DOCUMENT RESUME

ED 410 262 TM 027 038

AUTHOR	Everson, Howard T.; And Others
TITLE	Do Metacognitive Skills and Learning Strategies Transfer across Domains?
SPONS AGENCY	College Entrance Examination Board, New York, N.Y.
PUB DATE	Mar 97
NOTE	23p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, March 24-28, 1997).
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Higher Education; Knowledge Level; *Learning Strategies; *Mathematics Instruction; *Metacognition; Models; Theory Practice Relationship; *Transfer of Training; Undergraduate Students; *Verbal Ability
IDENTIFIERS	Domain Knowledge; *Monitoring; Self Regulated Learning

ABSTRACT

Current theories of metacognition suggest that effective control of learning by either metacognitive or self-regulatory processes cannot occur without accurate monitoring of learning. Given this theoretical framework, there are questions of whether knowledge monitoring and self-regulated learning abilities are domain-specific or whether metacognitive processes, in particular knowledge monitoring ability, generalize across academic domains. This study examines that issue by exploring the correlations among measures of metacognitive knowledge, learning, and study strategies, and academic achievement across the domains of verbal ability and mathematics. Using parallel measures of knowledge monitoring in both the verbal and mathematical domains, 120 undergraduates estimated their metacognitive knowledge, reported their confidence in the accuracy of those estimates, and completed a self-report measure of learning and study strategies. Results suggest that metacognitive knowledge is generalizable across both the verbal and mathematical domains. The correlations between the two knowledge monitoring measures and students' confidence estimates were also in the expected directions. Moreover, both knowledge monitoring measures correlated with students' grade point averages. Correlations with subscales of the Learning and Study Strategies Inventory were not significant. Findings are discussed in the framework of current theory in metacognition and conceptions of strategic learning. An appendix shows multiple regression results. (Contains 1 table and 47 references.) (Author/SLD)

Do Metacognitive Skills and Learning Strategies Transfer Across Domains?

Howard T. Everson
The College Board

Sigmund Tobias
City College of New York

Vytas Laitusis
Fordham University

This paper was presented at a symposium on *Assessing Metacognitive Knowledge Monitoring* held at the annual convention of the American Educational Research Association, Chicago, March 1997. The research was supported by the College Board.

ABSTRACT

Current theories of metacognition suggest that effective control of learning by either metacognitive or self-regulatory processes cannot occur without accurate monitoring of learning. Given this theoretical framework, there are questions of whether knowledge monitoring and self-regulated learning abilities are domain specific or whether metacognitive processes, in particular knowledge monitoring ability, generalizes across academic domains. This study examines that issue by exploring the correlations among measures of metacognitive knowledge monitoring, learning and study strategies, and academic achievement across the domains of verbal ability and mathematics. Using parallel measures of knowledge monitoring in both the verbal and mathematical domains, 120 students estimated their metacognitive knowledge, reported their confidence in the accuracy of those estimates, and completed a self-report measure of learning and study strategies. Results suggest that metacognitive knowledge monitoring is generalizable across both the verbal and mathematical domains ($r = .49$, $p<.01$). , The correlations between the two knowledge monitoring measures and students' confidence estimates ($r=.30$, and .53, $p<.01$) were also in the expected directions. Moreover, both knowledge monitoring measures correlated with students' gpa ($r = .35$ and .24, $p<.01$, respectively). The correlations with the LASSI subscales, however, were not significant, although a number of LASSI subscale scores did correlate significantly with gpa. The findings are discussed within the framework of current theory in metacognition and contemporary conceptions of strategic learning.

INTRODUCTION

Metacognition has been defined as the ability to monitor, evaluate, and make plans for one's learning (Flavell, 1979; Brown 1980). The literature in this area identifies two distinct aspects of metacognition, knowledge about cognition and the regulation of cognition, with both viewed as important for effective learning (Brown, 1987; Garner and Alexander, 1989; Jacobs and Paris, 1987). Indeed, researchers have reported differences in metacognitive abilities between capable and less capable learners (see, for example, Baker, 1989; Brown and Campione, 1986; Garner and Alexander, 1989; Pressley and Ghatala, 1990). In general, students with effective metacognitive skills accurately estimate their knowledge in a variety of domains, monitor their on-going learning, update their knowledge, and develop effective plans for new learning.

Though widely recognized as important, assessing individual differences in metacognition has proven to be both difficult and time consuming (O'Neil, 1991; Schwartz and Metcalfe, 1994), and remains an obstacle to the advance of research. Typically, assessments of metacognition rely either on inferences from classroom performance, or ratings based on interviews of students who are questioned about their knowledge and cognitive processing strategies, or on analyses of "think-aloud" protocols (Meichenbaum, Burland, Gruson, & Cameron, 1985). Recently, a number of self-report measures of metacognition (Everson, Hartman, Tobias, and Gourgey, 1991; O'Neil, 1991; Pintrich, Smith, Garcia, and McKeachie, 1991; Schraw and Dennison, 1994) have been developed. For the most part, these measures are more efficiently administered and scored than "think aloud" protocols. Unfortunately, the use of self-report measures raises questions of validity (see Schwartz and Metcalfe (1994) for a review of these methodological issues). In light of these concerns, it is not surprising that little research has been conducted on the metacognitive processes related to learning in adults, looking, for example, at those in college or in advanced instructional or training programs, where instructional times less easily accommodates research. Thus, more efficient measures of metacognition are needed not merely to satisfy psychometric standards (although important), but because they would permit research in settings where instructional time is less flexible, such as college classrooms and training courses.

