DOCUMENT RESUME

ED 419 013		TM 028 315

AUTHOR	Phye, Gary D.
TITLE	Components of Self-Regulation during Within- and Between-Domain Problem-Solving Performance.
PUB DATE	1998-04-00
NOTE	12p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Diego, CA, April 13-17, 1998).
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Cognitive Processes; Deduction; Higher Education; Induction; Memory; *Prior Learning; *Problem Solving; *Self Efficacy; *Undergraduate Students
IDENTIFIERS	Analogies; *Domain Knowledge; *Self Regulation

ABSTRACT

Self-regulation components linked to academic problem-solving were studied. Cognitive process instruction on analogy problems was given to 63 undergraduates on a Monday. On Wednesday, problem-solving performance within the inductive reasoning domain was assessed with 30 Remote Associate Test (RAT) problems. On Friday, problem-solving performance between the inductive and deductive problem-solving task of 20 categorical syllogism problems was assessed. Results indicate that both within- and between-domain problem-solving performance is influenced by knowledge acquired prior to practice. In both cases, this influence is indirect, being mediated by the learner's ability to monitor working memory during practice. Self-efficacy assessed during practice is directly linked to within-domain, but not between-domain problem solving. On the other hand, eductive mental activity directly influenced between-domain, but not within-domain problem-solving performance in this study. Exploratory path analysis can provide insight into the relative roles played by selected cognitive-motivational components of self-regulation when learners are required to adopt to changing demands during problem solving. (Contains one figure, three tables, and four references.) (SLD)

****
*   Reproductions supplied by EDRS are the best that can be made   *
*   from the original document.   *
****

ED 419 013

Components of Self-regulation During within-and Between-domain Problem-Solving Performance

Gary D. Phye

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY
Gary Phye
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

TM028315

This paper is prepared for the:
Annual Meeting of the American Educational Research Association in San Diego, CA
April 1998

BEST COPY AVAILABLE

ERIC

Title: Components of self-regulation during within-and between-domain problem-solving performance.
Author: Gary D. Phye
Institution: Iowa State University

Presenter: Gary D. Phye
Address: Dept. of Curr. & Inst.
N 164 Lagomarcino, ISU
Ames, IA. 50011-3190

This investigation involves an extension of exploratory work focusing on the identification of in self-regulation components linked to academic problem-solving. In this study, *cognitive process instruction* on Monday was followed by a *within-domain problem-solving* task on Wednesday and a *between-domain problem-solving* task on Friday.

Perspective

As conceptualized in the present study, problem-solving transfer is not automatic. Consequently, factors other than instructional manipulations during practice must be considered when viewing problem-solving performance as a self-regulated process (Schunk & Zimmerman, 1994). Initial efforts have been made to identify individual differences of a cognitive-motivational nature, that are involved in the self-regulation of problem-solving within the inductive reasoning domain. This study which takes a psychometric approach is an extension of this effort. Previously identified learner characteristics of self-efficacy, prior knowledge, and monitoring of working memory (MWM) ability are combined with eductive ability as predictors of problem-solving performance. In addition, the scope of problem-solving has been expanded to include both within-domain and between-domain transfer performance. The underlying assumption driving this investigation is that learner characteristics involving self-regulation foster executive functioning (decision making and judgments) that promotes adaptability to new problem situations. Ideally, this information will provide impetus for further integration efforts involving self-regulatory components and their role in problem-solving transfer.

Previous findings (Phye, under review), indicate that the self-regulatory components of self-efficacy and MWM predict within-domain transfer. Thus, it is hypothesized that these self-regulatory components will be significant predictors of within-domain problem solving even though within-domain transfer is more broadly defined in the present study. Based on recent work , it is hypothesized that eductive ability will be a significant predictor of between-domain problem-solving performance. " Eductive ability involves making meaning out of confusion: developing new insights; going beyond the given to perceive that which is not immediately obvious; forming (largely non-verbal) constructs which facilitate the handling of complex problems involving many dependent variables" (Raven, Raven & Court, 1993, p.3). Hypotheses are tested using psychometric procedures to construct a path analysis model.

Method and Data Source

Participants. Sixty-three undergraduate students enrolled in introductory psychology courses at a larger Midwest university received extra credit for voluntary participation.

