The Role of Domain-Specific Non-Cognitive Variables in Postsecondary Academic Success

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Abstract

The Self-Regulated Learner must possess certain non-cognitive beliefs in order to remain sufficiently motivated in the pursuit of academic success. Students who are do not possess such beliefs are more likely to struggle in academics. This problem is especially pronounced in students at public universities and community colleges. Even though these students have the appropriate background knowledge to be awarded a high school diploma, they must still acquire certain non-cognitive beliefs, in particular self-efficacy (a belief in one's ability to succeed and master the tasks at hand within a given domain), in order to be motivated to apply the knowledge they learned in high school, regulate their study habits, and monitor their progress. This exploratory study surveyed 42 undergraduates enrolled in a psychological statistics course. A hierarchical multiple regression assessed the extent to which self-efficacy predicted final statistics exam grades, while controlling for prior GPA. This analysis showed that prior GPA explained 38.9% of the variability in final exam grades and self-efficacy accounted for another 7.3% of the variance, explaining a total of 46.2% of the variance in final exam performance. These findings indicate that non-cognitive variables play an essential role in the prediction and promotion of academic performance at the college level in public universities. Developing students' self-efficacy beliefs in specific courses may improve students' performance. Different methods of employing interventions to alter students' non-cognitive beliefs are discussed, with particular focus on the use of exam wrappers to promote self-efficacy and improve course grades.

Keywords: Post-secondary education; Self-Regulated Learning; Metacognition; Non-Cognitive Variables; Self-Efficacy; Growth Mindset; Domain Specificity

1. Introduction

The transition from high school to college creates a variety of new experiences and challenges for students (van der Meer, 2012). Education at the university level is considerably different than at high school. Not only is the college student expected to master a great deal of material in a relatively short time period, the post-secondary learner is also held responsible for much of their own learning (Ainscough, Foulis, Colthrope, Zimbardie, et al. 2016; Hanebutt, 2015). Although students completing high school have documented academic capabilities, many researchers including Conley (2003) have shown that high school achievement exams often do not sufficiently assess the skills students need to succeed in post-secondary institutions. In other words, possessing a high school diploma seems to be an insufficient predictor of college success (Komarraju, & Nadler, 2013; Komarraju, Ramsey, & Rinella, 2013).

When undergraduate college students fail examinations and/or courses, their overall high school GPAs and their achievement entrance test scores provide little insight into reasons for this situation. Even though these students may have been successful in high school, their high level of achievement at the secondary level does not always carryover to their performance at the college level. Consequently, researchers have begun to examine the beliefs, attitudes, and behaviors of *low*-performing college students, in the hopes of identifying recurring traits that may predict their academic ineptitude (Komarraju, & Nadler, 2013). Students who fail in college often have several things in common: (1) they do not identify what they know and don't know before a test; (2) they spend excessive amounts of time reviewing material they already know and not enough time studying information that is "foggy" at best; (3) they don't know if their study strategies are effective until the graded exam is returned (Garrett, Alman, Gardner, & Born, 2007); (4) they don't connect the method they use for studying with the level of difficulty and type of questions on the exam (Komarraju, Ramsey, & Rinella, 2013); and (5) many students assume that making flash cards and memorizing definitions is as effective in college courses as it was in high school courses.

Conley (2007) supports the idea that students who enter college must not only possess sufficient knowledge of core areas such as English and Mathematics and well established reasoning and problem-solving skills, but these undergraduates must also have well-developed self-monitoring abilities and other metacognitive skills. In an attempt to bridge the gap created between success in high school and in college, researchers have focused on identifying characteristics of college preparedness that students commonly lack. This area of study has led researchers to investigate the various behaviors, beliefs, and skill sets of successful undergraduates as compared to non-successful students. The most successful students are those who are highly motivated, are able to set and meet challenging and realistic goals (Artino, 2012), and possess an accurate perception of their current knowledge and skill sets– that is, they are aware of what they know and do not know and are able to accurately monitor their progress and performance (Zimmerman, 2000). In other words, motivational variables help transform students into self-regulated learners. Two important aspects of self-regulation are metacognition (how we evaluate our own knowledge and reasoning and skill sets) and self-monitoring (assessing performance)

The motivational beliefs that students hold impact their ability to monitor their performance and regulate their study strategies (Zimmerman, 2000). These motivational beliefs are commonly termed *non-cognitive variables*, which are variables that do not pertain to one's overall knowledge or reasoning skills. These variables instead concern students' motivations, beliefs about their abilities, and perceptions of their capacity to acquire skill sets (Sedlacek, 2011). Non-cognitive variables have been implicated in success at all educational levels– including the college level, as Sedlacek (2011) argues. However, studies suggest that non-cognitive variables may affect students' performance differently at the various educational levels.

