Synthesis of Research on Reviews and Tests

Whether or not "practice makes perfect" depends on the frequency and the form of the repetitions, the time elapsed between them, and whether they are massed or spaced.

Reviews may do more than simply increase the amount learned; they may shift the learner's attention away from the verbatim details of the material being studied to its deeper conceptual structure.

"Practice makes perfect" in itself is hardly a reliable guide to successful learning. Mere repetition over the course of days or even weeks is no guarantee of long-term learning. How many Americans, despite weeks of concentrated practice, can recall more than the opening phrase of the preamble to *The Constitution*, which has just 52 words? Yet most of us can still remember the "Pledge of Allegiance" or an evening prayer we once recited daily for years.

When, then, is practice most effective? Answers from learning research show that the effectiveness of repetition depends on a number of factors, including the time interval between repetitions, the frequency of repetitions, and even the form of the repetition, that is, whether it is in the form of a review or a test. The effects of these factors are currently being explained in terms of *constructive* processing. My purpose here is to review research and theory relating to effective practice and to suggest implications for classrooms.

Research on Reviews

Several findings concerning the effects of reviews deserve special attention. First, with total study time constant, two or more opportunities to study the same material are more effective than a single opportunity. For example, in a study conducted early in the century, Edwards (1917) had one group of elementary school children study a history or arithmetic lesson for six-and-one-half minutes continuously and another group for four minutes on one occasion and for two-and-one-half minutes several days later. Overall, the group given the opportunity to study the material twice performed about 30 percent better on the achievement measure than the group that did not receive a review.

More recent research has found that an opportunity to review previously presented material may affect not only the quantity of what is learned but also the quality. For example, Mayer (1983) found that repeated presentations of a science passage resulted in a hefty increase in recall of conceptual principles but did little to promote the recall of technical details. Thus, reviews may do more than simply increase the amount learned; they may shift the learner's attention away from the verbatim details of the material being studied to its deeper conceptual structure.

Another important finding about reviews is that the amount of learning following two reviews that occur close together in time (massed) often is only slightly better than that following a single study opportunity. Thus, massed reviews, such as reviews that occur just a few hours apart, may be entirely uneconomical when evaluated in terms of additional learning.

Much more effective are reviews that are spread out or distributed over lengthier periods of time. This phenomenon—known as the "spacing effect"—is one of the most robust and dependable phenomena yet documented by psychologists (Dempster 1988, Hintzman 1974, Melton 1970). In fact, two spaced presentations are often about twice as effective as two massed presentations, and this advantage tends to increase as the frequency of review increases. In a recent study of vocabulary learning, for example, a surprise retention test was administered to 35 adults who had studied Spanish vocabulary words at 30-day intervals, 24-hour intervals, or all in one day, in an experiment conducted eight years earlier (Bahrick and Phelps 1987). At the end of the experiment, each of the subjects had achieved a high level of initial learning. On the retention test, however, only the subjects who had received reviews at 30-day intervals remembered a respectable number of definitions. For subjects in the other spacing conditions, even words reviewed seven times or more were almost always forgotten eight years later.

The spacing effect also is remarkable in the scope of its application: with students of all ages and ability levels, in all sorts of situations, and with a wide variety of materials and procedures. Spacing effects have been found in a variety of instructional modes, including learning from text (for example, Dempster 1986, English et al. 1934), lecture presentations (Glover and Corkill 1987), and computer-assisted instruction (Gay 1973). Subject matter has included historical facts (Edwards 1917), arithmetical rules (Gay 1973), addition facts (Pyle 1913), science concepts (Reynolds and Glaser 1964), and vocabulary (Bahrick and Phelps 1987, Dempster 1987).

Research on Tests

One of the complexities of research is that the act of measurement often has an effect on what is measured. In physics, for example, procedures designed to pinpoint the location of a single quantum of light may actually alter its behavior. Memory is no exception; it is affected not only by additional study opportunities but also by tests—even though they may be designed simply to assess the individual's state of knowledge about a subject. As Lachman and Laughery (1968) put it, "Test[s] . . . though they be designed to measure changes in the state of the human memory system have profound and perhaps residual effects on the state of that system" (p. 40).

Research on learning—specifically research on the effectiveness of tests—has found consistently that tests do more than simply test; they also promote learning (for example, Jones 1923–24, Nungester and Duchastel 1982, Rea and Modigliani 1985, Slamecka and Katsaiti 1988). In many cases, the effect has been strong. For example, Jones (1923–24) found that the retention test scores of previously tested students were twice that of untested students. In other words, taking a test can confer substantial benefits on the retention of the same material tested at a later date, even when no corrective feedback is provided and when there are no further study opportunities. Moreover, testing may be more productive than an additional review, especially if the student has achieved a high level of initial learning (Nungester and Duchastel 1982).

