrect responses were corrected: (a) immediately after the occurrence of an incorrect response, or (b) immediately before the next opportunity to respond to the just incorrectly answered stimulus. In both situations, the correction procedure consisted of presenting a model that said, "The English word for ____ is ____".

Dependent variables. The dependent measures were accuracy of responding during the baseline and training phases, total time spent studying the model during the training phase (latency between presentation of the feedback and subject’s response of pressing the enter key), and total response time (latency between presentation of the stimulus and subject’s response in the baseline and training phases). Accuracy was graphically displayed on the screen as the number of correct responses emitted over 15 trials. The time spent looking at the model was recorded as the number of seconds elapsed from the onset of the model until the subject pressed the enter key. The total time was calculated by adding all the seconds spent looking at the model in 15 trials. The dependent measures were taken during baseline, training, retention, and reacquisition.

Procedures

Overview. The experiment was carried out in three phases. First, the subjects were tested for their knowledge of the experimental word elements. Second, each subject learned 15 stimulus-response pairs by each of the two different training
methods. Third, two weeks later, subjects were tested for the retention and reacquisition of the words previously learned.

Introduction. At the beginning of the first experimental session, subjects were greeted, provided with a brief written description of the study, and asked to sign an informed consent form (see Appendix A).

Word selection. During this session the subject took a test to select the words to be used during the experiment. The test began with the subject seated in front of the computer. A prompt was displayed on the screen that asked the subject to type his/her last name and then press the enter key. Then a new screen appeared with the following instructions:

In the following exercise, you will see a Japanese word displayed on the screen. Your job is to type a corresponding English word for the Japanese word. If you do not know what English word to type, type the numeral 0. When you finish typing your answer, please press the enter key.

Once the subject pressed the enter key, a Japanese word was displayed on the screen, along with an answer box below the word, and the instructions to press the enter key to continue below the answer box. After the subject typed his/her answer and pressed the enter key, the next trial was presented. No feedback was given during this test. This session was conducted 1 week prior to training; it consisted of the presentation of 75 Japanese words and lasted approximately 30 minutes. The 30 Japanese words used in the experiment were selected from the trials incorrectly answered on this test.
**Baseline.** This condition began with the subject seated in front of the computer screen which displayed the following instructions:

*In the following exercise, you will see a Japanese word displayed on the screen. Your job is to type a corresponding English word for the Japanese word. If you do not know what English word to type, type the numeral 0. When you finish typing your answer, please press the enter key.*

Each trial began with a Japanese word displayed on the computer screen and ended after the subject typed his/her answer and pressed the ENTER key. There was no feedback delivered in this condition. A new trial was presented after the subject responded and pressed the ENTER key. There were 30 randomly presented trials per subsession, and 5 baseline subsessions were scheduled per session. Each experimental session always began with a baseline subsession (30 trials); and each baseline subsession was alternated with a training subsession (30 trials).

**Training.** This condition began with the subject seated before the computer with the following instructions displayed on the screen:

*During this exercise, you will see a Japanese word displayed on the screen. Your job is to type an English word for that Japanese word. If you do not know an English word for the Japanese word, type the numeral 0. When you finish typing the answer, please press the enter key. You will receive*
feedback regarding your performance. Now press any key when ready to begin.

Each training subsession consisted of 30 randomly presented trials. There was a total of five training subsessions per session. These subsessions were interspersed with the baseline subsessions such that each training subsession always followed a baseline subsession. Thus, a session consisted of five baseline subsessions interspersed with five training subsessions. Sessions always started with a baseline subsession and ended with a training subsession. One session was conducted per day.

Each trial began with a Japanese word displayed on the computer screen and ended after the subject typed his/her answer and pressed the ENTER key. Correct responses were followed by phrases such as “Good”, “Great”, ”You got it" presented in the center of a blank screen. A correct response consisted of typing the English counterpart of the Japanese word presented on the computer screen. Incorrect responses were corrected in one of two ways. For 15 of the 30 stimulus-response pairs, a model of the correct response was presented immediately after the occurrence of the incorrect response (e.g. “The English word for ____ is ____”). For the other 15 stimulus-response pairs, the same model was presented immediately before the next opportunity to respond to the stimulus incorrectly answered. This type of corrective feedback was dependent on the accuracy of responding in the previous baseline (see Figure 2 in Appendix B).

Retention and reacquisition probe. This phase was the same as the previous baseline and training phases, in that there were a total of five training subsessions and
five baseline subsessions interspersed. This phase was conducted 2 weeks after the
subject had completed 25 baseline and 25 training subsessions (five sessions).