Materials & Procedure. During instruction, all participants practiced 20 verbal analogy problems under the same instructional condition. Practice consisted of a series of test and study trials. During study trials, participants were provided with both advice about the general procedure to be used when attacking analogy problems and corrective feedback in the form of the correct solution. Problems were presented individually via a carousel projector. Exposure times varied across trials with each problem being presented for 18 s during trial one, 12 s during trial two, 9 s for trials three through five and 12 s for the last trial. In all cases, the inter-stimulus interval was .5 s.

During practice, in addition to acquisition-learning performance, the cognitive-motivational variables of self-efficacy, prior knowledge, MWM and eductive ability were also assessed. Self-efficacy, prior knowledge and MWM were assessed using previously established procedures (Phye, under review), and eductive ability was assessed with the Raven Advanced Progressive Matricies (Raven, Raven & Court, 1993). These learner characteristics serve as predictor variables of within-domain and between-domain problem-solving performance on subsequent problem-solving tasks.

Problem-solving performance within the inductive reasoning domain was assessed two days after practice. This problem solving task consisted of 30 Remote Associate Test (RAT) problems (Mednick, 1967). Problem-solving performance between the inductive and deductive reasoning domains was assessed four days after practice. The between-domain problem-solving task consisting of 20 categorical syllogism problems has been employed in previous experiments (Phye, under review).

Results and Discussion

Acquisition-learning performance during practice (process instruction) was consistent with prior findings and is shown in Table 1.

BEST COPY AVAILABLE

Due to the exploratory nature of the path analysis, the model initially developed included all possible paths (and, thus, all possible direct and indirect effects) from each variable at an earlier time point to each variable at a later point in time. Shown in Table 2 are the pair-wise correlation coefficients for the learner characteristic variables. The different path coefficients and the corresponding t values are shown in Table 3. The path-analytic model (Figure 1) that was developed reflects four points in time. The first time point incorporates pre-training measures of self-efficacy, prior knowledge, and eductive ability. These variables were the exogenous or independent variables in the model. The second to fourth time points incorporate the endogenous or dependent variables. Specifically, the second time point incorporates MWM which was assessed during the last practice trial. The third time point incorporates within-domain problem-solving performance, and the fourth time point incorporates between-domain problem-solving performance.

No tests were conducted to determine if each path coefficient was significantly different from zero; this was because there were no data from an independent sample that could be used in a confirmatory analysis. Only the potentially important path coefficients (i.e., those with relatively large t values) are included in the diagram and will be considered in the following interpretation as substantially different from zero.

When considering self-regulation of within-domain problem solving performance, present findings pertaining to self-efficacy, monitoring of working memory (MWM), and prior knowledge can be viewed as a partial replication and extension of previous efforts (Phye, under review). These findings are considered a replication because learner characteristics are assessed in the same manner and the task is problem-solving within the inductive reasoning domain. These findings are also an extension of previous studies. Previous efforts have used analogy problems (with differing mapping strategies) for both the acquisition-learning and transfer tasks as measures of within-domain problem-solving. In the present study, analogy problems are practiced, but RAT problems made up the delayed task. Also, constructed responses (fill in the blank) are required in order to complete RAT problems.

The path analysis indicates that RAT performance is directly linked to self-efficacy and WMW. In contrast, RAT performance is not directly linked to prior (background) knowledge of analogy problems encountered during practice or educative ability. However, prior (background) knowledge is indirectly linked (mediated) by WMW. These findings suggest that relatively speaking, self-efficacy and MWM play important roles in the self-regulation of within-domain problem-solving performance. Although, prior knowledge is an influential factor, it is mediated by MWM ability. These findings support previous findings (Phye, under review) pertaining to the roles of self-efficacy, the monitoring of working memory, and prior knowledge in the self-regulation of a problem-solving process. A point of particular interest is the direct, but non-interacting contributions of self-efficacy and working memory monitoring ability. In practice, these data suggest that individuals who undertake practice with confidence in their prior knowledge, and exhibit the ability to keep track of their progress during practice, are those who are most successful in applying (within a problem domain) what they have learned.

When the problem-solving sequence involves *a change from within-domain problems to between-domain problems*, performance continues to be directly influenced by self-regulatory activities involving working memory monitoring ability (MWM). Further, prior knowledge continues to influence performance indirectly through working memory. Interestingly, eductive ability that played no apparent role in the self-regulation of within-domain performance is directly linked to between-domain problem-solving performance.