As with reviews, however, the most effective tests are those that come at spaced intervals, especially if the intervals are of an expanding nature (Landauer and Bjork 1978, Rea and Modigliani 1985). This means that three or more tests covering the same educational objectives are likely to result in more learning if there is a progressive increase in the interval between each of the successive tests (for example, 1 day, 3 days, 6 days), than if the interval between the tests is the same.

Research on testing has revealed a number of other conditions that either lengthen or diminish the effects of tests, whether massed or spaced. First, tests are most effective if the material to be learned is first tested relatively soon after its presentation. The importance of early testing is nicely illustrated in a study by Spitzer (1939), who tested the entire 6th grade population of 91 elementary schools in Iowa. Each child read a highly factual article and was then tested one or more times at various intervals. An especially noteworthy outcome was that students whose initial test occurred either 1 day or 7 days after reading scored 15 to 30 percent higher on a final test two weeks later than did students whose initial test occurred either 14 or 21 days following reading.

Second, information tested but not remembered at the first opportunity is not as likely to be remembered later as is information that was successfully negotiated on the first test (for example, Jones 1923–24, Modigliani 1976, Runquist 1986). Thus, the facilitating effect of tests applies mainly to questions with successful outcomes. Third, the effects of testing are greater for repeated questions than for new items (Anderson and Biddle 1975, Nungester and Duchastel 1982, Runquist 1986, Sones and Stroud 1940). For example, Rothkopf (1966) had students study a lengthy selection from a book on marine biology, followed by a quiz on the passage. On a later test, these students performed substantially better than a control group on repeated items and modestly better on new items (an indirect effect), even though knowing the answer to one question should not have given the

Spaced repetitions are likely to encourage exactly the kinds of constructive mental processes, founded on effort and concentration, that teachers hope to foster.

answer to another. However, as Anderson and Biddle (1975) noted, the aggregate indirect benefit is likely to be greater than the direct benefit: "Only the points of information about which ... questions are asked could be directly affected, whereas presumably every point in the text could be indirectly influenced" (p. 92).

Finally, research has demonstrated that frequent cumulative tests result in higher levels of achievement than do infrequent tests or tests related only to content since the last test. For example, Fitch et al. (1951) found that students who received weekly quizzes followed by cumulative monthly quizzes had significantly higher final exam scores than did students who had only the monthly quizzes. Similarly, 5th graders tested daily performed better on cumulative weekly spelling tests than did students who received only the weekly tests (Reith et al. 1974). However, even quizzes that contain just one or two questions covering previously tested material can be helpful, so long as the quizzes are frequent (Burns 1970, MacDonald 1984).

Spaced vs. Massed Repetitions

Psychologists have attempted to understand the relation between practice and learning for nearly a century. Yet for many years, the theoretical picture surrounding spacing effects was confused and uncertain, despite numerous attempts at clarification. Recently, however, the "reconstruction" or "accessibility" hypothesis has emerged as the single most compelling explanation of spacing effects (for example, Dempster 1988, Rea and Modigliani 1987).

The basic idea is that when an individual is confronted with a repetition, he or she makes an attempt to remember, that is, to "retrieve" or "access" the previous experience with the repeated information. If the spacing between occurrences is relatively short, memory of the previous encounter will be more accessible than if the spacing between repetitions is relatively lengthy. Thus, the individual will need to devote more attention or processing effort to spaced repetitions than to massed repetitions. In general terms, the assumption is that repetitions are effective to the extent that they engender successful retrieval of the results of earlier processing and that the effort involved in a successful retrieval operation, and thus the additional learning, increases with spacing.

One bit of evidence favoring the reconstruction hypothesis is that spaced reviews and tests have been found to be more attention-grabbing than similar massed events (Dempster 1986, Magliero 1983, Zechmeister and Shaughnessy 1980). Massed repetitions, because there is not much time between them, tend to inspire a false sense of knowing or confidence (Zechmeister and Shaughnessy 1980). Thus, they receive relatively little attention ("Since I remember it so well, why pay much more attention to it?"). In short, massed repetitions are likely to encourage superficial rote processing. Spaced repetitions, on the other hand, are likely to encourage exactly the kinds of constructive mental processes, founded on effort and concentration, that teachers hope to foster.

