An integrated model of early community college student success: understanding success in developmental mathematics

David Arthur Keller

University of Iowa

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AN INTEGRATED MODEL OF EARLY COMMUNITY COLLEGE STUDENT SUCCESS: UNDERSTANDING SUCCESS IN DEVELOPMENTAL MATHEMATICS

by

David Arthur Keller

An Abstract

Of a thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Educational Policy and Leadership Studies (Higher Education) in the Graduate College of The University of Iowa

May 2011

Thesis Supervisor: Professor Michael B. Paulsen
ABSTRACT

The purpose of this study was to integrate traditional student success models with theories which focus on nontraditional students to create a model of early community college student success. The researcher sought to understand the pre-college behaviors, attitudes, and attributes, from both cognitive and noncognitive domains, which influence the success of first-time community college students enrolled in a developmental mathematics course. First-time community college students enrolled in Elementary Algebra (N=385) were surveyed on their educational goals, prior academic achievement, anticipated interactions during the first semester, and items from the Noncognitive Questionnaire (NCQ) (Sedlacek, 2004). Institutional data supplemented the survey variables as well as provided all dependent variables.

Factor analyses were conducted to reduce the number of anticipatory variables. Descriptive statistics were reported for all dependent and independent variables. Both linear regression and logistic regression were utilized to examine the six research questions. Variables were entered into the regression equations in five blocks: demographics, college plans, prior mathematics achievement, anticipated experiences and interactions, and noncognitive variables. The model proved to be statistically significant in explaining each of the six dependent measures of student success. Moreover after controlling for the first four blocks of independent variables, six of the eight noncognitive variables reached statistical significance in its relationship to at least one dependent variable, with
at least one significant finding regarding the effects of noncognitive variables on each of the six outcome measures.

The findings of the study suggest noncognitive variables are useful in predicting student success and persistence at least early in the community college experience. Future researchers, policymakers, and administrators will gain insights into the application of noncognitive variables with a population of community college students.

Abstract Approved: ________________________________
Thesis Supervisor

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Title and Department

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Date
AN INTEGRATED MODEL OF EARLY COMMUNITY COLLEGE STUDENT SUCCESS: UNDERSTANDING SUCCESS IN DEVELOPMENTAL MATHEMATICS

by

David Arthur Keller

A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Educational Policy and Leadership Studies (Higher Education) in the Graduate College of The University of Iowa

May 2011

Thesis Supervisor: Professor Michael B. Paulsen
This is to certify that the Ph.D. thesis of

David Arthur Keller

has been approved by the Examining Committee for the thesis requirement for the Doctor of Philosophy degree in Educational Policy and Leadership Studies (Higher Education) at the May 2011 graduation.

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Ernest T. Pascarella

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Vilia M. Tarvydas
To Adam and Allison
Dogs are not our whole life, but they make our lives whole.

Roger Caras
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CHAPTER 1: INTRODUCTION

Introduction

One of the most widely researched topics in higher education is student success. Despite several decades of research there is still much we do not know about the factors which influence course completion and student enrollment decisions. Several prominent theories (e.g., Astin, 1970a, 1970b; Pascarella, 1985; Tinto, 1975) have been developed, tested, and revised over the last four decades to study the impact college has on students and yet the college dropout rate has remained nearly constant for more than one hundred years (Braxton, 2000). Researchers have made progress in understanding student departure in certain segments of higher education, but until recently most research efforts have largely ignored community college students (Braxton, Sullivan, & Johnson, 1997; Pascarella & Terenzini, 2005). The lack of research focused on community college students frequently results in either borrowing college impact models and educational theories from other institutional types or making policy decisions without any theoretical grounding at all. Pascarella and Terenzini (2005) reported that during the 1990s researchers “expanded their vision to include community colleges” and consequently “the impact of community colleges on students is no longer an empirical ‘black hole’” (p. 631). Perhaps most importantly, researchers are beginning to identify significant differences between students attending a community college and those attending four-year institutions.
Background to the Study

