

IMMEDIATE FEEDBACK DURING ACADEMIC TESTING¹

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Summary.—Performance on two multiple-choice testing procedures was examined during unit tests and a final examination. The Immediate Feedback Assessment Technique provided immediate response feedback in an answer-until-correct style of responding. The testing format which served as a point of comparison was the Scantron form. One format was completed by students in introductory psychology courses during unit tests whereas all students used the Scantron form on the final examination. Students tested with Immediate Feedback forms on the unit tests correctly answered more of the final examination questions which were repeated from earlier unit tests than did students tested with Scantron forms. Also, students tested with Immediate Feedback forms correctly answered more final examination questions previously answered incorrectly on the unit tests than did students tested previously with Scantron forms.

The role of feedback in learning remains an area of continuing interest and investigation (Kluger & DeNisi, 1998). Feedback has been shown to enhance perceptual motor skill learning during rotary pursuit tasks (Elliott, 1988), repeated testing on several forms of geometric illusions (e.g., Brosvic, Walker, Perry, & Degnan, 1997), and performance during recall and recognition tasks (Aiken, 1968; Sullivan, Schutz, & Baker, 1971). These improvements are especially prominent when feedback contains accurate information provided immediately whereas the imposition of a delay has yielded less consistent improvements.

Delayed feedback during learning is typically associated with lowered retention scores for college students (e.g., Sassen, Yonge, & Shrable, 1968; Beeson, 1973; Gaynor, 1981; Phye & Bender, 1989). Hetherington and her colleagues (Hetherington, Ross, & Pick, 1964; Ross, Hetherington, & Wray, 1965; Hetherington & Ross, 1967) found that delaying feedback for normal and intellectually challenged students during problem solving for 12 and 18 sec. resulted in more errors and more trials to reach solutions. Erickson and Lipsitt (1960) found similar detrimental effects on children's learning when feedback was delayed for 6 sec. The delayed feedback effect can be substantially reduced when an answer-until-correct procedure is used (e.g., Brackbill,

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Adams, & Reaney, 1967) as such feedback is neither delayed into nor beyond the time during which the learner is solving a new problem.

Examinations should assess students' knowledge, correct false impressions, and produce new knowledge. The typical multiple-choice examination, however, requires students to answer questions without information about the correctness of their selections until the next class meeting at best, and even then correct solutions may not be reviewed. If the answer form is returned without the test questions, feedback is both delayed and unrelated to the specific test questions and their correct solution. For others, the information in some test questions may be related to additional test questions, and, thus, incorrectly answering an earlier question (in the absence of corrective feedback) may result in incorrectly answering a later and related question. Indeed, the last response a student makes to a particular question is likely to become associated with that question and to be repeated when the question recurs (Guthrie, 1935), possibly on a final examination.

This study examined performance on a multiple-choice final examination when unit multiple-choice tests were administered using the Immediate Feedback Assessment Technique² or Scantron forms. The former provides students with immediate feedback for each answer selected and permits students to respond until the correct answer is selected whereas Scantron forms provide neither feedback nor the opportunity to make more than one answer selection per test question.

Students who had been evaluated on unit tests with the Immediate Feedback forms should learn more facts than students who had been evaluated with Scantron forms as measured by the number of correct responses to repeated unit test questions on the final examination. In addition, more questions initially answered incorrectly on the unit tests should be answered correctly on the final examination by students evaluated with Immediate Feedback forms.

METHOD

Participants

Seventy-five undergraduates in two introductory psychology classes participated in the study as part of their normal course activity and on a voluntary basis. The examination items were identical for both sections; however, the manner in which answers were recorded differed, as described below.

Materials

The Immediate Feedback Assessment Technique form is a multiple-

²Information on how to use the Immediate Feedback Assessment Technique as well as information about the varieties, cost, and availability can be obtained from Michael L. Epstein, Department of Psychology, Rider University, Lawrenceville, NJ 08648.

choice answer form with rows and columns of rectangular answer spaces corresponding to the number of the examination questions and the answer options, respectively. Students scraped off an opaque, waxy coating covering each option to indicate an answer selection. An X indicated a correct selection; a blank space indicated an incorrect answer. The Scantron form had the same number of rows and columns of blank answer spaces. A student indicated an answer by darkening the appropriate space with a pencil. Both answer forms were commercially designed and printed.

Design and Procedure

Type of test form (Immediate Feedback Assessment Technique versus Scantron) and type of final question (new versus repeated) defined the 2×2 mixed factorial design. Forty students used former forms and 35 students used Scantron forms during the initial unit tests whereas all students used Scantron forms on the final examination. Four identical (unit) tests were developed and students were randomly assigned to use either the Immediate Feedback Assessment Technique or the Scantron forms during unit tests.