General, as opposed to course specific, non-cognitive constructs predict success at the primary and secondary educational llevels. At these levels, students' general or global beliefs– in contrast with course or task specific beliefs– are good indicators of their achievement; this is because children are less able to differentiate between their intellectual abilities in general, as opposed to in extracurricular activities, as opposed to academics. Furthermore, they are unable to differentiate between different subject areas; if you ask a child if they are good in school, they'll say yes or no—they won't differentiate their performance within courses. That is, they see themselves as "smart" or "not smart" in school, but are not as able to differentiate their social studies performance from their math performance (Stipek & Gralinski, 1996). In line with this reasoning, possessing a growth mindset (the belief that one's intelligence can improve through learning and experience) about one's general intelligence in elementary through middle-school-aged students has been tied to academic achievement (Mueller & Dweck, study 4, 1998; Romero, Master, Paunesku, Dweck, & Gross, 2014).

However, measuring *college students'* responses to non-cognitive variables in a *general* sense may have little relation to their academic performance. That is, college students' non-cognitive beliefs about their performance in one subject may be different from their beliefs about a different subject. Prior studies have indicated that non-cognitive variables may only affect college performance within specific subject areas (Scott & Ghinea, 2013; Dai & Cromley, 2014). Additionally, our prior research on Dweck's implicit theories of intelligence echo these studies' findings. In a previous unpublished study, we determined that adapted, domain-specific measure of mindset was equally as reliable as Dweck's original questionnaire (Nelson, Gee, Heath, & McAndrew, 2015). However, participants' responses to the adapted questionnaire were consistently significantly higher than their responses to the original questionnaire. In other words, participants' course-specific beliefs were significantly more growth-minded than were their general beliefs about their intelligence.

In his studies of self-regulation among college students, Zimmerman (2000) identifies several more non-cognitive variables that affect self-regulation and metacognition. However, he argues that the most powerful motivational belief is self-efficacy, which refers to an individual's belief in his or her ability to be successful in acquiring a certain academic skill set. This belief strongly predicts the quality of a learner's self-regulation (Schunk & Swartz, 1993) and governs learning, effort, persistence, achievement, motivation, strategy use, and adaptive functioning (Linnenbrink & Pintrich, 2002; Pintrich & de Groot,

2001). For example, Byrne et al. (2014) found that several domain and task specific measures of accounting self-efficacy were able to predict course achievement, explaining 21% of the variability in financial accounting module grades, 21% of the variability in management accounting module grades, and 24% of the variance in the average of the module grades in the course. Likewise, domain specific measures of self-efficacy have been shown to significantly predict college GPA (Feldman & Kubota, 2015).

Over the last two decades, there has been an increased interest in identifying the role of non-cognitive variables in predicting success in post-secondary education. This direction of research is warranted because many students entering college are insufficiently motivated to succeed. As a result of this lack of motivation, these students are not driven to learn to differentiate the class material they know from that which they do not know. In turn, this makes students unable to monitor their own learning, which is a skill that has been directly linked with success in post-secondary academic endeavors and with lifelong learning. This study compared the effectiveness of several non-cognitive variables in predicting academic performance at the post-secondary level. The results of this study will help direct future interventions by dictating which traits to foster in struggling students.

1.1 Research Question

Do non-cognitive variables significantly predict final exam grades, while controlling for prior performance? If so, which variable is the best predictor?

2. Method

2.1 Participants

The participants in this study were undergraduate students at a Northeastern state university, all evaluated over the course of a single semester. Participants were enrolled in three sections of a mandatory statistics course for psychology majors. A total of 42 students consented to participate. Students ranged from age 18 to 65 (M = 23.33, SD = 8.53) and 64% were female. The same professor taught all three sections of this course, utilizing identical materials and teaching methods across the sections.