Another finding congruent with the reconstructive hypothesis is that research subjects have consistently reported that spaced repetitions are more interesting and enjoyable than either massed repetitions or single presentations (for example, Burns 1970, Dempster 1986, Elmes et al. 1983). Massed repetitions, in fact, are perceived as "boring" and unnecessarily repetitive (Dempster 1986).

The Use of Reviews and Tests in Classrooms

Reviews and tests are currently underutilized in terms of their potential for improving classroom learning. First, we'll look at teachers' use of reviews. In a study of the effectiveness of an experimental mathematics teaching program, the teachers summarized the previous day's lessons only about 25 percent of the time, and homework was checked or reviewed only about 50 percent of the time (Good and Grouws 1979). Many topics are presented just once (for example, Armbruster and Anderson 1984). In their synthesis of research on classroom instruction, Rosenshine and Stevens (1986) noted that review is a teaching function that

Reviews and tests are currently underutilized in terms of their potential for improving classroom learning.

could be done more frequently in most classrooms. Unfortunately, textbooks do not help much. In surveys of mathematics texts, for example, the use of a distributed method of presentation, with frequent use of spaced review, is clearly the exception rather than the rule (Saxon 1982, Stigler et al. 1986). Clearly, review—and certainly *spaced* review—is not a common practice in the classroom.

As to the use of tests in the classroom, many, if not most, courses of instruction offer far less than optimal testing patterns. For example, tests are rarely as frequent as they could be. They do not appear to be an integral part of teachers' regular instruction at the elementary level, even though a particular subject may be taught three to five times a week. In one survey, 4th and 6th grade mathematics teachers reported having administered an average of about 18 curriculum-embedded tests per year, or approximately one test every two weeks (Burry et al. 1982). Research also suggests that teachers test more frequently in mathematics than in reading and that grade level and amount of testing are inversely related (Yeh 1978).

There appear to be two primary reasons for this state of affairs. First, there is no evidence of any serious effort to disseminate the results of research on reviews and tests to the educational community. In a recent sampling of practitioner-oriented textbooks suitable for use in teacher education programs (for example, Good and Brophy 1986, Kim and Kellough

Highlights of Research on Reviews and Tests

- With total study time equated, two or more opportunities to study the same material are much more effective than a single opportunity.
- Achievement following two massed study opportunities often is only slightly higher than that following a single study opportunity.
- Spaced reviews yield significantly better learning than do massed reviews.
- The effectiveness of spaced review, relative to massed review, tends to increase as the frequency of review increases.
- Tests promote learning, especially if the material to be learned is first tested relatively soon after its introduction.
- Spaced tests are more effective than massed tests, especially if the inter-test intervals are of an expanding nature.
- Frequent spaced testing results in higher levels of achievement than does relatively infrequent testing.
- The use of cumulative questions on tests is one of the keys to effective learning.

—Frank N. Dempster

1987, Mayer 1987, Slavin 1988, Woolfolk 1987), I found very little mention of spacing effects and no mention of the relation between testing and learning. Tests are regarded as instruments for making decisions about grading and pacing, not as vehicles for promoting learning (Kuhs et al. 1985).

Second, spacing effects are not intuitively obvious. Students tend to be more confident they will remember material presented under massed conditions than under spaced conditions (Zechmeister and Shaughnessy 1980). Thus, it is not surprising that cramming—"a heavy burst of studying immediately before an exam following a long period of neglect"—is the rule rather than the exception among students (Sommer 1968). Even experienced educators, when judging the instructional effectiveness of text passages, tend to rate prose in which the repetition of information is massed as better than prose in which it is spaced (Rothkopf 1963).

Implications for Educators

With relatively little difficulty, teachers can incorporate spaced reviews and tests into a variety of their existing instructional activities. For example, they can ask questions about concepts and skills taught in previous lessons, assign and check homework, and provide feedback (a form of review) on quizzes covering material from previous lessons. Discussion, too, can be an occasion for spaced review. DiVesta and Smith (1979), for example, showed that spaced discussions of a topic interspersed during a lecture facilitated learning more than did massed discussions.

Teachers can organize lessons by setting aside a brief period of time each day for reviewing the main points of the previous day's lessons. Once or twice a month, they can set aside a longer period of time for a more comprehensive review covering the main points of all previously presented material. To make the most efficient use of these review sessions, teachers can interweave related new material with old material expressed in paraphrased form. To be effective, reviews need not consist of verbatim repetitions of previously presented material (for example, Rothkopf and Coke 1966).