Community colleges fulfill a critical need in higher education by offering high-quality services to a diverse population in a variety of convenient locations and formats. Nationally there is considerable debate about postsecondary remediation. Critics argue that taxpayers should not have to pay twice for the same educational opportunity, once in high school and again in college (Bahr, 2008; Grimes & David, 1999; McCabe, 2000). Rosenbaum, Redline, and Stephan (2007) determined that “students' predicted propensity to attend public four-year colleges overlaps little with that for public two-year colleges” (p. 50). In other words, community colleges offer educational opportunities to students who would otherwise not be in higher education. In particular, the remediation services provided by community colleges offer help to overcome disparities in primary and secondary education opportunities frequency associated with social class and race/ethnicity (Bahr, 2008).

Community college populations are more diverse compared to four-year institutions, often exhibiting wider variation in terms of age, academic ability, educational goals, drive to achieve, family support and obligations, and family socioeconomic status (SES) than typical in four-year institutions. Phillipe (1995) reported that approximately 80% of community college students are first-generation college students, many of whom are minorities and/or come from low SES families. Community college students are more likely to be academically underprepared, racial/ethnic minorities, adult students, and to attend college part-time than their counterparts at four-year institutions. In fall 2005, 40.9% of white
college students attended a community college while 45.6% of black students, 55% of Hispanic students, 44.5% of Asian/Pacific Island students and 50% of American Indian/Alaska Native attended community colleges (NCES, 2007). Additionally, in fall 2005 19.8% of four-year college students attended part-time, while 58% of community college students attended part-time (NCES, 2007). The combination of convenience, high quality for low cost, and open-door admission policies has resulted in significant enrollment increases over the last few decades. By fall 2007, 7.0 million of 16.0 million, or 43.9% of all undergraduate students were enrolled in two-year or less-than-two year institutions (NCES, 2009).

Community colleges have undoubtedly provided educational opportunities to segments of the population who would have otherwise not pursued postsecondary education. Rosenbaum and colleagues (2007) reported that “the racial gap in college enrollment has largely disappeared” (p. 49). Existing evidence suggests that community college students may differ in significant ways from the student body of four-year colleges and universities. Therefore it is essential that scholars intensify their research efforts to better understand the differences between two-year and four-year college populations.

According to NCES data, 43.6% of students beginning postsecondary education in a public two-year college left college without a credential and did not return within three years (Bradburn, 2002). Nearly one in four (23.9%) left after the first year at the two-year college. Results were similar at private not-for-profit two-year colleges where 34.7% of students left without a credential and did not
return within three years; 15.3% left after the first year. In contrast, student
departure rates at four-year institutions were much lower. Only 18.8% of
students at public four-year institutions and 17.2% of students at private not-for-
profit four-year institutions left without a credential and did not return within three
years. First year departure was only 7.3% at public four-year colleges and 6.4%
at private four-year colleges (Bradburn, 2002). Clearly community college
students are more at-risk to leave college before achieving their goals than
students attending four-year institutions. I believe that a better understanding of
community college student success will facilitate policy recommendations at the
institutional level which will ultimately lead to increased student success and
retention at America’s community colleges.

One promising arena for initially improving community college student
success is in mathematics. Successfully completing one or more mathematics
courses is a requirement nearly every college student faces. The necessity for
mathematical thinking and reasoning continues to intensify as the world becomes
more quantitatively oriented. More generally, mathematics aptitude is commonly
used as an indicator of the overall level of education in our workforce. The Third
International Mathematics and Science Study (TIMSS) compared the general
mathematics and science knowledge of U.S. students in their last year of high
school with those of 20 other countries, as well as student achievement in
physics and advanced mathematics courses with those in 15 other countries.
Interestingly in the early grades U.S. students perform at a similar level to their
peers in other countries, however achievement falls behind by eighth grade and
is even worse at the end of high school (NCES, 1998). As a group, U.S. twelfth graders performed among the lowest of the 21 TIMSS countries in mathematics general knowledge. Performance in advanced mathematics and physics was among the lowest of the 16 countries which administered the advanced mathematics and physics assessments.