2.2 Materials

2.2.1 Dweck's Theories of Intelligence Questionnaire

The first questionnaire we included was Dweck's Theories of Intelligence questionnaire (Dweck 2000, p. 178). This questionnaire measured the extent to which a student views his or her intelligence as innate and unchangeable (referred to as a "fixed mindset" or an "entity belief" of intelligence), as opposed to seeing his or her intelligence as malleable and able to be changed though effort and learning (referred to as a "growth mindset" or an "incremental view" of intelligence). The Implicit Theories of Intelligence Questionnaire was comprised of eight items, each with a six-point Likert scale, in which 1 corresponded to "strongly disagree" and 6 corresponded to "strongly agree," with higher scores indicative of a more growth-minded individual. Items 3, 5, 7, and 8 were negatively worded and had to be reverse coded. An

example of one of the eight items in this questionnaire was, "You can change even you basic intelligence level considerably" (Dweck, 2000, p.178) Dweck reported Cronbach's alpha for this scale as ranging from .90 to .96 (Dweck, 1995).

2.2.2 Adapted Mindset Questionnaire

In a prior study, we modified Dweck's original questionnaire, such that the word "intelligence" in each question was replaced with the words "academic ability in this course" (Nelson, Gee, Heath, & McAndrew, 2015). We changed the word intelligence because we believed that it was too vague and may have been influencing the questionnaire results. "Academic ability in this course" called to mind a more specific construct in the context of the classroom. Therefore, in the context of this questionnaire: those with a fixed mindset believed that their academic ability in this course is something they cannot change, while those with a growth mindset believed that they had the capacity to improve their academic ability in this course. Other than replacing "intelligence" with "academic ability in this course," all other wording of this mindset questionnaire was identical to the original questionnaire. It contained eight items, each with a six-point Likert scale, in which 1 corresponded to "strongly disagree" and 6 corresponded to "strongly agree." Just as in Dweck's original questionnaire, higher scores were indicative of a more growth-minded individual. Items 1, 2, 4, and 6 were negatively worded, and thus had to be reverse-coded. An example of one of the adapted mindset items was, "No matter how much academic ability you have you can always change it quite a bit." The reliability of this adapted mindset questionnaire was first demonstrated in a previous publication, in which we calculated a reliability coefficient of .90 (Nelson, Gee, Heath, & McAndrew, 2015).

2.2.3 Self-Efficacy

Self-efficacy was defined as one's belief in one's own ability to succeed at and master a given task; it was thought to be a motivational force tied to academic achievement (Bandura, 1993). A self-efficacious individual was confident that he or she could go about the steps and exert the effort necessary to achieve an objective in question– in this case, academic success. In order to measure self-efficacy, we utilized the eight-item Self-Efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ). The Likert scale to each of the items in this questionnaire was changed from a five-point scale to a six-point scale, such that 1 corresponded to "strongly disagree," and 6 corresponded to "strongly agree." This modification was included for two reasons. First, it was done to avoid presenting students with a neutral response option. Second, and perhaps more importantly, it was done so that all the subscales could be answered on the same 1 to 6 response scale. Higher scores were still representative of higher self-efficacy. One of the items read, "I'm certain I can master the skills taught in this class" (Pintrich, 1991). Pintrich (1991) reported the reliability of this subscale as .93.

2.2.4 Prior GPA

With the students' consent, we gathered their GPAs as of the start of the semester from the university's Office of Institutional Research. GPAs in the three sections ranged from 2.00 to 4.00.

2.2.5 Final Exam Score

The three sections were all given the same cumulative final worth a maximum of 200 points. All questions were either short answer and/or required the use of SPSS. Final exam grades were based on the percentage of points a student earned out of 200 points.