With relatively little difficulty, teachers can incorporate spaced reviews and tests into a variety of their existing instructional activities.

Saxon (1982) demonstrated that textbooks also can be designed to make use of spaced practice. In his algebra text, each lesson contains a set of problems in much the same fashion as most other mathematics texts. However, of the two dozen or so problems contained within each problem set, only a few deal with the most recently presented topic; the remaining problems are review questions containing elements of all previously presented topics. Notably, this text has fared very well in comparisons with standard algebra texts in terms of achievement gains, at least when the students have been of low and average ability (Johnson and Smith 1987, Klingele and Reed 1984, Saxon 1982).

Ideally, tests should be cumulative and administered according to a pattern of increasing intervals between successive tests. A test administered soon after the material is introduced is likely to have a successful outcome, engender feelings of success and accomplishment, and strengthen the information in memory sufficiently to survive a somewhat longer interval. A recent example of this sort of application has been provided by Siegel and Misselt (1984), who conducted a study in which students were taught foreign language vocabulary using a computer-assisted instruction program. When a student made an error, he or she received corrective feedback, and the missed word was programmed to reappear according to an expanded ratio practice schedule. For example, the first retesting of a missed word might occur after an interval of three intervening items; if that test had a successful outcome, the third test would occur after an interval of six intervening items, and so forth. Clearly this technique could be expanded to guide instruction in a variety of areas, including spelling, arithmetic, history, English, and science.

In addition, tests, as well as informal recitation questions, should be frequent. Process-outcome research (reviewed in Brophy and Good 1985) indicates a positive relationship between frequency of academic questions addressed to students and size of gain in student achievement. Moreover, the largest gains are seen in classes where most, perhaps 75 percent, of the teachers' questions are answered correctly (Brophy and Evertson 1976), just as the results of research on testing would predict.

The Benefits of Frequent Spaced Practice

To summarize, more frequent use of properly spaced reviews and tests in the classroom can dramatically improve classroom learning and retention. In addition, research suggests that spaced repetitions can foster time-on-task and help students develop and sustain positive attitudes toward school and learning.

Another potential benefit hinges on recent theoretical developments (that is, the reconstruction hypothesis), which suggest that spaced repetitions encourage highly constructive thinking. Exactly how this works is still a mystery, but there is reason to believe that spaced repetitions result in a richer, more elaborate understanding of the topic (McDaniel and Masson 1985). The point is that spaced repetitions require the student to engage in active, conscious processing, whereas a massed repetition or a single presentation tends to evoke shallow, effortless processing—which, though it involves "no pain," results in little or "no gain."

Obviously, frequent spaced practice requires a precious classroom resource—namely, time, which otherwise could be devoted to the presentation of new material. However, schools are already exposing students to too many topics, a high percentage of which are taught only briefly and thus superficially (see, for example, Armbruster and Anderson 1984, Porter 1989). The alternative is to expose students to relatively few, but important, ideas (Porter 1989) and—with the aid of principles of distributed practice—attempt to teach them thoroughly.□

References

Anderson, R. C., and W. B. Biddle. (1975). "On Asking People Questions about What They Are Reading." In *The Psychology of Learning and Motivation*, Vol. 9, pp. 90–132, edited by G. H. Bower. New York: Academic Press.

Armbruster, B. B., and T. H. Anderson. (1984). "Structures of Explanation in History Textbooks, or So What If Governor Stanford Missed the Spike and Hit the Rail?" *Journal of Curriculum Studies* 16: 181–194.

Bahrick, H. P., and E. Phelps. (1987). "Retention of Spanish Vocabulary over Eight Years." *Journal of Experimental Psychology: Learning, Memory, and Cognition* 13: 344–349.

Brophy, J., and C. Evertson. (1976). *Learning from Teaching: A Developmental Perspective*. Boston: Allyn and Bacon.

Brophy, J., and T. Good. (1985). "Teacher Effects." In *Handbook of Research on Teaching*, 3rd ed., p. 372, edited by M. C. Wittrock. New York : Macmillan.

Burns, P. C. (1970). "Intensive Review as a Procedure in Teaching Arithmetic." *Elementary School Journal* 60: 205–211.

Burry, J., J. Catteral, B. Choppin, and D. Dorr-Bremme. (1982). *Testing in the Nation's Schools and Districts: How Much? What Kinds? To What Ends? At What Costs?* (CSE Report No. 194). Los Angeles: Center for the Study of Evaluation, University of California.