The National Assessment of Educational Progress (NAEP) found that 61% of U.S. high school seniors performed at a basic level while only 23% were deemed proficient (NCES, 2007). Higher levels of mathematical competence will be required to keep up with global competition for jobs. According to the US Department of Labor job forecast 12 of the 20 occupations with the fastest growth rates and 6 of the 20 occupations with the largest increase in the number of jobs will require an associate’s degree or higher between 2006 and 2016 (Bureau of Labor Statistics, 2008). Additionally 19 of the 20 occupations expected to see the greatest number of jobs lost require on-the-job-training as the most significant level of education (Bureau of Labor Statistics, 2008). From these projections it seems clear that demand for a college-educated workforce will continue for the foreseeable future.

Studies have consistently shown that the number of high school math courses, grades in high school math courses, grades in college math courses, highest level of math taken, and math placement scores are among the best academic predictors of student success in college (Adelman, 2006). Mathematics coursework is necessary for nearly every college major. Mathematics is also the discipline in which students are most likely to need
remediation (Adelman, 2004; McCabe, 2000; Oudenhoven, 2002; Parsad & Lewis, 2003). As a result, the majority of students need to take more than one math course in college. Mathematics coursework must be completed sequentially because the concepts build on one another, so it is important students begin taking mathematics courses early in their college experience. Students needing only math remediation have been found to graduate and transfer at nearly the same rate as students entering college ready for college-level math courses (Adelman, 1996).

Mathematics preparation is significantly different for students attending two-year institutions and four-year institutions. According to NCES (2008a) data, 27% of students under age 24 who started at four-year institutions reported taking calculus in high school while 6% reported taking only courses below algebra II. Among students under age 24 who started at two-year institutions, 5% reported taking calculus in high school and 25% reported taking only courses below algebra II.

Despite the clear importance of mathematics in determining student success in college, relatively few studies address this key concern. Those that do are primarily descriptive in nature, reporting enrollment patterns in mathematics courses and subsequent completion rates. The independent variables employed in these studies include demographics such as gender, ethnicity, economic status, and academic aptitude as measured by standardized test scores, type and number of mathematics courses taken, and high school grades (Hagedorn, Siadat, Fogel, Nora, & Pascarella, 1999; Umoh & Eddy, 1994;
Waits & Demana, 1988). Other research compared delivery modes and classroom management styles (Abadir, Anglin, & Gooden, 1993), as well as class size, attendance, and student participation (Waycaster, 2001). Bahr (2007, 2008, 2010) offers one bright spot in community college developmental mathematics research with his in-depth study of California community college students. Bahr (2008) found that three-quarters of remedial math students do not remediate successfully. Of those who do not complete mathematics remediation, 81.5% did not earn a credential from the community college and did not transfer. This finding highlights the importance of mathematics remediation for student success in the community college and reinforces the need to conduct research to better understand factors which increase the likelihood of success in remedial mathematics.

Much of the available research studied college-level mathematics courses at four-year institutions. There are numerous differences both between college-level and developmental-level mathematics courses and between student populations at four-year institutions and community colleges that minimize the value of these findings to the present study.

A few studies of mathematics student success in four-year institutions have included variables measuring beliefs, self-concept, study habits and time usage, and student’s interest in learning (House, 1995b; Stage & Kloosterman, 1995; Thomas & Higbee, 2000; Wheat, Tunnell, & Munday, 1991). The findings suggest these variables, along with demographic variables and measures of academic ability, are significantly correlated with mathematics success.
A significant amount of student success research has been guided by the work of Astin (1970a, 1970b, 1993), Pascarella (1985), and Tinto (1975, 1993) through their models for studying the impact college has on students. Guidance from these three founders of college impact literature is essential for this study, but not sufficient for two key reasons. First the intended population for each of these models is traditional college students, primarily attending four-year residential institutions. Second, these models are college impact models. In-college experiences, particularly interaction with the college social and academic environments, are critical components to understanding what effect college has on students.