Experimental design. The experimental design was an alternating treatment
design embedded in an A-B-A-B design (Barlow & Hersen, 1984). Each subject
experienced the two values of the independent variable within the same training
subsession. Training subsessions were interspersed with baseline subsessions. The
effects of the independent variable were determined by noting the correlated changes
on the behavior for an individual during training, retention, and reacquisition. To
control for task difficulty, the stimuli and response sets assigned to the two
experimental conditions for three subjects (Group A: AB, AW, and CG) were
reversed for the other three subjects (Group B: CM, OA, and TJ).
CHAPTER 3

RESULTS

Experiment 1

Figure 3 (in Appendix B) shows the number of correct responses during interspersed baseline sessions for all subsessions for subjects during both the Feedback Before (FB) and After (FA) conditions. The three subjects shown on the top correspond to Group A and the three on the bottom to Group B. For most of the subjects, there was not much difference in performance between the two conditions. Only subject TJ showed a difference in performance, favoring the FA condition.

Figure 4 (in Appendix B) shows the response latencies during interspersed baseline sessions for all subsessions for subjects during both the FA and FB conditions. There does not appear to be a difference in the results between the two conditions, with the exception being subject AB who initially showed longer response latencies in the FB condition. Response latencies for subjects AB, AW, CG, and CM show a steady increase from session 1 through 10, followed by declines in latencies thereafter. Response latencies for subjects OA and TJ remained relatively level throughout. There appears to be less stability in the results found in Group A, suggesting that there might be a difference in the counterbalanced groups.

Figure 5 (in Appendix B) shows the number of correct responses during interspersed training sessions for all subsessions for subjects during both the FB and
FA conditions. Figure 5 reveals a large difference between the two conditions; all six subjects made few errors in the FB condition, and considerable more errors in the FA condition during the initial 6 to 10 subsessions.

Figure 6 (in Appendix B) shows response latencies during interspersed training sessions for all subsessions for subjects during both the FA and FB conditions. With the exception of subject AB, all subjects in both groups initially had longer response latencies in the FA condition than in the FB. These differences, however, disappeared at about session 10 for these subjects.

Figure 7 (in Appendix B) shows study times during interspersed training sessions for all subsessions for subjects during both the FA and FB conditions. Two of the subjects (AB and AW) had longer study times in the FB condition; the remaining four subjects show little difference between the two conditions. There appears to be less stability in the results found in Group A, suggesting once again that there might be a difference in the counterbalanced groups.

Figure 8 (in Appendix B) shows the number of correct responses during the retention and reacquisition for each of the five subsessions in both the FB and FA conditions. Subsession 1 is the retention part of this phase and subsessions 2 through 5 are reacquisition part of this phase. In the retention test (subsession 1), only subject AB’s performance showed considerably better accuracy on the items trained under the FB condition. Subjects CG and CM showed slightly better accuracy on the items of the FB condition; accuracy of responding was equivalent for the items of the FB and FA conditions for subjects OA and TJ. Only subject AW responded more accurately
in the FA condition during session 1. There was not a difference between the two conditions during reacquisition for any of the subjects. Nor is there a difference in the results between the counterbalanced groups.
CHAPTER 4

DISCUSSION

Experiment 1

Results show that there were no differences between the FA and FB conditions in accuracy of responding during testing, response time during baseline, or study time during training. The only differences between the two conditions were the number of errors made and the response latencies during training. There were considerably fewer errors during the training phase for FB than for FA, which supports previous research on errorless learning. There were shorter response latencies in the FB condition than in the FA condition during training. These shorter latencies may be a result of subjects being told the correct response just prior to the trial presentation in the FB condition. Another reason may be a result of the possible aversiveness of receiving corrective feedback following an incorrect response in the FA training condition. In contrast to FA, there was never any corrective feedback delivered after an incorrect response in the FB training condition. The response latencies during baseline seem to support this last argument. During baseline there was no corrective feedback delivered for either condition. Although there were no differences in response latencies between the FA and FB groups, baseline latencies were considerably shorter than the response latencies of the FA training condition.
Collectively, there were relatively few differences found between the FA and FB conditions. Thus for practical purposes, it seems advantageous to deliver feedback before the next opportunity to respond, because it creates an errorless learning situation that might reduce the potential aversiveness of FA.

The task used here was a relatively simple task. The subjects already had the response in their repertoire. The only thing they had to acquire was the controlling relation between the Japanese word stimuli and the English word responses. Perhaps the task complexity is a factor in the effectiveness of the time of feedback delivery. Would a more complicated task further differentiate the effects of the timing of feedback? Specifically, would results differ if subjects had to learn the response topography and stimulus control? The next experiment was designed to explore this possibility.
Method

Experiment 2

Subjects. The subjects were another six undergraduate students recruited through advertisement. Their ages ranged from 21 to 46 years. Their participation was voluntary, and they were told at the outset that they could withdraw from the study at any time. Subjects who completed the study received $24. The money was not contingent on subjects' performance in the experiment.

