Psychological Variables in Relation to Academic Success in Developmental Math Courses

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This study examined psychological predictors of academic achievement for students enrolled in self-paced math courses. At the beginning of the fall 1998 semester, 250 students who were enrolled in developmental math courses at Missouri Western State College completed a questionnaire packet with standardized measures of procrastination, optimism, self-esteem, anxiety, locus of control, need for achievement, and fear of success. At the end of the term, academic performance and time of unit completion in the self-paced courses were correlated with the psychological factors. Regression analysis indicated those students with high levels of achievement motivation, low math anxiety, and low procrastination scores were most likely to complete the class with a passing grade.

Although most people view procrastination as a negative and unproductive trait, it is estimated that 70% of college students procrastinate (Ellis & Knaus, 1977) and that such behavior negatively affects academic performance. According to Solomon and Rothblum (1984), procrastination is related to fear of failure arising from low self-esteem and high anxiety levels. In support of this hypothesis, Beswick, Rothblum, and Mann (1988) found that procrastination was correlated with low self-esteem and high anxiety in high school students. Solomon and Rothblum also found that although students gave a variety of reasons for their procrastination, fear of failure was salient.

Some students may use procrastination to protect their perceived level of self-worth (Owens & Newbegin, 1997). By using procrastination as an excuse for not studying or completing work, individuals can blame failure on lack of effort, thus keeping their self-concept intact. This contention is supported by Berzonsky’s (1992) “diffuse/avoidant orientation” (p. 772), which refers to an approach that an individual can use in order to escape the responsibility of an outcome. If a student waits too long to study for an exam, then the responsibility for failing is due to lack of time, and the individual has an excuse for doing poorly that is based on external control.

Lay (1988) attributes procrastination to overestimating or underestimating the time it takes to complete a task. This attribution implies that time restraint on task completion and how individuals deal with these restraints, optimistically or pessimistically, are key conditions for procrastination. According to Lay (1988), “optimistic persons would be more likely to form favorable outcome expectancies in some specific situation than pessimistic persons would, resulting in a greater likelihood of renewed effort on the part of the optimist than the pessimist” (p. 202).

Vallerand and Bissonnette (1992) suggested that how students make use of internal and external locus of control could affect their academic performance. This view is further supported by Rotter’s (1966) view that a person’s belief in personal control over situational outcomes may enhance environmental coping skills. According to Rotter, there is an interaction between internal locus of control and success. Individuals with a strong internal, as opposed to external, locus of control believe they personally are most influential over life events. The ability for individuals with internal control to take blame for their actions allows them to manipulate their environment in order to benefit from it. It is believed that high external control leads to passivity in the face of environmen-
nal difficulties. Thus, a student with an external locus of control may take a passive rather than active role when faced with academic challenges. Rotter (1966) indicated that internal–external locus of control can predict school success, with internals performing better than externals.

One of the major academic hurdles for first-year students at many colleges and universities is the general studies mathematics requirement. Many students enter college underprepared in mathematics; moreover, many of these students suffer from math anxiety (Betz, 1978). The present study sought to investigate associations between several psychological variables and the time it took students to complete units in developmental math courses. These courses are designed to help students make a successful transition into college-level math courses. Procrastination was predicted to be negatively correlated with grades and time completion.

Method

Participants
Participants for this study consisted of 250 undergraduates (147 women, 103 men) at Missouri Western State College who were enrolled in developmental math during the fall semester of 1998. This course encompasses both beginning and intermediate algebra. The class fulfills the prerequisite for general studies mathematics and uses a mastery-based format, which follows the premise that students learn at different rates. The students can test their mastery of the prescribed concepts whenever they are done with the assigned work. Approximately 6% of the students had enrolled in the course before and had failed or withdrawn from the course before completing it. The average course load per student was 12.31 academic hours, and over half (54%) were employed.