The present study focuses on pre-college characteristics from a variety of constructs which have been shown to predict student success in college. There is minimal direct measurement of the impact college has on students; instead, the purpose of this research is to explore other student attributes, both cognitive and noncognitive, which are correlated with early student success or departure from college and/or from a course. More particularly, this study seeks to identify those precollege attributes and behaviors which positively impact success early in the first semester of community college attendance. The intent of this study is to assist in the creation of early warning policies in which community college students can be quickly and accurately identified as likely to benefit from some type of college intervention. As Astin (1993) suggested, I measured key variables very early in the student’s college career and used anticipatory
questions to gain student perceptions about variables which cannot yet be measured.

Research has shown academic measures including high school grade point average (GPA), number of math, English, and science courses taken, and scores on standardized tests such as the ACT and SAT contribute to models reasonably predicting student success and persistence in college, however much variation in student behavior is left unaccounted for (Mouw & Khanna, 1993; Pascarella & Terenzini, 2005). Further, research suggests the less “traditional” an individual is the poorer job standardized tests do of predicting college academic achievement. Moffat (1993) found the SAT to be a valid predictor of achievement for white students under 30 years old, but not for black students or for students over 30 years old. Robbins, Le, Davis, Lauver, and Langley (2004) reported that a combination of high school grades and standardized achievement test scores accounted for approximately 25% of the variance when predicting first-year college GPA. Most studies of student persistence include measures of both attributes students possess prior to beginning college and experiences students gain while in college. This fact is not a surprise since both Astin and Tinto based their theories of student persistence largely on the extent to which students become integrated into the college environment. However on community college campuses it seems student persistence is “more a function of academic than social integration” (Pascarella & Terenzini, 2005, p. 395). Thus it seems appropriate to follow the suggestion of Bean and Metzner (1985) and conduct a study without an emphasis on in-college environmental measures.
The research seems relatively clear that precollege student attributes have a significant effect on student persistence. First generation students are less likely to persist than students who have at least one parent with some college education (Pascarella & Terenzini, 2005). There is a direct correlation between family SES and college persistence. Older students are less likely to persist than younger students, largely due to non-academic factors such as child care, job constraints and other family obligations. While student background characteristics are important to consider, student’s grades typically offer “the largest contribution to student persistence and attainment” (Pascarella & Terenzini, 2005, p. 397).

In several persistence studies the researchers chose to include noncognitive measures in addition to or instead of environmental and other in-college measures. The majority of these studies suggest the inclusion of noncognitive variables increased the validity of student persistence models as compared to traditional models only measuring academic and aptitude factors. Pascarella and Terenzini (1991) suggest that aside from academic ability and intelligence, “grades at the individual level are significantly influenced by such factors as personal motivation, organization, study habits, and quality of effort” (p. 388). As such, grades not only reflect academic ability but also suggest quality work habits and attitudes. Tracey and Sedlacek (1984, 1985, 1987) suggest a set of noncognitive variables and a well researched instrument which has been shown to predict student success and persistence in a wide array of nontraditional student populations. Astin’s (1970a, 1970b, 1993) input-
environment-output (I-E-O) model provides a methodological guide to studying the impact of college on students. According to this model college outcomes are a function of both student inputs and student environment. Student inputs include demographic and family characteristics as well as academic and social experiences before entering college while student environment encompasses the interpersonal, organizational, cultural, occupational, and other experiences which occur during college. Together these formulate the outcomes of college in the form of individual skills, attitudes, behaviors, and values.

Tinto’s (1975, 1993) theory of student departure offers an interpretation of the process of student withdrawal. Similar to Astin’s I-E-O model, this model contends that students enter college with a host of individual characteristics which impact the decision to depart from college. These background characteristics include family SES, parental education level, parental expectations, high school characteristics, high school academic achievement, academic ability, race, and gender. According to Tinto, entry characteristics influence the degree of initial commitment to the institution and the goal of college graduation. Both the initial institutional commitment and the goal of graduation affect the extent to which the student becomes integrated into the academic and social systems of the institution. The goodness of fit between individual and institutional expectations will significantly impact the student’s integration into the college culture. Pascarella and Terenzini (2005) defined this integration as “the extent to which the individual shares the normative attitudes and values of peers and faculty in the institution and abides by the formal and
informal structural requirements for membership in that community or in subgroups of it” (p. 54). If student experiences and relationships are predominantly positive, integration into the institution is likely to increase and therefore so does the likelihood that the student will remain enrolled at the institution. However, students who face negative interactions are more likely to distance themselves from the institution, and the possibility of withdrawal increases. The degree of academic and social integration positively impacts the subsequent commitment to the institution as well as commitment to the goal of graduation. Further, as institutional commitment increases so does the likelihood of persistence in college to graduation.