Students using the Immediate Feedback Assessment Technique form rubbed off the coating of the response options to indicate their answers and were instructed to rethink the question and their response when an initial choice was incorrect and to continue this process until they responded correctly. Students tested with Scantron forms could only select one response option as these forms were designed to be machine scored, so the correct answer is not available during the testing process. Both classes used Scantron forms to complete an identical comprehensive final examination of 50 multiple-choice questions, 38 new questions and three questions from each of the earlier four unit tests.

RESULTS

There were two groups of students, those who had taken the unit tests using Immediate Feedback Assessment Technique forms and those who had taken identical unit tests using Scantron forms. The percent correct initial answer choices on the unit tests for the former ($M=65.0\%$, $SD=12.23$) and the latter ($M=65.0\%$, $SD=7.47$) groups did not differ ($t_{73}=.04$, $p>.05$) so overall performance on the final examination was not differentially affected by earlier performance.

There was no difference in the probability of correctly answering new final examination questions between students evaluated with Immediate Feedback Assessment Technique ($M=58.9\%$, $SD=13.8$) and those evaluated with Scantron ($M=61.4\%$, $SD=14.6$) forms. On the final examination the percentage of items answered correctly was significantly higher for those questions repeated from the four unit tests ($M=69.0\%$, $SD=17.12$) than for new questions ($M=59.0\%$, $SD=14.2$; $F_{1,148}=12.25$, $p<.001$). Students evalu-

ated previously with Immediate Feedback Assessment Technique forms ($M = 72.8\%$, $SD = 15.6$) answered the repeated items significantly more accurately than those evaluated with Scantron forms ($M = 64.5\%$, $SD = 18.0$). On the final examination, there was a difference in responses to the previous unit test questions that had been incorrectly answered. Students previously evaluated with Immediate Feedback Assessment Technique forms ($M = 60.0\%$, $SD = 26.0$) were twice as likely to now respond correctly than were students previously evaluated with Scantron forms ($M = 30.0\%$, $SD = 25.4$; $F_{1,23} = 98.24$, $p < .005$).

DISCUSSION

Overall scores on the unit tests and on the final examination did not differ between participants using the Immediate Feedback Assessment Technique and Scantron forms. The use of Immediate Feedback Assessment Technique forms enhanced retention and also performance on those items repeated from prior unit tests. Similarly, students evaluated with Immediate Feedback Assessment Technique forms were significantly more likely, on the final examination, to answer items correctly which had been previously answered incorrectly. These findings were robust despite all participants having used Scantron forms on the final examination.

Students evaluated with the Immediate Feedback Assessment Technique immediately knew whether their choices were correct or incorrect and were able to select the correct answer before proceeding to the new question. Students evaluated with Immediate Feedback Assessment Technique forms responded correctly to every question and never left a question without learning the correct answer. The performance of such students on those items repeated on the final examination indicated retention of answers learned on the unit tests.

At the instructor's discretion partial credit could be assigned for proximal knowledge, that is, for answering correctly on the second, third, or fourth attempt. Correct responding on the first attempt is assigned 100% of item credit whereas responding on the second, third, or fourth attempt could be assigned 40%, 20%, and 0%, respectively, or at other reduced percentages. Such a scoring procedure enables the student to learn the correct answer and receive partial credit, thereby decreasing test credit for proximal knowledge. The Scantron answer form did not provide corrective feedback, which may actually foster the assumption that incorrect responses were correct. This assumption is evident in performance on the items repeated on the final examination: Only 30% of the items previously answered incorrectly were responded to correctly, and of the other 70%, approximately 50% received the same incorrect response. Indeed, performance on the Scantron form provided considerable support for the recency theory described by

Guthrie (1935): that individuals tend to repeat the last response (even an error) made in a recurring situation. In contrast, the last response a student made with an Immediate Feedback Assessment Technique form always provided the correct answer.

In this and related studies conducted in our laboratory participants evaluated with both Immediate Feedback Assessment Technique and Scantron forms responded to follow-up measures related to test-taking comfort, learning, acceptance of feedback, and satisfaction. In each study the Immediate Feedback Assessment Technique had significantly higher ratings on each measure except test-taking anxiety, an outcome which did not differ between the test formats and observed during informal subject debriefings.