Dempster, F. N. (1986). "Spacing Effects in Text Recall: An Extrapolation from the Laboratory to the Classroom." Manuscript submitted for publication.

Dempster, F. N. (1987). "Effects of Variable Encoding and Spaced Presentations on Vocabulary Learning." *Journal of Educational Psychology* 79: 162–170.

Dempster, F. N. (1988). "The Spacing Effect: A Case Study in the Failure to Apply the Results of Psychological Research." *American Psychologist* 43: 627–634.

DiVesta, F. J., and D. A. Smith. (1979). "The Pausing Principle: Increasing the Efficiency of Memory for Ongoing Events." *Contemporary Educational Psychology* 4: 288–296.

Edwards, A. S. (1917). "The Distribution of Time in Learning Small Amounts of Material." In *Studies in Psychology: Titchener Commemorative Volume*, pp. 209–213. Worcester, Mass.: Wilson.

Elmes, D. G., C. J. Dye, and N. J. Herdelin. (1983). "What Is the Role of Affect in the Spacing Effect?" *Memory and Cognition* 11: 144–151.

English, H. B., E. L. Wellborn, and C. D. Killian. (1934). "Studies in Substance Memorization." *Journal of General Psychology* 11: 233–260.

Fitch, M. L., A. J. Drucker, and J. A. Norton, Jr. (1951). "Frequent Testing as a Motivating Factor in Large Lecture Courses." *Journal of Educational Psychology* 42: 1–20.

Gay, L. R. (1973). "Temporal Position of Reviews and Its Effect on the Retention of Mathematical Rules." *Journal of Educational Psychology* 64: 171–182.

Glover, J. A., and A. J. Corkill. (1987). "Influence of Paraphrased Repetitions on the Spacing Effect." *Journal of Educational Psychology* 79: 198–199.

Good, T. L., and J. E. Brophy. (1986). *Educational Psychology*. 3rd ed. New York: Longman.

Good, T. L., and D. A. Grouws. (1979). "The Missouri Mathematics Effectiveness Project: An Experimental Study in Fourth-Grade Classrooms." *Journal of Educational Psychology* 71: 355–362.

Hintzman, D. L. (1974). "Theoretical Implications of the Spacing Effect." In *Theories in Cognitive Psychology: The Loyola Symposium*, pp. 77–99, edited by R. L. Solso. Potomac, Md.: Erlbaum.

Johnson, D. M., and B. Smith. (1987). "An Evaluation of Saxon's Algebra Text." *Journal of Educational Research* 81: 97–102.

Jones, H. E. (1923–24). "The Effects of Examination on Permanence of Learning." *Archives of Psychology* 10: 21–70.

Kim, E. C., and R. D. Kellough. (1987). *A Resource Guide for Secondary School Teaching*. 4th ed. New York: Macmillan.

Klingele, W. E., and B. W. Reed. (1984). "An Examination of an Incremental Approach to Mathematics." *Phi Delta Kappan* 65: 712–713.

Kuhs, T., A. Porter, R. Floden, D. Freeman, W. Schmidt, and J. Schwille. (1985). "Differences among Teachers in Their Use of Curriculum-Embedded Tests." *The Elementary School Journal* 86: 141–153.

Lachman, R., and R. R. Laughery. (1968). "Is a Test Trial a Training Trial in Free Recall Learning?" *Journal of Experimental Psychology* 76: 40–50.

Landauer, T., and R. Bjork. (1978). "Optimum Rehearsal Patterns and Name Learning." In *Practical Aspects of Memory*, pp. 625–632, edited by M. M. Gruneberg, P. E. Morris, and R. N. Sykes. New York: Academic Press.

MacDonald, C. J., II. (1984). "A Comparison

of Three Methods of Utilizing Homework in a Precalculus College Algebra Course." Doctoral diss., Ohio State University, 1984. *Dissertation Abstracts International* 45: 1674-A.

Magliero, A. (1983). "Pupil Dilations Following Pairs of Identical Words and Related To-Be-Remembered Words." *Memory and Cognition* 11: 609–615.

Mayer, R. E. (1983). "Can You Repeat That? Qualitative Effects of Repetition and Advanced Organizers on Learning from Science Prose." *Journal of Educational Psychology* 75: 40–49.

Mayer, R. E. (1987). *Educational Psychology: A Cognitive Approach*. Boston: Little, Brown.

McDaniel, M. A., and M. E. J. Masson. (1985). "Altering Memory Representations through Retrieval." *Journal of Experimental Psychology: Learning, Memory, and Cognition* 11: 371–385.