In this paper we introduce a method for assessing students'' knowledge monitoring abilities (referred to generally as the KMA) in two salient academic domains, verbal ability and mathematics, and we relate these measures to self-report indices of learning and study strategies and to academic performance in college. Before presenting our results, it may be useful to establish the context for investigating the relationship between metacognition and complex learning in environments such as college and industry-based training courses.

Metacognition and Learning

In college students learn a great deal of new knowledge, and are faced, at times, with classroom and laboratory situations that require them to learn material and apply problem solving skills in new and innovative ways. The literature on human metacognition makes a compelling case for its importance in these learning and training environments (Bjork, 1994; Davidson, Deuser, and Sternberg, 1994). Accurate monitoring of new learning enables students with effective metacognitive strategies to concentrate on new content and adjust their learning goals. In college classrooms or advanced training programs, for example, the learner usually has to master a great deal of new knowledge in a limited amount of time. Moreover, learning in classrooms or other structured training environments is often dynamic, with knowledge and information being acquired and updated frequently. Clearly, those who accurately distinguish between what they have already mastered and what is yet to be learned have an advantage in these situations, since they can be more strategic and effective learners. Yet many students have ineffective metacognitive strategies. It is important, therefore, to evaluate students' metacognitive abilities and target instruction to the development of these key learning strategies.

Monitoring Knowledge

Given the premise outlined above, we assumed that knowledge monitoring accuracy, an ability presumably involved in the regulation of cognition, would be related to learning in complex environments and reflected in indices such as students' grades in college. Thus, we developed a technique for assessing this metacognitive dimension that conjointly evaluates students' self-reports of their knowledge in a domain (e.g., verbal ability or mathematics) and their performance on an objective measure of knowledge in that domain (see, for example, Everson, Smodlaka, and Tobias, 1994; Tobias and Everson, 1996;

Tobias and Everson, in press). The basic strategy is to assess knowledge monitoring by evaluating the differences between students' estimates of their knowledge in a particular domain (both procedural and declarative) and their actual knowledge as determined by performance on a test. In the prototypical KMA, students are asked to estimate their knowledge (e.g., in the verbal domain they identify words they know or do not know from a word list, or in mathematics its in problems they expect they can solve) and these estimates are contrasted with their performance on a standardized test containing many of the same words or math problems. Differences between students' estimates and their test performance provide an index of knowledge monitoring ability. This approach is similar to methods used in research on metamemory (Nelson and Narens, 1990), reading comprehension (Glenberg, Sanocki, Epstein and Morris, 1987), and psychophysics (Green and Swets, 1966). A brief description of our use of the KMA in an earlier study (Everson et al., 1994) serves as an illustration.

In an effort to understand better the relationship between metacognition and reading comprehension, the KMA was administered to 169 college students. Each was given a list of 33 words and asked to indicate the words they knew and did not know. This was followed by a vocabulary test based on the same words. The KMA generated four scores, including estimates that the word was: a) known and correctly identified on a subsequent vocabulary test [+ +]; b) known, yet incorrectly identified on the test [+ -]; c) unknown, yet correctly identified on the test [- +]; and d) unknown and incorrectly identified on the test [- -]. Within this framework the [+ +] and the [- -] scores represented accurate metacognitive estimates of vocabulary word knowledge, while the two other measures [+ -, and - +] represented inaccurate knowledge monitoring estimates. The results indicated that college students' accurate metacognitive judgments, both the + + and - - scores, were positively correlated with their scores on a standardized measure of reading comprehension (i.e., the Descriptive Test of Language Skills, 1979), $r = .46$ and $-.43$, respectively. Encouraged by these findings, we adapted the KMA for use in an extensive program of research (Tobias and Everson, 1996; Tobias and Everson, in press).

Learning and Study Strategies

As we noted earlier, there has been a growing research interest in the role that metacognitive abilities play in facilitating learning in complex environments. In addition to

the work on metacognitive knowledge monitoring, interest in the more general learning-to-learn phenomena continues to increase (see, for example, Nickerson, Perkins, & Smith, 1985; Weinstein & Mayer, 1986; Weinstein, Goetz, & Alexander, 1988; Zimmerman & Schunk, 1989). In general, this research suggests that effective learning depends not only on what the learner knows about a given subject or academic domain, but also what the learner thinks about prior to, during, and after the learning activity--i.e., the strategic aspects of learning. Weinstein (Weinstein & Mayer, 1986; Weinstein et al., 1988) refers to these as learning and study strategies, which include... "a variety of cognitive processes and behavioral skills designed to enhance learning effectiveness and efficiency" (Weinstein & Meyer, 1991, p. 41). In an effort to assess these aspects of effective learning, Weinstein, Schulte, and Palmer (1987) developed the Learning and Study Strategies Inventory (LASSI), a self-report instrument that includes measures of attitude, motivation, time management, anxiety, concentration, information processing, selecting main ideas, study aids, self testing, and test strategies.