Pascarella (1985) provides an extensive review of college impact studies which includes analyses of the collective degree of empirical support for a number of student learning propositions, a critique of methodological strategies, and concludes with a general model to assess the effects of college environment on student learning. While the heart of Pascarella’s model is the impact of the college environment on student learning, many of his arguments highlight the need to better understand the impact of pre-college attributes and anticipated actions and behaviors on student success. Pascarella (1985) reported “most of the output achievement differences among students at different institutions was explainable by differences in the pre-college characteristics of the students they enrolled four year earlier” (p. 16). Pascarella concluded that after controlling for student input characteristics “institutional structural or environmental characteristics accounted for a relatively minor percentage of the variance in
standardized measures of post-college learning” (p. 20). Instead, the environmental and structural characteristics of an institution influence both the quality and quantity of interaction with socializing agents. Since community college students often interact less with the institutional environment, there is less potential for significantly influencing student success. Therefore more and better measures are necessary to assess the initial characteristics of students and identify those which are most likely to encourage interaction within the institutional environment. Furthermore, additional measures of the interaction with, and influence by the external environment must be explored to better address community college student success.

The models proposed by Astin, Pascarella, and Tinto do not adequately address characteristics of nontraditional students which impact student success and persistence in college. Bean and Metzner (1985) concentrate on this theoretical gap by developing a conceptual model for nontraditional student attrition. Bean and Metzner define a nontraditional student as follows:

A nontraditional student is older than 24, or does not live in a campus residence (e.g., is a commuter), or is a part-time student, or some combination of these three factors; is not greatly influenced by the social environment of the institution; and is chiefly concerned with the institution’s academic offerings (especially courses, certification, and degrees). (p. 489)

Nontraditional students often spend less time on campus than their traditional counterparts and therefore are likely impacted to a lesser degree by interactions
with the campus environment. Bean and Metzner’s model differs significantly from those proposed by Astin, Pascarella, and Tinto because it deemphasizes the institutional environment as a socializing agent and instead suggests the external environment has a much greater impact. Furthermore, Bean and Metzner suggest persistence decisions likely contain a psychological dimension and therefore put some emphasis on measuring the influence of background, academic preparation, and environmental variables on psychological outcomes.

Arguably the most influential of all student attrition models is Tinto’s (1975, 1993) interactionalist theory. Braxton et al. (1997) identified four criticisms of Tinto’s model: little attention focused on the internal consistency of Tinto’s propositions, the lack of emphasis on the extent to which empirical evidence supports Tinto’s propositions across different types of institutions and across different groups of students, the lack of research to determine the impact of theory integration to improve student success models, and the lack of research addressing critiques and shortcomings of Tinto’s theory. In their analysis of the literature utilizing Tinto’s model, Braxton and his colleagues (1997) determined that multiple-institution research offered strong support to four of Tinto’s propositions while single-institution research strongly supported six of the propositions. Analysis of single-institution studies by institutional type indicated strong support for four propositions in residential universities, strong support for two propositions in commuter universities, and only one proposition received strong support in community colleges. Furthermore, five propositions had only
been tested once in a single community college with the remaining nine propositions never tested in a community college.