Self-efficacy is no longer directly linked to problem-solving performance. This is not unexpected given the marked differences in analogy problems and syllogism problems. Also, there is no direct linkage between RAT and Syllogism problem-solving performance. However, as can be noted from the path analysis model, working memory monitoring ability during practice is directly linked to both RAT (within) and Syllogism (between) domain problem-solving.

Scientific Importance of Study

To summarize, both within- and between-domain problem-solving performance is influenced by knowledge acquired prior to practice. However, in both cases this influence is indirect, being mediated by the learner's ability to monitor working memory (MWM) during practice. On the other hand, MWM assessed during practice is directly linked to both within- and between-domain problem-solving performance. Self-efficacy assessed during practice is directly linked to within-domain, but not, between-domain problem-solving. . On the other hand, eductive mental activity directly influenced between-domain, but not, within-domain problem-solving performance. Thus, exploratory path analysis provides insight into the relative roles played by selected cognitive-motivational components of self-regulation when learners are required to adapt to changing demands during problem-solving.

References

Mednick, S. A. (1967). Remote associates test. Boston: Houghton Mifflin Co.

Phye. G. D. (under review). Cognitive process instruction and problem-solving transfer. Journal of Educational Psychology.

Raven, J, Raven, J. C. & Court, J. H. (1993). General overview: Raven manual - section 1. Oxford England: Oxford Psychologist Press.

Schunk, D. H. & Zimmerman, B. J. (1994). Self-regulation of learning and performance: Issues and educational applications. Hillsdale NJ: Earlbaum.

Table 1.

Mean Number of Problems Solved (Acquisition-Learning) During Practice on Monday.

Trial 1	Trial 2	Trial 3	Trial 4
12.86	13.00	19.16	19.67

Table 2.

Intercorrelations Among the Variables in the Path-analytic Model.

Variable	1	2	3	4	5	6
1. Self-efficacy	--	.46	.22	.31	.38	.07
2. Prior knowledge		--	.35	.51	.41	.20
3. Eductive mental activity			--	.18	.21	.37
4. Working memory monitoring				--	.49	.42
5. Within-domain transfer					--	.34
6. Between-domain transfer						--

Table 3.

Path Coefficients (t Values) Among the Variables in the Path-analytic Model.

Path Coefficients (t Values) Among the Endogenous Variables

Variable	1	2	3
1. Working memory monitoring	.00 (.00)	.00 (.00)	.00 (.00)
2. Within-domain transfer	.36 (2.81)	.00 (.00)	.00 (.00)
3. Between-domain transfer	.38 (2.80)	.19 (1.46)	.00 (.00)