In an effort to refine our understanding of the cognitive processes underlying effective learning, we sought to examine the patterns of relationships among the LASSI subscales to the knowledge monitoring estimates derived from the KMA measures in both the verbal and mathematical domains. By viewing the metacognitive components of learning in this manner, we hope to gain additional understanding of the contextual boundaries of cognition (Perkins & Salomon, 1989). Thus, the objectives of the research reported below are (1) to examine the empirical relationships between and among the KMA scores, the LASSI subscale scores, and indices of learning in college; and (2) to address the question of whether the metacognitive knowledge monitoring skills are generalizable across academic domains.

METHOD

Participants

A total of 120 undergraduates from an urban college participated in the study, 73 females and 47 males. Participants were recruited from an introductory psychology course, and were awarded extra course credit for taking part in the study.

Materials and Procedures

Experimental materials in this study were administered in three distinct large-scale (N=40) testing sessions. At the beginning of each session participants were administered a paper-and-pencil version of the Learning and Study Strategies Inventory (LASSI). The LASSI is a 77-item self-report instrument that includes ten subscales: Attitude, Motivation, Time Management, Anxiety, Concentration, Information Processing, Selecting Main Ideas, Study Aids, Self Testing, and Test Strategies. The individual items on each scale are presented using a 5 point Likert-type scale. The LASSI scales have reported reliabilities that range from a = .68 to .86 (Weinstein et al., 1987). After completing the LASSI, the KMA measures were administered to participants in a group setting.

Two KMA measures were administered: the first, the KMA verbal (KMAV), included the presentation of 39 words adopted from the Nelson-Denny Vocabulary subscale (Riverside Press, 1979) appropriate for post-secondary students, with difficulty estimates ranging from easy (p =.84) to hard (p =.43); the second KMA, mathematics (KMAM), included the presentation of 21 math problems adapted from the Preliminary Scholastic Assessment Test (College Board, 1994). Each of the KMA items was presented singly to the participant groups using a Performa computer projection device. The KMA math items were programmed to remain visible for a delay of 20 seconds, the vocabulary words were presented for 8 seconds. The proper delay was determined for each of the two sets of items in an earlier pilot study. The delay was designed to afford the participants only enough time to read the problem, quickly determine if they could solve it, and indicate this on a response form.

Participants were instructed to view the math problems and vocabulary items and assess whether they could or could not answer the item correctly, if given enough time. They were then asked to indicate, separately, the degree of confidence they had in that decision. The degree of confidence was presented in a 5 point Likert type scale ranging from 0 to 100% confident. Following the estimates, participants were asked to complete a form indicating their current and projected grades in Mathematics and English subject areas. Participants were then administered the paper-and-pencil multiple-choice math and vocabulary tests which contained the identical sets of items presented earlier. The 21 item math test and the 39 item vocabulary test were scored as correct or incorrect, and the

Hamman coefficient (Schraw, 1995), a measure of the accuracy of the estimates, was computed for each participant.

RESULTS

Following suggestions made by Schraw (1995), the KMA math and vocabulary scoring methods discussed earlier were transformed from simple measures of association or recognition to a measure of the accuracy of the knowledge monitoring estimates. The Hamman coefficient (HC) described by Romesberg (1984) and subsequently discussed by Schraw (1995), was used to transform the KMAV and KMAM scores into the appropriate metric for subsequent analyses. In general, the HC, and by extension the KMAV and KMAM, varies from -1 to 1, with higher values indicating more accurate estimates of knowledge. Both the KMAV and KMAM scores were related to students' academic achievement using their undergraduate gpa's, as well as to scores derived from the LASSI subscales. The zero-order correlations of the two KMA scores, the confidence estimates, the LASSI subscales, and gpa are presented in Table 1.

INSERT TABLE 1 HERE

The correlation between the two KMA measures, math (KMAM) and word knowledge (KMAV) was significant, $r = .49$ ($p < .01$), suggesting that knowledge monitoring abilities tend to generalize, albeit not very powerfully, across academic domains. The estimates of students' confidence in their knowledge monitoring abilities with reference to test response were also moderately correlated with metacognitive performance in the math ($r = .53$, $p < .01$) and verbal ($r = .30$, $p < .01$) domains. Students' confidence in their estimates were more weakly correlated across the math and verbal domains ($r = .2653$, $p < .01$), suggesting that domain specificity may be more salient for this type of confidence measure.