Braxton et al. (1997) identified three studies which employed psycho-social variables in a “Tinto-based study” (Stage, 1989, p. 385) to improve the predictability of student persistence. Brower (1992) included task life predominance measures to characterize student’s initial institutional integration focus as either affiliation or achievement oriented. Brower concluded that measures of life task predominance improved the amount of variance accounted for in predicting student persistence. Stage (1989) sought to improve upon Tinto’s model by categorizing students based on their motivational orientation for attending college. The results indicate markedly different persistence patterns for students with different motivational orientations. This finding reinforces the complex nature of student persistence decisions and supports continued research in identifying key student attributes which impact student decision-making early in the college experience. Peterson (1993) found a significant relationship between career making self-efficacy variables and social and academic integration in a study of underprepared university students. Each of these studies support enhancing Tinto’s model with an array of variables measuring psycho-social constructs.

Based on Braxton’s et al. (1997) report of weak empirical support for the majority of the propositions in Tinto’s (1975, 1993) interactionalist theory, several researchers have recommended possible revisions or enhancements which may improve the understanding of student success and persistence in college. One
proposal seems particularly well suited for examining student success early in college. Bean and Eaton (2000) identify an acute weakness in Tinto’s theory; the lack of any meaningful psychological perspective in explaining student persistence decisions. Furthermore psychological theories “have only played a tangential role in research influenced by Tinto’s model” (Bean & Eaton, 2000, p. 48). In other words, Tinto as well as the vast majority of researchers employing Tinto’s theory have largely neglected the potential of individual attitudes, behaviors, and motivations as a basis for explaining student persistence. To address this weakness in Tinto’s theory, Bean and Eaton (2000) propose a psychological model of college student retention in which they recommend measuring a host of individual psychological characteristics upon entering college. Their premise for developing this psychological model is clear: “leaving college, is a behavior and that behavior is psychologically motivated” (Bean & Eaton, 2000, p. 49). Bean and Eaton acknowledge that behaviors are “enormously complex” (p. 49) and multiple theories of motivation exist, none of which dominates the field. Bean and Eaton drew from multiple psychological theories including Attitude-Behavior theory (e.g., Fishbein & Ajzen, 1975), Coping Behavioral theory (see Bean, 1990; Eaton & Bean, 1995; French, Rodgers, & Cobb, 1974; Lazarus, Averill, & Opton, 1974), Self-efficacy theory (Bandura, 1986), and Attribution theory (Weiner, 1986) to formulate the necessary constructs for their model. The psychological variables identified for inclusion in the model are past behavior, personality, initial self-efficacy, initial attributions, normative beliefs, coping strategies, motivation to attend, and skills and abilities.
Bean and Eaton’s theoretical model stands poised to extend the understanding of college student success, especially very early in college, by integrating Tinto’s interactionalist theory with key constructs from sound psychological theories. Unfortunately their theory does not offer researchers with an instrument for measuring the proposed constructs. I have identified one theoretical perspective from educational psychology literature which closely maps to the constructs Bean and Eaton identified.

Originally, Tracey and Sedlacek (1984, 1985, 1987) created the Noncognitive Questionnaire (NCQ) in an effort to more accurately predict academic success by race. The use of standardized tests for admission decisions was less valid for black students than white students (Tracey & Sedlacek, 1984). The original form of the NCQ contained two nominal items on educational expectations, eighteen Likert-type items regarding college expectations and self-assessment, and three open-ended questions to collect information about goals, previous accomplishments, and group membership and leadership (Tracey & Sedlacek, 1984). Tracey and Sedlacek (1987) revised and expanded the NCQ by adding an additional 38 Likert-type statements in an effort to improve reliability and validity. Sedlacek (2004) made two decades of research more accessible and user friendly with the publication of his book *Beyond the Big Test: Noncognitive Assessment in Higher Education*. Included in the book are three versions of the NCQ, each of which gather self-reported measures on the extent to which individuals possess characteristics associated with the eight noncognitive variables Tracey and Sedlacek originally identified.
The variables are positive self-concept, realistic self-appraisal, successfully handling the system, preference for long-term goals, availability of strong support person, leadership experience, community involvement, and knowledge acquired in a field.