Path Coefficients (t Values) Between the Endogenous and Exogenous Variables

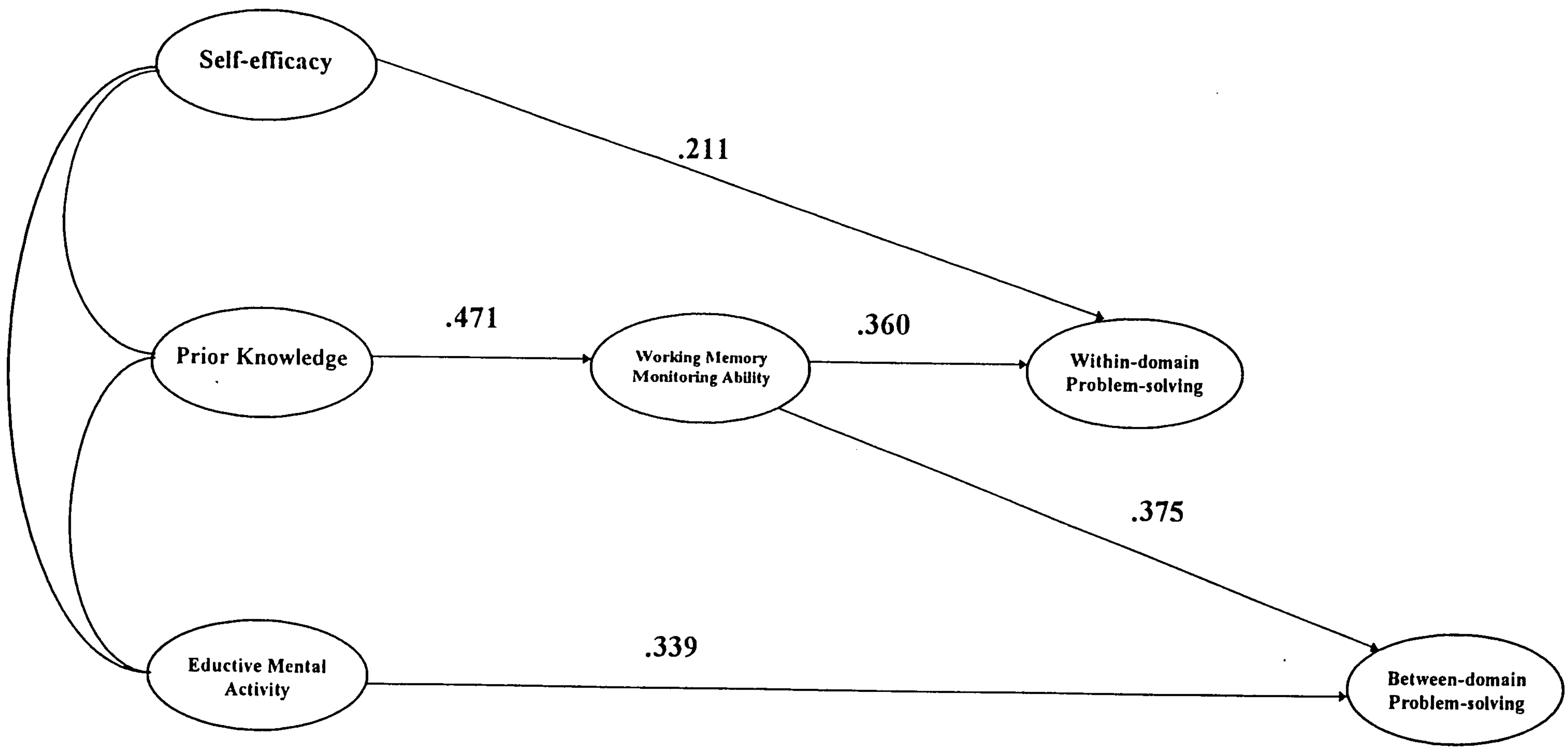
Variable	1	2	3
4. Self-efficacy	.10 (.75)	.21 (1.72)	-.14 (-1.09)
5. Within-domain transfer	.47 (3.61)	.10 (.74)	-.13 (-.89)
6. Between-domain transfer	-.01 (-.07)	.07 (.56)	.34 (2.93)

Note. Path coefficients with values zero were constrained to that value. Each of these paths were from an endogenous variable at a later time point to an endogenous variable at an earlier time point.

Figure Caption

Figure 1. Trimmed path analysis model linking self-regulating learner characteristics to within domain and between domain problem-solving performance.

ERIC



Indirect effects:

Prior knowledge, through MWM, to within-domain problem-solving = .167

Prior knowledge, through MWM, to between-domain problem-solving = .228

BEST COPY AVAILABLE

TM028315

ERIC

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE
(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Components of self-regulation during within-domain and between-domain problem solving performance

Author(s): Gary D Phye

Corporate Source: Dept. of Curriculum & Instruction, Iowa State University, Ames Iowa 50011-3190

Publication Date: 4/3/98

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 media, and sold through the ERIC Document Reproduction Service (EDRS). 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 and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 1	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2A	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2B
Level 1	Level 2A	Level 2B
[X]	[ ]	[ ]
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic 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.

Sign here, please

Signature: Gary Phye

Printed Name/Position/Title: Gary D Phye Assoc. Prof.

Organization/Address: Iowa St University Ames, IA 50011-3190

Telephone: (515) 294-1962

FAX: (515) 2946202

E-Mail Address: gdphye@iastate.edu

Date: 4/3/98

ERIC

ERIC® Clearinghouse on Assessment and Evaluation

University of Maryland
1129 Shriver Laboratory
College Park, MD 20742-5701

Tel: (800) 464-3742
(301) 405-7449
FAX: (301) 405-8134
ericae@ericae.net
http://ericae.net

March 20, 1998

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://ericae.net.

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 (424)** or mail to our attention at the address below. Please feel free to copy the form for future or additional submissions.

Mail to:

AERA 1998/ERIC Acquisitions
University of Maryland
1129 Shriver Laboratory
College Park, MD 20742

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.

CUA

The Catholic University of America

ERIC Full Text Provided by ERIC