In Table 1 there are twenty zero-order correlations reported for the LASSI subscales (N=10) and the two KMA measures. Of the twenty, only four were significant and, somewhat unexpectedly, they were all negative. The correlations, for example, between KMAM and LASSI measures of motivation, mental self-testing, and time management

skills (r = -.24, -.21, and -.23 (p< .05), respectively), as well as the correlation between KMAV and mental self-testing (r = -.19 (p< .05), indicate that students' self-reports of poor strategy use and undeveloped skills in these areas was not aligned with their metacognitive knowledge monitoring as measured more objectively with the KMA procedure. Interestingly, both the two KMA scores and the LASSI subscale scores were, for the most part, significantly correlated with academic achievement as measured by gpa.

Multiple regression methods were used to explore further students' KMA scores, as well as the complex relationship of their KMA scores, LASSI self-reports, and academic achievement. Looking first at the math KMA scores, the results of the regression analyses suggest that both the students' confidence estimates and their self-reports of academic motivation explain a significant portion of the variance (R^2 = .33, F (2, 113) = 27.94, p < .001). With respect to the vocabulary word knowledge KMA scores, the regression analysis reveals that students' confidence estimates and their self-reports of the self-testing strategies explain a small, but significant, proportion of the variance (R^2 = .21, F (2, 109) = 14.78, p < .001). As noted earlier, in both of these exploratory measurement models the LASSI self-report measures were negatively related to performance on the KMA's.

In order to understand the joint influences of the KMA scores and LASSI self-reports on academic success, multiple regression analysis was used in much the same way. The dependent variable in these analyses, however, was the total gpa as reported by the college. The regression analyses suggested that the KMA verbal score, as well as the LASSI subscale measuring self-testing and reviewing strategies, explained a portion of the variance in students' gpa variance (R^2 = .23, F (2, 104) = 15.91, p < .001). It is important to note that the math KMA score did not enter the regression equation, and that the LASSI test-taking subscore, unlike the other LASSI scores discussed earlier, was positively related to academic achievement. (See Appendix A for a more complete presentation of the regression analyses.)

DISCUSSION

Knowledge monitoring is an important component of academic success. The findings of this study, along with findings of a series of studies in this area (Everson and Tobias, in press; Tobias and Everson, in press) support this general conclusion. Moreover, this study

continues a line of research that supports the validity of the KMA, both in terms of the construct of metacognitive knowledge monitoring and the predictive validity of the assessment procedure. Interestingly, the results of this study suggest that knowledge monitoring may have a relatively large domain specific component, and that a general metacognitive knowledge monitoring ability may be context-bound. This argues, we suspect, for developing KMA procedures that are more domain specific, e.g., in science and social science. On the other hand, the vocabulary KMA scores more successfully differentiated the academically capable students than did the math KMA scores in this study, partially replicating findings reported elsewhere (Tobias and Everson, 1996). Also, the correlation between the verbal KMA score and gpa was higher than for the math KMA. This suggest that verbal metacognitive knowledge monitoring scores may be more salient predictors of college, since effective learning may be largely related to students' ability to process text-based materials across a variety of academic domains. Given the large body of research indicating that vocabulary test scores are one of the most powerful predictors of school learning (Breland, Jones, & Jenkins, 1994; Just & Carpenter, 1987), this finding is not altogether surprising.

Learning in complex domains such as science and engineering, or making diagnoses in medicine or other fields, often requires that students bring substantial amounts of prior learning to bear in order to understand and acquire new knowledge or solve problems. Some prior learning may be recalled imperfectly, or may never have been completely mastered during initial acquisition. Students who can accurately distinguish between what they know and do not know should be at an advantage while working in such domains, since they are more likely to review and try to relearn imperfectly mastered materials needed for particular tasks, compared with those who are less accurate in estimating their own knowledge. In view of the fact that the knowledge monitoring scores reported in the study, i.e., math and word knowledge, shared about 25% of the variance between them, it would be useful to develop a KMA procedure in the science domain to determine its relationship to achievement in science and engineering.

Several factors are likely to have reduced the magnitude of the effects and the generalizability of the results to other groups of college students. First, many of the students in this sample took less than a full-time schedule of courses. That fact is likely to have decreased the reliability of the gpa, because it was based on fewer courses and credits

than is usually the case after a year of college. Second, it is well known that college grades are often unreliable (Werts, Linn & Jöreskög, 1978; Willingham, Lewis, Morgan, & Ramist, 1990), reducing the magnitude of any correlations with them. The reliability of the grades may have been reduced further by three factors: a) students took dissimilar courses; b) when similar courses were taken they were often taught by different instructors; and c) the differences in students' major fields of study. Criteria other than summary gpa's need to be considered in future research studies.

Further research is also needed to determine the relationships between the KMA procedure and self-report measures of metacognition, study skills, and self-regulated learning strategies measured by the LASSI . Since these constructs are theoretically related to measures obtained with the KMA, a positive empirical relationship between the KMA scores and the LASSI subscales was expected. Surprisingly, none were found in this sample of college students. It is not clear whether these findings would be supported if the LASSI were administered earlier in the students' academic careers, before they experienced a full measure or academic success or failure. We suspect there may be issues related to the method variance, i.e., self-report versus objective scoring, in these two assessment techniques. Finally, the relationship between knowledge monitoring ability, learning and study strategies, and measures of intelligence should be investigated. Sternberg (1991) has suggested that metacognition should be a component of intelligence tests; presumably those who consider metacognition an executive process (Borkowski, Chan, and Muthukrishna, in press) would also agree with that recommendation. Research findings (Schraw, in press) indicate that academically able students have higher knowledge monitoring ability than those less able. Therefore, positive relationships between the KMA procedure and measures of general intellectual ability may be expected. It remains for further research to explore that possibility.