Survey Instruments
The participants completed a questionnaire packet that contained the following seven assessment instruments:

- **The Life Orientation Test.** The Life Orientation Test (LOT; Scheier & Carver, 1985) consists of 12 items and measures optimism. Four items are keyed in a positive direction, four are reversed scored, and four are filler items designed to disguise the purpose of the test. Each item is rated on a 5-point Likert-type scale (4 = strongly agree to 1 = strongly disagree). Examples of items include statements such as “In uncertain times, I usually expect the best,” and “I hardly ever expect things to go my way.” The LOT’s test–retest reliability correlation is .79, and internal consistency is .76 (Cronbach’s alpha; Scheier & Carver, 1985).

- **General Procrastination Scale.** Lay’s (1986) 20-item General Procrastination Scale is based on a 5-point Likert-type scale (5 = extremely characteristic to 1 = extremely uncharacteristic). Half the items are reversed scored. The items range from everyday statements such as, “I generally return phone calls promptly” to school-related statements such as “I usually start an assignment shortly after it is assigned.” The scale has a Cronbach alpha of .82 and a retest reliability of .80 (Lay, 1986).

- **Rotter’s Internal–External Locus of Control.** Rotter’s (1966) internal–external locus of control scale is a 23-item, forced-choice scale, including 6 filler items that are intended to help disguise the purpose of the scale. For the purposes of this study, 11 of the 23 questions were used. Examples of items used in this study are “In my case, getting what I want has little or nothing to do with luck” and “Many times we might just as well decide what to do by flipping a coin.” The test–retest reliability is .72.

- **Eckhoff’s Fear of Success Scale.** The Fear of Success Scale (Eckhoff, 1990) measures negative consequences associated with success. This measure consists of 13 true/false questions. An example of one of the questions is “Success may cause me to lose some of my closest friends.” Test–retest reliability is .78, and the Cronbach alpha is .62.

- **Quick Measure of Achievement Motivation.** The Quick Measure of Achievement Motivation (Smith, 1973) consists of 17 true/false questions. Ten of the questions deal with achievement motivation, whereas 7 of the questions deal with carelessness in answering questionnaire items. An example of one of the questions is “I would sooner admire a winner than win myself.” The split-half reliability is .56.

- **Fennema-Sherman Mathematics Attitude Scale.** A revised version of the Fennema-Sherman Mathematics Attitude Scale (Betz, 1978) evaluated math anxiety in this study. Participants recorded their responses on a 5-point Likert-type scale; responses ranged from 1 (strongly disagree) to 5 (strongly agree). The scale consisted of 10 items; half of the items were positively worded, whereas the other half were negatively worded. An example of one of the questions is “It wouldn’t bother me at all to take more math courses.”
Procedure

Math professors distributed the survey during the first week of class. The students completed the questionnaires during the class period and returned the questionnaire packets to the professor before leaving. Each student who intended to participate in this research project was asked to complete an informed consent form before completing the questionnaire packets. Students received five extra credit points for their participation in this study and were debriefed at the end of the semester.

Results

Intercorrelations

Table 1 summarizes the mean scores and t-value comparisons for the psychological variables for all students enrolled in the developmental math courses. Table 2 shows the intercorrelations among the psychological measures. As expected, procrastination was significantly negatively correlated with optimism, self-esteem, locus of control, and need for achievement. Math anxiety was not significantly correlated with procrastination, but there were significant negative correlations between math anxiety and optimism and between math anxiety and locus of control. As can be seen, there was a significant positive relation between optimism and both need for achievement and locus of control.

Multiple Regression

Regression analyses indicated that the psychological variables did not predict either math units completed or final grades. However, these measures did predict whether students would successfully complete the course, $R^2 = .03, F = 2.35, p < .05$. Stepwise regression indicated that need for achievement was the strongest predictor, $\beta = .17, t = 2.70, p < .01$. A subsequent analysis with need for achievement removed from the equation showed that both math anxiety, $\beta = -.18, t = -1.99, p < .05$, and procrastination, $\beta = -.18, t = -1.98, p < .05$, also predicted success in the self-paced class. Consistent with our predictions, students with high levels of achievement motivation and with low math anxiety and low procrastination scores were the students most likely to complete the class with a passing grade.