The setting, apparatus, stimuli, responses, independent and dependent variables, procedures, and design were the same as the ones in Experiment 1 with the following exceptions. In experiment 2, subjects were required to type Japanese words in response to English stimuli. The instructions and the correction procedures were modified to reflect this change.
CHAPTER 6

RESULTS

Experiment 2

Figure 9 (in Appendix B) shows the number of correct responses during interspersed baseline sessions for all subsessions for subjects during FA and FB conditions. Figure 9 reveals that all six subjects responded more accurately in the FB condition than in the FA condition. The size of the difference varied across subjects. It was larger for subjects KB, NW, and RM than for subjects JD, LS, and UA. There does appear to be a slight difference in the results between the counterbalanced groups, with Group B having more noticeable differences between conditions.

Figure 10 (in Appendix B) shows the response latencies during interspersed baseline sessions for all subsessions for subjects during both the FA and FB conditions. Response latencies for subjects JD, KB, LS, and UA show little difference between the two conditions. Response latencies for subjects NW and RM show more of a difference, with longer latencies in the FA condition for subject NW and longer latencies in the FB condition for subject RM. Both subjects NW and RM had large differences in accuracy of responding during testing in favor of the FB condition.

Figure 11 (in Appendix B) shows the number of correct responses during interspersed training sessions for all sessions for subjects during both the FB and FA conditions. Figure 11 reveals large differences between the two conditions with the
results from all six subjects in favor of the FB condition. All subjects, with the exception of UA, had considerably slower acquisition rates in the FA condition during Experiment 2 than subjects in the FA condition during Experiment 1. There does not appear to be a difference in the results between the counterbalanced groups.

Figure 12 (in Appendix B) shows response time latencies during interspersed training sessions for all subsessions during both the FA and FB conditions. There were shorter latencies in the FB condition for all subjects in both groups, with subjects LS, NW, and RM showing the most noticeable differences, subject KB showing a less dramatic but stable difference, and subjects JD and UA showing a minimal difference. These differences disappeared around session 20 for most subjects.

Figure 13 (in Appendix B) shows study times during interspersed training sessions for all subsessions during both the FA and FB conditions. There appears to be shorter study times for subjects LS, NW, and RM in the FB condition. Study times for subjects UA, JD, and KB do not reveal a difference between the two conditions. There does not appear to be a difference between the counterbalanced groups as there was in the study times in the testing phase.

Figure 14 (in Appendix B) shows the number of correct responses during the retention testing phase for each of the five subsessions in both the FB and FA conditions. Subsession 1 is the retention part of this phase and subsessions 2 through 5 are reacquisition part of this phase. In the retention test (subsessions 1), subject RM showed considerably better accuracy on the items trained under the FB condition; subjects KB and LS showed slightly better performances in the FB condition.
Accuracy of responding was equivalent for subjects NW and UA. Subject JD responded slightly more accurately in the FA condition.
CHAPTER 7

DISCUSSION

Experiment 2

This experiment replicated the results of Experiment 1, in that fewer errors occurred and response latencies were shorter in the FB condition during training. There were again no differences found between the FA and FB conditions in response time during baseline or study time during training. However, in Experiment 2 there were differences in the rate of learning as revealed by the baseline sessions, showing the FB condition to produce faster learning. Because the only difference between Experiments 1 and 2 was the task difficulty, results of Experiment 2 suggest that the importance of time of feedback delivery depends on the complexity of the task (number of elements that had to be learned). Perhaps further complicating the task by making both the stimulus and the response unknown to the learner (e.g. Russian to Japanese) would produce more dramatic results. Further research could address this question.

This research supports Tosti's recommendation that during acquisition, feedback should be immediately useful, that is, delivered before the next opportunity to respond. This is also congruent with other research that shows that practicing a response immediately after it is corrected is more effective than presenting corrective feedback.
without opportunity to practice (Barbetta, Heron, & Heward, 1993; Drevno, Kimball, Possi, Heward, Gardner, & Barbetta, 1994).

Besides, the potential gains on the rate of acquisition of behavior, delivering corrective feedback immediately before the next opportunity to respond seems more desirable as it produces fewer errors. This difference in errors produces consequences that might produce differential physiological responding associated with what has been called frustrations, aggressions, etc. (Keller & Shoenfeld, 1950/1995), situations that subjects are likely to avoid if they are given a choice. Reid and Parsons (1996) compared staff acceptability of immediate versus delayed verbal feedback in staff training. Staff were provided with a choice of whether to receive immediate or delayed feedback regarding their client teaching performance. Among staff who expressed a preference 100% preferred immediate over delayed feedback. It would be interesting to see if subjects would prefer corrective feedback presented immediately before the next opportunity to respond, over corrective feedback presented immediately after the response.