REFERENCES

Baker, L. (1989). Metacognition, comprehension monitoring, and the adult reader. Educational Psychology Review, 1, 3-38.

Bjork, R.A. (1994). Memory and metamemory considerations in the training of human beings. In J. Metcalfe & A.P. Shimamura (Eds.), Metacognition: Knowing about knowing (pp. 185-206). Cambridge, MA: MIT Press.

Borkowski, J.G., Chan, L.K.S., & Muthukrishna, N. (in press). A process-oriented model of metacognition and executive functioning. In G. Schraw (Ed.), Issues in the measurement of metacognition. Lincoln, NE: Buros Institute / The University of Nebraska Press.

Breland, H., Jones, R.J., & Jenkins, L. (1994). The College Board vocabulary study. College Board Report No. 94-4. NY: The College Board.

Brown, A.L. (1980). Metacognitive development and reading. In R.J. Spiro, B.B. Bruce, & W.F. Brewer (Eds.), Theoretical issues in reading comprehension (pp. 453-481). Hillsdale, NJ: Erlbaum Associates.

Brown, A.L. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In F. Weinart & R. Kluwe (Eds.), Metacognition, motivation, and understanding (pp. 65-116). Hillsdale, NJ: Erlbaum Associates.

Brown, A.L. & Campione, J.C. (1986). Psychological theory and the study of learning disabilities. American Psychologist, 14, 1059-1068.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, 297-334.

Davidson, J.E., Deuser, R., & Sternberg, R.J. (1994). The role of metacognition in problem solving. In J. Metcalfe & A.P. Shimamura (Eds.), Metacognition: Knowing about knowing (pp. 207-226). Cambridge, MA: MIT Press.

Descriptive Test of Language Skills. (1979). Princeton, NJ: The College Entrance Examination Board.

Everson, H.T., Hartman, H., Tobias, S., & Gourgey, A. (1991, June). A metacognitive reading strategies scale: Preliminary validation evidence. Paper presented at the annual convention of the American Psychological Society, Washington, DC.

Everson, H.T., Smodlaka, I., & Tobias, S. (1994). Exploring the relationship of test anxiety and metacognition on reading test performance: A cognitive analysis. Anxiety, Stress, and Coping, 7, 85-96.

Everson, H.T., & Tobias, S. (in press). The ability to estimate knowledge and performance in college: A metacognitive analysis. Instructional Science.

Flavell, H. (1979). Metacognition and cognitive monitoring: A new era of cognitive developmental inquiry. American Psychologist, 34, 906-911.

Garner, R., & Alexander, P. (1989). Metacognition: Answered and unanswered questions. Educational Psychologist, 24, 143-158.

Glenberg, A.M., Sanocki, T., Epstein, W., & Morris, C. (1987). Enhancing calibration of comprehension. Journal of Experimental Psychology: General, 116 (2), 119-136.

Green, D.M., & Swets, J.A., (1966). Signal detection theory and psychophysics. NY: Wiley.

Jacobs, J.E., & Paris, S.G. (1987). Children's metacognition about reading: Issues in definition, measurement, and instruction. Educational Psychologist, 22, 255-278.

Just, M.A., & Carpenter, P.A. (1987). The psychology of reading and language comprehension. Needham Heights, MA: Allyn & Bacon.

Meichenbaum, D., Burland, S., Gruson, L., & Cameron, R. (1985). Metacognitive assessment. In S.R. Yussen (Ed.), The growth of reflection in children (pp. 3-27). NY: Academic Press.

Nelson, T.O., & Narens, L. (1990). Metamemory: A theoretical framework and new findings. In G. Bower (Ed.), The psychology of learning and motivation (Vol. 26) NY: Academic Press.

Nickerson, R.S., Perkins, D.N., & Smith, E.E. (1985). The teaching of thinking. Hillsdale, NJ: Erlbaum Associates.

O'Neil, H.F. (1991, August). Metacognition: Teaching and Measurement. Paper presented at the annual convention of the American Psychological Association, San Francisco, CA.

Perkins, D.N., & Salomon, G. (1989). Are cognitive skills context-bound? Educational Researcher, 18(1) 16-25.

Pintrich, P.R., Smith, D.A., Garcia, T., & McKeachie, W.J. (1991). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ). Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning.

Preliminary Scholastic Assessment Test (1994). NY: The College Entrance Examination Board.

Pressley, M., & Ghatala, E.S. (1990). Self-regulated learning: Monitoring learning from text. Educational Psychologist, 25, 19-33.