Several of the constructs identified by Tracey and Sedlacek (1984, 1985, 1987) and Sedlacek (2004) match up reasonably well with those proposed by Bean and Eaton (2000). Sedlacek (2004) defined positive self-concept as a variable that “assesses the applicant’s confidence, self-esteem, independence, and determination, all vital components of future achievement and success” (p. 50). This variable fits closely with Bean and Eaton’s self-efficacy variable and also includes some key personality attributes. Both theories utilize these variables to identify key characteristics of an individual’s perception of their ability to perform tasks which will lead to the attainment of one’s educational goals.

Two of Sedlacek’s other variables include realistic self-appraisal and successfully handling the system. Realistic self-appraisal is operationalized as assessing “the applicant’s ability to recognize and accept his or her strengths and deficiencies, especially in academics, and works hard at self-development to broaden his or her individuality” (Sedlacek, 2004, p. 50) while successfully handling the system assesses “the applicant’s ability to understand the role of ‘the system’ in life and to develop a method of assessing the cultural or racial demands of the system and respond accordingly/assertively” (Sedlacek, 2004, p. 51). These two variables capture much of Bean and Eaton’s constructs of coping strategies, initial attribution, and normative beliefs. When considering either Sedlacek’s
theory or Bean and Eaton’s theory, an individual’s behavior or set of life experiences often cannot be demarcated nicely into one of the eight constructs. The constructs in each theory are not mutually exclusive, but instead overlap to some degree with others within the same theory. Consider the trait of perseverance exhibited by a college student. Perseverance itself is a complex quality which includes self-confidence, a positive outlook on one’s ability to perform tasks, positive feelings of self-worth, awareness of individual strengths and weaknesses and a willingness to strive for improvement, the ability to accept criticism and use it for improvement, and the desire to overcome obstacles. While neither Sedlacek nor Bean and Eaton include a variable for perseverance, both clearly acknowledge the importance of the characteristics which comprise my definition of perseverance. There is no clean mapping from one theory to the other, however taken as a whole it seems the two theories measure many of the same characteristics, perceptions, and behaviors. The distinct advantage of Sedlacek’s theory is the existence of the NCQ, an effective instrument for measuring each of his constructs. Tracey and Sedlacek have tested the NCQ numerous times over the last two decades and offered subsequent revisions to the instrument. The result is a reliable and valid instrument which has consistently shown a positive correlation with student success as measured by grades, GPA, and persistence in college for a variety of nontraditional student groups. What research employing the NCQ often lacks is measurement of a robust set of demographic, aptitude, and academic variables.
There appear to be two distinct lines of research on student success which would each benefit from the great strides the other has made. Theory elaboration involves the use of constructs derived from various theoretical perspectives to explain phenomenon of interest (Thornberry, 1989). Berger and Braxton (1998) suggest theory elaboration is appropriate when parts of a theory are incomplete. In this instance, the factors which predict early success of community college students are not clear. To better understand this phenomenon and eventually impact the development of early warning and intervention systems to further improve community college student success, the integration of several theoretical perspectives is necessary. The traditional models of Astin, Pascarella, and Tinto have influenced huge numbers of student success studies but the vast majority fail to include any substantial measures of noncognitive student attributes. Researchers in educational psychology have developed a sizeable number of motivationally-related theories used to quantify a vast array of individual student characteristics related to college success. Unfortunately most of this research fails to effectively control for student aptitude, prior academic work, and a multitude of other demographic and background characteristics shown to influence student success. My study is a response to Bean and Eaton’s (2000) call for a psychological model of student success by integrating theories from each line of inquiry. By employing many of the variables from traditional student success models of Astin, Pascarella and Tinto along with key constructs from the noncognitive literature my study enhances and extends the currently available student success models. Tracey and
Sedlacek’s NCQ seems a likely candidate for measuring many of the constructs put forth by Bean and Eaton. Furthermore, with the guidance for studying nontraditional students provided by Bean and Metzner (1985), Sedlacek (2004), and Tracey and Sedlacek (1984, 1987), this study focuses directly on community college students, a population largely absent from both lines of research.