3. Procedure

At the beginning of the semester, all the students in each of the three sections of the statistics course responded to the same twenty-four questionnaire items at the beginning of a designated class period. The survey session in each section lasted approximately fifteen to twenty minutes. Each participant logged onto a computer, opened the survey on Survey Monkey©, and electronically signed an informed consent, which listed the IRB approval number (1415-15). All participants were then asked to indicate their name, student ID, and gender. Each participant was given a randomized mix of the twenty-four items; no two students received the items in the same order. Each survey question was presented one at a time, such that students had to select their response (on a scale of 1 to 6) and then click "continue" before being able to proceed to the next question. Once a student clicked "continue," he or she wasn't permitted to go back and look at his or her previous answers. This mitigated the threat of response biases, prompting students to answer each of the questions as honestly as possible. At the completion of the semester, we collected both students' final exam scores as well as their prior GPAs from the university's Office of Institutional Research.

4. Results

A hierarchical multiple regression was conducted as an exploratory analysis to assess the predictive ability of several different non-cognitive variables on performance. Cronbach's alpha reliability analysis indicated that each measure was reliable (Table 1). Participants' mean scores on each of the three scales were calculated and are presented in Table 1.

Table 1. *Descriptive Statistics and Reliability Coefficients for Sample*

Subscale [a]	Mean (SD)	Previously reported Cronbach's Alpha	Cronbach's Alpha for this Sample
Self-Efficacy	5.01 (.72)	.93	.92
Adapted Mindset	4.76 (.82)	.90	.91
Original Mindset	4.52 (.89)	.90 – .96	.93

Note: N = 39; [a] Each subscale contains 8 items and was evaluated with Likert responses from 1 to 6.

Examination of boxplots revealed three outliers; these participants were excluded from further analyses. Pearson's *r* correlation analyses were performed, in which each predictor variable was correlated with students' final exam grades. As shown in Table 2, neither measure of mindset was significantly related to final exam performance, so they were omitted from subsequent analyses. However, as self-efficacy

increased, so did final exam performance, $r(37) = .40$, $p < .05$. Students' prior GPAs were also significantly and positively correlated with their final exam grades, $r(37) = 0.64$, $p < .05$.

Table 2. *Pearson's r for Each Subscale*

	Semester GPA	Final Course Grade
Self-Efficacy	.17	.37**
Adapted Mindset	–.13	–.03
Original Mindset	–.19	–.07

*p < .05, **p < .01, ***p < .001

The assumptions underlying hierarchical multiple regression were assessed and satisfied.
A hierarchical multiple regression was performed to evaluate the predictors of final exam grades (Table 3). Students were separated into high (3.01 to 4.00) and low (2.00 to 3.00) prior GPA groups and entered in step 1, so as to control for past performance. Self-efficacy was entered in step 2. The entire model was significant, accounting for a total of 46.2% of the variability in final exam grades. Prior GPA accounted for 38.9% of the variability in final exam grades and self-efficacy explained another 7.3% of the variance (see Table 3).

Table 3. *Predicting Final Exam Grades*

Variable		β	*t*	*R*	R^2	ΔR^2
Step 1						
	Prior GPA	.62	4.85***	.62	.39	
Step 2						
	Prior GPA	.56	4.50***	.68	.46	.07
	Self-Efficacy	.28	2.20*			

Note: N = 39; *p < .05, **p < .01, ***p < .001

5. Discussion

This study produced several important findings. First, at the post-secondary level, students' current academic abilities are influenced by their prior performance. As such, researchers should not ignore students' past GPAs as a predictive variable of course achievement. Second, domain-specific non-cognitive variables do play a significant role in students' course performance. Specifically, the only significant non-cognitive predictor of final exam performance in this study was self-efficacy. This finding parallels the results of prior studies, which show that domain-specific self-efficacy beliefs are accurate predictors of task performance, namely course success. Self-efficacy is tied to performance because it prompts students to evaluate themselves and realize that they must change their behavior to reach a specific goal. A self-efficacious individual is confident that he or she can go about the steps and exert the effort necessary to achieve an objective in question. Highly self-efficacious individuals are likely to persist in the

face of failure and to devote effort to the mastery of academic challenges (Artino, 2012, 78). Self-efficacy helps students persist because it instills in them the beliefs that failure is not permanent and that with effort and resilience they can succeed; it also prompts students to challenge themselves so that they can continually grow academically.