Romesburg, H.C. (1984). Cluster analysis for researchers. London: Wadsworth, Inc.

Schraw, G. (in press). Issues in the measurement of metacognition. Lincoln, NE: Buros Institute/ The University of Nebraska Press.

Schraw, G. (1995). Measures of feeling-of-knowing accuracy: A new look at an old problem. Applied Cognitive Psychology, 9, 321-332.

Schraw, G., & Dennison, R.S. (1994). Assessing metacognitive awareness. Contemporary Educational Psychology, 19, 460-475.

Schwartz, B.L., & Metcalfe, J. (1994). Methodological problems and pitfalls in the study of human metacognition. In J. Metcalfe & A.P. Shimamura (Eds.), Metacognition: Knowing about knowing (pp. 93-114). Cambridge, MA: MIT Press.

Sternberg, R.J. (1991). Toward better intelligence tests. In M.C. Wittrock & E.L. Baker (Eds.), Testing and cognition (pp. 31-39). Englewood Cliffs, NJ: Prentice-Hall.

Tobias, S., & Everson, H.T. (in press). Assessing metacognitive word knowledge. In G. Schraw (Ed.), Issues in the measurement of metacognition. Lincoln, NE: Buros Institute /University of Nebraska Press..

Tobias, S. & Everson, H.T. (1996). Assessing metacognitive knowledge monitoring. College Board Report No. 96-01. NY: The College Board.

Tobias, S., Hartman, H., Everson, H.T., & Gourgey, A. (1991, August). The development of a group administered, objectively scored metacognitive evaluation procedure. Paper presented at the annual convention of the American Psychological Association, San Francisco, CA.

Weinstein, C.E., & Mayer, R.E. (1986). The teaching of learning strategies. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed.) (pp. 315-327). NY: Mamillan.

Weinstein, C.E., & Meyer, D.K. (1991). The implications of cognitive psychology for testing: Contributions from work in learning strategies. In M.C. Wittrock & E.L. Baker (Eds.), Testing and cognition (pp. 40-61). Englewood Cliffs, NJ: Prentice-Hall.

Weinstein, C.E., Schulte, A.C., & Palmer, D.R. (1987). The learning and study strategies inventory (LASSI). Clearwater, FL: H&H Publishing Co.

Weinstein, C.E., Goetz, E.T., & Alexander, P.A. (1988) (Eds). Learning and study strategies: Issues in assessment, instruction, and evaluation. NY: Academic Press.

Werts, C., Linn, R.L., & Jöreskög, K.G. (1978). Reliability of college grades from longitudinal data. Educational and Psychological Measurement, 38, 89-95.

Willingham, W.W., Lewis, C., Morgan, R., & Ramist, L. (1990). Predicting college grades: An analysis of institutional trends over two decades. NY: The College Board.

Zimmerman, B.J., & Schunk, D.H. (1989). (Eds.). Self-regulated learning and academic achievement: Theory, research and practice. NY: Springer-Verlag.

APPENDIX A

```
* * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data

Equation Number 1    Dependent Variable..   KMA Verbal

Block Number  1.  Method:  Forward      Criterion   PIN  .0500
   VCONFIDENCE SFT


Variable(s) Entered on Step Number
   1..    VCONFIDENCE  voc test conf mean


Multiple R            .42060
R Square              .17690
Adjusted R Square     .16942
Standard Error        .28098

Analysis of Variance
                     DF       Sum of Squares      Mean Square
Regression            1              1.86648          1.86648
Residual            110              8.68433           .07895

F =      23.64170       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta          T  Sig T
VCONFIDENCE     .161018     .033116    .420599      4.862  .0000
(Constant)     -.263157     .124218               -2.119  .0364

------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler         T  Sig T
SFT         -.191012 -.210520    .999803    -2.248  .0266


Equation Number 1    Dependent Variable..   KMA Verbal

Variable(s) Entered on Step Number
   2..    SFT

Multiple R            .46193
R Square              .21338
Adjusted R Square     .19895
Standard Error        .27594

Analysis of Variance
                     DF       Sum of Squares      Mean Square
Regression            2              2.25135          1.12568
Residual            109              8.29946           .07614

F =      14.78395       Signif F =  .0000
```

```
------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta         T  Sig T

VCONFIDENCE     .162045     .032525    .423283     4.982  .0000
SFT            -.010484     .004663   -.191012    -2.248  .0266
(Constant)      .014838     .173697                .085  .9321


End Block Number   1   All requested variables entered.


Equation Number 1    Dependent Variable..   KMA Math

Block Number  1.  Method:  Forward      Criterion   PIN  .0500
   MCONFIDENCE MOT      TMT      SFT


Variable(s) Entered on Step Number
   1..    MCONFIDENCE  math test conf mean


Multiple R           .53180
R Square             .28281
Adjusted R Square    .27652
Standard Error       .34784

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           1             5.43915          5.43915
Residual           114            13.79341           .12099

F =      44.95356       Signif F =  .0000

------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta         T  Sig T

MCONFIDENCE     .294806     .043970    .531798     6.705  .0000
(Constant)    -1.028385     .174755               -5.885  .0000

------------- Variables not in the Equation -------------

Variable     Beta In  Partial  Min Toler         T  Sig T

MOT         -.219367 -.258839    .998507    -2.849  .0052
TMT         -.203835 -.240406    .997626    -2.633  .0097
SFT         -.180162 -.212309    .995966    -2.310  .0227
```