Melton, A. W. (1970). "The Situation with Respect to the Spacing of Repetitions and Memory." *Journal of Verbal Learning and Verbal Behavior* 9: 596–606.

Modigliani, V. (1976). "Effects on a Later Recall by Delaying Initial Recall." *Journal of Experimental Psychology: Human Learning and Memory* 2: 609–622.

Nungester, R. J., and P. C. Duchastel. (1982). "Testing Versus Review: Effects on Retention." *Journal of Educational Psychology* 74: 18–22.

Porter, A. (1989). "A Curriculum Out of Balance: The Case of Elementary School Mathematics." *Educational Researcher* 18: 9–15.

Pyle, W. H. (1913). "Economical Learning." *Journal of Educational Psychology* 3: 148–158.

Rea, C. P., and V. Modigliani. (1985). "The Effect of Expanded Versus Massed Practice on the Retention of Multiplication Facts and Spelling Lists." *Human Learning* 4: 11–18.

Rea, C. P., and V. Modigliani. (1987). "The Spacing Effect in 4- to 9-Year-Old Children." *Memory and Cognition* 15: 436–443.

Reith, H., S. Axelrod, R. Anderson, F. Hathaway, K. Wood, and C. Fitzgerald. (1974). "Influence of Distributed Practice and Daily Testing on Weekly Spelling Tests." *Journal of Educational Research* 68: 73–77.

Reynolds, J. H., and R. Glaser. (1964). "Effects of Repetition and Spaced Review upon Retention of a Complex Learning Task." *Journal of Educational Psychology* 55: 297–308.

Rosenshine, B., and R. Stevens. (1986). "Teaching Functions." In *Handbook of Research on Teaching*, 3rd ed., pp. 376–391, edited by M. C. Wittrock. New York: Macmillan.

Rothkopf, E. Z. (1963). "Some Observations on Predicting Instructional Effectiveness by Simple Inspection." *Journal of Programmed Instruction* 3: 19–20.

Rothkopf, E. Z. (1966). "Learning from Written Instructive Materials: An Exploration of the Control of Inspection Behavior by Test-Like Events." *American Educational Research Journal* 3: 241–249.

Rothkopf, E. Z., and E. V. Coke. (1966). "Variations in Phrasing and Repetition Interval and the Recall of Sentence Materials." *Journal of Verbal Learning and Verbal Behavior* 5: 86–91.

Runquist, W. N. (1986). "The Effect of Testing on the Forgetting of Related and Unrelated Associates." *Canadian Journal of Psychology* 40: 65–76.

Saxon, J. (1982). "Incremental Development: A Breakthrough in Mathematics." *Phi Delta Kappan* 63: 482–484.

Siegel, M. A., and A. L. Misselt. (1984). "Adaptive Feedback and Review Paradigm for Computer-Based Drills." *Journal of Educational Psychology* 76: 310–317.

Slamecka, N. J., and L. T. Katsaiti. (1988). "Normal Forgetting of Verbal Lists as a Function of Prior Testing." *Journal of Experimental Psychology: Learning, Memory, and Cognition* 14: 716–727.

Slavin, R. E. (1988). *Educational Psychology: Theory into Practice*. 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall.

Sommer, R. (1968). "The Social Psychology of Cramming." *Personnel and Guidance Journal* 9: 104–109.

Sones, A. M., and J. B. Stroud. (1940). "Review with Special Reference to Temporal Position." *Journal of Educational Psychology* 31: 665–676.

Spitzer, J. F. (1939). "Studies in Retention." *Journal of Educational Psychology* 30: 641–656.

Stigler, J. W., K. C. Fuson, M. Ham, and M. S. Kim. (1986). "An Analysis of Addition and Subtraction Word Problems in American and Soviet Elementary Mathematics Textbooks." *Cognition and Instruction* 3: 153–171.

Woolfolk, A. E. (1987). *Educational Psychology*. 3rd ed. Englewood Cliffs, N.J.: Prentice-Hall.

Yeh, J. P. (1978). *Test Use in Schools*. Washington, D.C.: National Institute of Education, U.S. Department of Health, Education, and Welfare.

Zechmeister, E. B., and J. J. Shaughnessy. (1980). "When You Know That You Know and When You Think That You Know But You Don't." *Bulletin of the Psychonomic Society* 15: 41–44.

Frank N. Dempster is Professor, University of Nevada, Las Vegas, Department of Educational Psychology, 4505 Maryland Pkwy., Las Vegas, NV 89154–3003.