In the context of Zimmerman's (2000) model of Self-Regulated Learning, self-efficacy influences performance in three phases: Forethought, Performance, and Self-Reflection. Self-efficacy beliefs influence the Forethought phase by motivating students and helping them to realize they have the capacity to formulate a plan to achieve their goals. These beliefs also help students remain motivated during the Performance phase. Becoming self-efficacious helps students to continue to progress toward their academic goals by helping them: (1) use the correct strategies, (2) remain attentive and interested in the material at hand, (3) manage their time appropriately, (4) seek help when necessary, and (5) continually monitor their performance and the efficiency of their study strategy usage (Zimmerman, 2000; Isaacson and Fujita, 2006). In the Self-Reflection phase, students evaluate their performance and the methods they used toward attaining their goals. Success improves self-efficacy beliefs; however, students who are highly self-efficacious throughout the phases of self-regulation will maintain their levels of motivation, even if they are faced with failure. In the latter case, they will be able to construct the reasons behind the weaknesses in their performance and will use this information to adjust their plans and goal setting behavior (Forethought) and to modify their use of learning strategies and to learn to more efficiently monitor their progress (Performance). Students' self-efficacy beliefs help them to persist throughout these phases of self-regulation.

It is important to note that due to its domain specificity, self-efficacy measured in statistics is only representative of those students' self-efficacy beliefs about *statistics*. These beliefs do not necessarily generalize to other courses and may not be reflected in students' performance in those areas. The domain-specific nature of self-efficacy is an important clarification, especially in reference to future research. This finding directs future interventions to improve self-efficacy and performance. In order to modify students' self-efficacy beliefs, instructors must target these beliefs within specific courses and with regard to particular tasks within the course.

The primary way through which self-efficacy can be improved is through repeated successes at mastering academic tasks; conversely, consistent patterns of failure may diminish self-efficacy beliefs (Muretta, 2004). Self-efficacy can also be improved through vicarious experiences. A student who observes another individual persist in completing and succeeding at a given task often experiences increased self-efficacy (Artino, 2012, 78). Additionally, certain exercises and activities directed toward fostering the characteristics of self-efficacy– as well as other traits that have been shown to promote self-efficacy– within a given course have proven successful (Nietfeld, 2006; Callendar, 2014). In previous studies, we have utilized metacognitive exercises to increase students' self-efficacy and improve their performance

(Nelson, Gee, Heath, & McAndrew, 2015). Promoting metacognitive monitoring accuracy has been shown to improve self-efficacy in college students (Nietfeld, Cao, & Osborne, 2006).

One such metacognitive activity is that of exam wrappers. The exam wrappers asked students to respond to a series of questions related to three areas: studying behaviors (how much, over what period of days/weeks, what material, and in what way did they study), student-assessment of incorrectly answered items (which question(s) were incorrect, what deficits in understanding the material caused the student to answer incorrectly, and what concepts the incorrectly answered questions had in common with one another), and a specific goal in anticipation of preparing for future tests (Lovett, 2010). The exam wrapper is a domain specific exercise that helps students understand that they can develop the appropriate skills to succeed in a given course– in other words, the exam wrapper is a way of fostering self-efficacy in a specific course by showing students which concepts they understood and which needed more work. Our prior research has provided further evidence for the effectiveness of using exam wrappers in undergraduate psychological statistics courses (Nelson, Gee, Heath, & McAndrew, 2015). Among other findings, we showed that both high and low performing students who completed exam wrappers had significant increases in self-efficacy, as compared to high and low performing students who did complete the wrappers. We argue that this, in turn, will encourage students to become self-regulated learners with accurate self-monitoring abilities.

A limitation of this study is that it only examines students' performance in a psychological statistics course. Future studies should closely examine the impact of self-efficacy in different sorts of course structures with differing assessment techniques. For example, further research could analyze whether self-efficacy impacts students' performance differently in essay or discussion-based courses that are more textually based as opposed to exam centered and mathematically oriented courses. Examining different courses will also help determine whether these results hold true in different courses of various difficulties, as well.

By developing self-efficacy, students will be able to steadily improve their performance and tackle more challenging goals through the continued understanding of their capacity to learn the skills necessary to accomplish a task at hand. Without self-efficacy, students will struggle to achieve success in difficult classes and are in danger of academic failure. Educational researchers should investigate and implement interventions, such as the ones mentioned above, in hopes of promoting students' academic growth and encouraging students to become self-regulated learners.

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