Equation Number 1 Dependent Variable.. KMA Math

Variable(s) Entered on Step Number
2.. MOT

Multiple R	.57520
R Square	.33086
Adjusted R Square	.31902
Standard Error	.33747

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	6.36327	3.18164
Residual	113	12.86929	.11389

F = 27.93667 Signif F = .0000

---------- Variables in the Equation ----------

Variable	B	SE B	Beta	T	Sig T
MCONFIDENCE	.290108	.042691	.523322	6.796	.0000
MOT	-.016322	.005730	-.219367	-2.849	.0052
(Constant)	-.494490	.252732		-1.957	.0529

---------- Variables not in the Equation ----------

Variable	Beta In	Partial	Min Toler	T	Sig T
TMT	-.115809	-.115549	.666135	-1.231	.2209
SFT	-.090131	-.093825	.725118	-.997	.3207

End Block Number 1 PIN = .050 Limits reached.

Listwise Deletion of Missing Data

Equation Number 1 Dependent Variable.. TOTGPA total gpa

Block Number 1. Method: Forward Criterion PIN .0500
KMAV KMAM TST ATT MOT SMI

Variable(s) Entered on Step Number
1.. TST

Multiple R	.39284
R Square	.15432
Adjusted R Square	.14627
Standard Error	.70451

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	9.50993	9.50993
Residual	105	52.11437	.49633

F = 19.16059 Signif F = .0000

---------- Variables in the Equation ----------

Variable	B	SE B	Beta	T	Sig T
TST	.049843	.011387	.392837	4.377	.0000
(Constant)	1.365726	.341756		3.996	.0001

---------- Variables not in the Equation ----------

Variable	Beta In	Partial	Min Toler	T	Sig T
KMAV	.286486	.307587	.974846	3.297	.0013
KMAM	.192832	.209263	.995939	2.182	.0313
ATT	.114426	.091456	.540237	.937	.3511
MOT	.069448	.059754	.626066	.610	.5429
SMI	-.100695	-.073817	.454469	-.755	.4520

Equation Number 1 Dependent Variable.. TOTGPA total gpa

Variable(s) Entered on Step Number
2.. KMAV

Multiple R	.48408
R Square	.23433
Adjusted R Square	.21961
Standard Error	.67357

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	14.44046	7.22023
Residual	104	47.18384	.45369

F = 15.91442 Signif F = .0000

---------- Variables in the Equation ----------

Variable	B	SE B	Beta	T	Sig T
KMAV	.697768	.211663	.286486	3.297	.0013
TST	.044078	.011026	.347401	3.998	.0001
(Constant)	1.297522	.327402		3.963	.0001

---------- Variables not in the Equation ----------

Variable	Beta In	Partial	Min Toler	T	Sig T
KMAM	.068519	.067734	.732381	.689	.4924
ATT	.133450	.111964	.528161	1.143	.2555
MOT	.147008	.130235	.587886	1.333	.1854
SMI	-.091812	-.070718	.447584	-.720	.4735

1. Zero-Order Correlations of LASSI Subscales, Knowledge Monitoring Measures, Confidence Estimates, and GPA

	ANX	ATT	CON	INP	MOT	SFT	SMI	STA	TST	TMT	KMAM	KMAV	CONF MTH EST	CONF MTH TEST	CONF VOC EST	CONF VOC TEST	TOT GPA
ANX	1.0000																
ATT	.5498**	1.0000															
CON	.5904**	.6017**	1.0000														
INP	0.0941	.2786**	.2571**	1.0000													
MOT	.3165**	.6627**	.6428**	.4105**	1.0000												
SFT	0.0514	.2988**	.4330**	.6576**	.5215**	1.0000											
SMI	.4458**	.5614**	.6528**	.4015**	.5949**	.4292**	1.0000										
STA	-0.053	0.136	.3116**	.4612**	.2891**	.6273**	.2025*	1.0000									
TST	.5788**	.6724**	.7045**	.3149**	.6011**	.3427**	.7416**	.1837*	1.0000								
TMT	.2747**	.4481**	.6083**	.2652**	.5737**	.5443**	.4542**	.4074**	.3993**	1.0000							
KMAM	0.1636	-0.107	-0.159	-0.053	-.2396**	-.2132*	-0.097	-0.091	0.025	-.2293*	1.0000						
KMAV	0.1189	0.0573	-0.002	-0.059	-0.0561	-.1902*	0.0975	-0.075	0.1445	-0.109	.4908**	1.0000					
CONF MTH EST	.2047*	0.1147	0.0967	0.1615	0.1691	0.0709	0.134	.2549**	0.0715	0.1012	.3199**	.2428**	1.0000				
CONF MTH TEST	.2308*	-0.019	0.0187	-0.021	-0.0417	-0.068	0.0714	0.0715	0.0673	-0.05	.5309**	0.1673	.5422**	1.0000			
CONF VOC EST	0.1403	0.1242	-0.026	0.1306	0.0533	-0.069	0.0286	0.0368	0.0307	-0.029	0.1639	.3042**	.2653**	0.073	1.0000		
CONF VOC TEST	.3111**	.2776**	.2561**	-0.017	0.1032	0.0145	.2047*	0.1048	.3026**	0.1213	0.1704	.4204**	0.1768	0.164	.4656**	1.0000	
TOTGPA	.2294*	.2901**	.2278*	0.1081	.2608**	0.1408	.2495**	.2149*	.3754**	.1876*	.2382*	.3467**	0.1135	0.123	0.0905	0.144	1.0000