Discussion

Inspired by the need to improve student performance in developmental math courses, this study sought to determine whether psychological factors could predict math performance. The original hy-

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Mean Scores on the Psychological Variables for Successful and Unsuccessful Students</th>
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<tbody>
<tr>
<td></td>
<td>Successful students $(n = 140)$</td>
</tr>
<tr>
<td>Procrastination</td>
<td>53.1</td>
</tr>
<tr>
<td>Optimism</td>
<td>20.1</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>32.9</td>
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<tr>
<td>Locus of control</td>
<td>5.6</td>
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<tr>
<td>Anxiety</td>
<td>33.5</td>
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<tr>
<td>Need for achievement</td>
<td>8.9</td>
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<tr>
<td>Fear of success</td>
<td>4.9</td>
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</tbody>
</table>

aUnsuccessful students were those who either withdrew from or failed the course.

*p < .05.

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Intercorrelations Among Psychological Variables $(N = 250)$</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
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<tr>
<td>1 Procrastination</td>
<td>—</td>
</tr>
<tr>
<td>2 Optimism</td>
<td>—</td>
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<tr>
<td>3 Self-esteem</td>
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<tr>
<td>4 Locus of control</td>
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<tr>
<td>5 Anxiety</td>
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<td>6 Need for achievement</td>
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<td>7 Fear of success</td>
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*p < .05. **p < .01.
hypothesis that procrastination would be correlated with grades and math units attempted was not supported. The lack of consistency with previous psychological studies can be explained by various factors. The mean age of participants in this study was 21.04, which was above the mean averages found in several of the previous studies (Beswick et al., 1988; Ellis & Knaus, 1977; Scheier & Carver, 1985). In addition, students had four attempts to successfully complete a unit in the present study. This procedure would give procrastinators a significant amount of time to complete each unit successfully.

Although the original hypothesis was not supported, procrastination, anxiety, and achievement motivation all significantly predicted successful completion of the developmental math course. These results are consistent with Solomon and Rothblum’s (1984) finding of a negative correlation between procrastination and self-esteem and also support Lay’s (1988) hypothesis that there is a negative relation between procrastination and optimism. In the present study, both optimism and self-esteem were significantly correlated negatively with procrastination.

The relation between procrastination and optimism found in this study should be of interest to teacher and school counselors. Lay (1988) suggests that optimistic procrastinators may postpone doing something undesirable by underestimating the time needed to complete a task. Educators and school counselors may want to take this result into consideration and help optimistic procrastinators prioritize their projects.

To help students through their math courses, it is also important to deal with their self-perceptions. The present results indicate a relation between procrastination and low self-esteem and suggest that students who suffer from poor academic performance in math courses ideally should receive psychological support from family and friends as well as academic assistance from teachers to enhance self-esteem. The ability for students to work at their own pace and interact one-on-one with faculty members may be the type of assistance that is needed to increase student self-confidence.

The present finding relating to grades and number of tries on unit exams supports the effectiveness of self-paced learning in developmental courses. In this study, the self-paced class is designed to allow each student four attempts to successfully complete a unit; the number of tries per unit increased, as did grades. When implementing this type of design, students can strive for success in an area regardless of previous failure.

Overall, the results of this study clearly indicate that psychological variables should be considered in designing developmental math courses and in structuring support services for students enrolled in these types of classes. However, although this study indicates several needs with regard to developmental math courses, it is important to remember the need for replication before generalization. This study was conducted at one college in the Midwest; therefore, this study should be replicated using students from other geographic areas. In addition, researchers should conduct correlational studies involving the effectiveness of self-paced math courses and regularly designed math courses. If further research addresses these limitations, it may be possible to reduce students’ math anxiety and thus increase math proficiency.

References