Although it will be important to experimentally test this possible side effect, the argument is appealing. Consider the following example: Your wife/husband asks you to bring home the groceries, and you happily do. After you bring them home, she/he says, "Thank you". While putting away the groceries she/he tells you that you bought the wrong kind of rice. What effect would this have on you at that time and to your willingness to bring home the groceries in the future? But what would happen if instead she/he does not correct your mistake immediately, but warmly thanks you for
bringing the groceries, and waits until the next opportunity for you to buy the
groceries to correct you, “Honey, would you please be sure to buy the rice in the
yellow and red bag”. Which way would you prefer?

The form of feedback used in this study does not meet the definitions of
feedback presented by Tosti (1978), Brethower (1972), or Weiner (1948). That is, it
did not provide information about past performance. In this study, corrective feedback
was delivered if the performer responded incorrectly in the past, but the subject was
not informed about what he/she did incorrectly. Perhaps, defining the procedure used
in this study as feedback confuses the issue, as Peterson (1982) suggested. Instead,
these procedures should be related to the basic behavioral principles. In this study, the
physical stimulus presented immediately before the next opportunity to respond to a
previously incorrect trial might have been functioning as a prompt, “an added stimulus
that increases the probability that a person will make the correct response in the
presence of a novel stimulus” (Miller, 1975). The physical stimulus presented
immediately after an incorrect response might have also been functioning as a prompt
for the next response, and may have had a second function as a punisher: “an event
that follows a behavior and decreases the frequency of that behavior” (Miller, 1975).
If this is the case, this stimulus should be presented before the response.
INFORMED CONSENT FORM

I, ________________________________, agree to participate in a study designed to investigate human learning. I understand that each session of this experiment that I will attend will last for approximately 30 minutes, and that I will be required to attend 7 sessions.

I understand that my responses during this study will be held in strictest confidence and used only under conditions of anonymity. I agree to allow Pam Roberts to use the results of this research in any way thought best for publication or education. I understand that I will receive 30 bonus points for an introductory behavior analysis course that I am enrolled in, contingent on my completion of the entire experiment. I also understand that if I fail to attend all 7 sessions that I will not receive bonus points. There are no anticipated risks for this study.

I understand that the results of this study will provide important information about human learning. I also understand that after all the sessions have been completed, my data will be explained to me in a debriefing session.

I understand that my participation in this experiment is voluntary and that I may withdraw at any time without penalty, prejudice, or loss of benefits. If I have any questions or problems that arise in connection with my participation with this experiment, I should contact Pam Roberts at (817) 383-1108, or Dr. Rosales at 565-2274.

_____________________________  ________________________________
(date)  (signature of participant)

_____________________________  ________________________________
(date)  (signature of participant)

This project has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (817) 565-3940.
APPENDIX B

FIGURES 1 - 14
Figure 1. Experimental stimuli and responses.
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Figure 2. Procedures for the Feedback Before (FB) Feedback After (FA).
Feedback After (FA) Condition

Present training trial

"The English word for ___ is ___.

No

Correct? Yes

"Good!" etc.

Present next training trial

Feedback Before (FB) Condition

Was the next trial correctly answered during the previous baseline?

Yes

Present training trial

"The English word for ___ is ___.

No

Correct? Yes

"Good!" etc.

Present next training trial
Figure 3. Number of correct responses during interspersed baseline sessions for all subsessions for subjects in Experiment 1 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 4. Response latencies during interspersed baseline sessions for all subsessions for subjects in Experiment 1 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 5. Number of correct responses during interspersed training sessions for all subsessions for subjects in Experiment 1 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 6. Response latencies during interspersed training sessions for all subsessions for subjects in Experiment 1 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 7. Study time latencies during interspersed training sessions for all subsessions for subjects in Experiment 1 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 8. Number of correct responses during the retention test for each of the 5 subsessions for subjects in Experiment 1 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 9. Number of correct responses during interspersed baseline sessions for all subsessions for subjects in Experiment 2 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 10. Response latencies during interspersed baseline sessions for all subsessions for subjects in Experiment 2 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 11. Number of correct responses during interspersed training sessions for all subsessions for subjects in Experiment 2 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 12. Response latencies during interspersed training sessions for all subsessions for subjects in Experiment 2 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 13. Study times during interspersed training sessions for all subsessions for subjects in Experiment 2 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
Figure 14. Number of correct responses during the retention test for each of the 5 subsessions for subjects in Experiment 2 during both the FA and FB conditions. The top three subjects were in Group A and the bottom three were in Group B.
REFERENCES


Kalamazoo: Behaviordelia.