* - Signif.< .05 ** - Signif. < .01 (2-tailed) " . " is printed if a coefficient cannot be computed

Legend:

ANX - Anxiety and worry about school performance
ATT - Attitude
CON - Concentration and attention
INP - Information processing, acquiring knowledge and reasoning
MOT - Motivation
SFT - Self testing, reviewing
SMI - Selecting main ideas and recognizing important information
STA - Use of support techniques and materials
TST - Test strategies and preparing for tests
TMT - Use of time management principles
KMAM - Knowledge monitoring accuracy for mathematics
KMAV - Knowledge monitoring accuracy for vocabulary
CONF MTH EST - Confidence in math estimates
CONF MTH TEST - Confidence in math test answer
CONF VOC EST - Confidence in vocabulary estimates
CONF VOC TEST - Confidence in vocabulary test answer
TOTGPA - Total grade point average

AREA 1997

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE
(Specific Document)

ERIC

TM027038

I. DOCUMENT IDENTIFICATION:

Title: Do Metacognitive Skills and Learning Strategies Transfer Across Domains?	
Author(s): H. Everson, S. Tobias & V. Laitusis	
Corporate Source: The College Board	Publication Date: 4/97

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic/optical media, and sold through the ERIC Document Reproduction Service (EDRS) or other ERIC vendors. Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce the identified document, please CHECK ONE of the following options and sign the release below.

☑ Sample sticker to be affixed to document

Check here
Permitting microfiche (4"x 6" film), paper copy, electronic, and optical media reproduction

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Sample
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Level 1

Sample sticker to be affixed to document ☐

"PERMISSION TO REPRODUCE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY
Sample
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Level 2

or here
Permitting reproduction in other than paper copy.

Sign Here, Please

Documents will be processed as indicated provided reproduction quality permits. If permission to reproduce is granted, but neither box is checked, documents will be processed at Level 1.

"I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce this document as indicated above. Reproduction from the ERIC microfiche or electronic/optical media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries."

Signature: Howard Everson	Position: Chief Research Scientist
Printed Name: HOWARD EVERSON	Organization: The College Board
Address: 45 Columbus Ave. NYC NY 10023-6992	Telephone Number: (212) 713 8301
	Date:

OVER

Vytas

CUA

THE CATHOLIC UNIVERSITY OF AMERICA
Department of Education, O'Boyle Hall
Washington, DC 20064
202 319-5120

February 21, 1997

Dear AERA Presenter,

Congratulations on being a presenter at AERA[1]. The ERIC Clearinghouse on Assessment and Evaluation invites you to contribute to the ERIC database by providing us with a printed copy of your presentation.

Abstracts of papers accepted by ERIC appear in *Resources in Education (RIE)* and are announced to over 5,000 organizations. The inclusion of your work makes it readily available to other researchers, provides a permanent archive, and enhances the quality of *RIE*. Abstracts of your contribution will be accessible through the printed and electronic versions of *RIE*. The paper will be available through the microfiche collections that are housed at libraries around the world and through the ERIC Document Reproduction Service.

We are gathering all the papers from the AERA Conference. We will route your paper to the appropriate clearinghouse. You will be notified if your paper meets ERIC's criteria for inclusion in *RIE*: contribution to education, timeliness, relevance, methodology, effectiveness of presentation, and reproduction quality. You can track our processing of your paper at http://ericae2.educ.cua.edu.

Please sign the Reproduction Release Form on the back of this letter and include it with **two** copies of your paper. The Release Form gives ERIC permission to make and distribute copies of your paper. It does not preclude you from publishing your work. You can drop off the copies of your paper and Reproduction Release Form at the **ERIC booth (523)** or mail to our attention at the address below. Please feel free to copy the form for future or additional submissions.

Mail to:

AERA 1997/ERIC Acquisitions
The Catholic University of America
O'Boyle Hall, Room 210
Washington, DC 20064

This year ERIC/AE is making a **Searchable Conference Program** available on the AERA web page (http://aera.net). Check it out!

Sincerely,

Lawrence M. Rudner, Ph.D.
Director, ERIC/AE

---

[1]If you are an AERA chair or discussant, please save this form for future use.