This latter outcome is similar to the results of recent studies in which the effects of differing types of feedback on test anxiety and performance were examined. Lundgren, Sampson, and Cahoon (1998) reported that male and female students accepted positive feedback, rejected negative feedback, and that female students' self-esteem was related to positive feedback. These ratings were made 8 to 10 weeks after completing tests whereas those of the present study were made immediately on completion. In our studies the Immediate Feedback Assessment Technique form was well received independently of performance on the test, and no sex differences have been observed. Stubblebine (1998) reported that feedback perceived as threatening to final course grades resulted in lower projected course grades and ratings of self efficacy. These outcomes have not been observed in our laboratory, although these differences may be related to the assessment of projected rather than actual performance. Clark, Fox, and Schneider (1998) reported that neither delayed nor immediate feedback presented in an item-by-item or an answer-until-correct format affected students' performance and that anxiety during testing was not related to type of feedback. Their participants were permitted to select the condition of feedback they preferred during later testing periods, and most selected the answer-until-correct format, a choice not related to self-reported test anxiety. The absence of a feedback effect in Clark, *et al.* (1998) is consistent with the present results as is the preference for an answer-until-correct format. Collectively, the results of these studies demonstrate that feedback, positive or negative, affects neither academic test performance with new items nor test anxiety. Thus, the immediacy of feedback and the answer-until-correct process offered by the Immediate Feedback Assessment Technique provides substantial opportunity without differentially disadvantaging a learner who fears the evaluation process.

Whereas multiple-choice tests allow faculty to assess students' performance in large classes and to return examination results expeditiously, the answer forms often typically used do not permit learning while testing and, in fact, may foster incorrect assumptions. In comparison, Immediate Feed-

back Assessment Technique forms are easily used with large classes, assess students' knowledge sensitively, and promote the retention of materials covered on earlier examinations. Indeed, when using the Immediate Feedback Assessment Technique, incorrect assumptions are dealt with while responding to each test item, and a test score can be calculated before the end of a test. The cost of the two test forms is comparable although the Immediate Feedback Assessment Technique does not require a scoring machine. Educators have long stressed the importance of reinforcement and corrective feedback in the learning process, and the Immediate Feedback Assessment Technique provides the cost-effective medium through which these concepts can be applied during practical assessment.

REFERENCES

- AIKEN, E. G. (1968) Delayed feedback effects on learning and retention of Morse Code symbols. *Psychological Reports*, 23, 723-730.
- BELSON, R. O. (1973) Immediate knowledge of results and test performance. *Journal of Educational Research*, 66, 224-226.
- BRACKBILL, Y., ADAMS, G., & REANEY, T. P. (1967) A parametric study of the delay-retention effect. *Psychological Reports*, 20, 433-434.
- BROSVIC, G. M., WALKER, M. A., PERRY, N., & DEGNAN, S. (1997) Illusion decrement as a function of duration of inspection and figure type. *Perceptual and Motor Skills*, 84, 779-783.
- CLARK, J. W., FOX, P. A., & SCHNEIDER, H. G. (1998) Feedback, test anxiety, and performance in a college course. *Psychological Reports*, 82, 203-208.
- ELLIOTT, D. (1988) The influence of visual target and limb information on manual aiming. *Canadian Journal of Psychology*, 41, 57-68.
- ERICKSON, M. T., & LIPSITT, L. P. (1960) Efforts of delayed reward on simultaneous and successive discrimination learning in children. *Journal of Comparative and Physiological Psychology*, 53, 256-260.
- GAYNOR, P. (1981) The effect of feedback delay on retention of computer-based mathematical material. *Journal of Computer-Based Instruction*, 8, 28-34.
- GUTHRIE, E. R. (1935) *The psychology of learning*. New York: Harper.
- HETHERINGTON, E. M., & ROSS, L. E. (1967) Discrimination learning by normal and retarded children under delay of reward and interpolated task conditions. *Child Development*, 38, 639-647.
- HETHERINGTON, E. M., ROSS, L. E., & PICK, N. L. (1964) Delay of reward and learning in mentally retarded and normal children. *Child Development*, 35, 653-659.
- KLUGER, A. N., & DENISI, A. (1998) Feedback interventions: toward an understanding of a double-edged sword. *Current Directions in Psychological Science*, 7, 67-72.
- LUNDGREN, D. C., SAMPSON, E. B., & CAHOON, M. B. (1998) Undergraduate men's and women's responses to positive and negative feedback about academic performance. *Psychological Reports*, 82, 87-93.
- PHYE, G. D., & BENDER, T. (1989) Feedback complexity and practice: response pattern analysis in retention and transfer. *Contemporary Educational Psychology*, 14, 97-110.
- ROSS, L. E., HETHERINGTON, E. M., & WRAY, N. P. (1965) Delay of reward and the learning of a size problem by normal and retarded children. *Child Development*, 36, 509-517.
- SASSEN, J. M., YONGE, G. D., & SHIRABLE, K. (1968) Immediate and delayed feedback on examinations and immediate and delayed retention. *California Journal of Educational Research*, 19, 226-231.
- STUBBLEBINE, P. C. (1998) Effect of threatening feedback on expected grade, self-efficacy, and motivation. *Perceptual and Motor Skills*, 86, 67-77.
- SULLIVAN, H. J., SCHUTZ, R. E., & BAKER, R. L. (1971) Effects of systematic variations in reinforcement contingencies on learner performance. *American Education Research Journal*, 8, 135-142.