**Problem Statement**

Persistence and student success continue to be significant concerns in America’s community colleges. Research has largely neglected these diverse and growing populations due to their varied educational goals, large numbers of nontraditional students, and lack of appropriate empirical models. Scholars must do more to facilitate a better understanding of the extent to which current models of student success need to be modified in order to best explain community college student success and persistence patterns. Based on existing research, it is clear that community college students are unique and current success models fail to effectively capture the attributes which predict continued student enrollment and likelihood of success.

Many community college students exhibit characteristics which identify them as at-risk to withdraw from college. Community college students are more likely to be academically underprepared, first-generation college students, members of a racial or ethnic minority, come from a low SES family, and attend college part-time. At-risk students may be more prone to leaving college very early in the first semester, even before the college has any opportunity to impact
the student. Unfortunately research has failed to provide community colleges
with guidance for creating efficient yet effective early intervention systems.

One promising venue to begin identifying traits which significantly and
positively impact community college student success is in mathematics.
Annually, huge numbers of students arrive at community colleges ill-prepared for
college-level mathematics. Fortunately research suggests students who correct
deficiencies in mathematics are just as likely to transfer and graduate as students
prepared for college-level mathematics upon matriculation in college (Adelman,
which increase the likelihood that a student will remain in college, researchers
can facilitate the development of better advising and early-intervention strategies
aimed at improving student success and retention. Only after we understand
predictors of early student success can scholars pursue more comprehensive
models for studying community college student success.

**Purpose Statement**

Current student success models fail to adequately integrate research
findings from higher education and educational psychology. Moreover scholars
interested in student success routinely neglect community college students in
favor of students attending four-year colleges and universities. Research has
identified several significant differences between these two student populations,
yet little has been done to identify the major student attributes which predict the
success of community college students.
Two approaches to modeling college student success have seemingly coexisted in educational literature for more than two decades, yet little evidence of cross-pollination of ideas exists. Traditional models of student success often make use of theories proposed by Astin, Pascarella, or Tinto and zero in on student aptitude, prior academic experiences, and the interaction between individual and institutional environment to predict student persistence, grades, and likelihood of graduation. These models neglect to include a psychological component to student success in a meaningful way. Several psychologically-oriented models of student success exist which measure a host of motivational, behavioral, attitudinal, and perceptual characteristics of college students and use them to predict student grades and retention. Student success models in this category frequently fail to adequately account for the impact of academic preparation, student aptitude, or many other influences beyond the student’s control. Neither of these theoretical perspectives have adequately addressed the problem of community college student success.

The purpose of this study is to integrate the traditional student success models of Astin (1970, 1993), Pascarella (1985), and Tinto (1975, 1993) with theories proposed by Bean and Metzner (1985), Tracey and Sedlack (1984, 1985, 1987), and Sedlacek (2004) which focus on nontraditional students to more thoroughly examine community college student success. In particular, this study focuses on student behaviors and attributes which positively impact success early in the first semester of community college attendance. By combining and extending multiple theories all attempting to explain some aspect
of college student success, I intend to create a model sensitive to the wide range of characteristics which impact nontraditional student success.

This integrated model of nontraditional student success will be applied to a population of first-year community college students enrolled in a developmental mathematics course. Given the importance of mathematics coursework in the pursuit of a degree and in the training of logical and critical thinking, improving student success in developmental mathematics seems to be a critical first step in improving overall community college student success. If students experience success early in college and in mathematics, they are much more likely to persist in college.

**Significance of the Study**

The ability to efficiently and accurately examine student success in college populations is essential. Predicting student success early in the semester, particularly for new students, is perhaps even more important for community colleges than other types of higher education institutions because of the diverse student body. Community colleges are more likely to enroll academically at-risk students yet rarely have data to identify these students. Without effective methods to identify concerns and intervene within the first few weeks of a student’s first semester, the chances of a student successfully completing the semester are greatly diminished.

According to NCES (2008b), 48% of undergraduate students began their postsecondary education at a community college in 2006. As a group, community college students are significantly different than students attending
four-year institutions. Community colleges are the fastest growing segment of higher education and serve huge numbers of students. First generation, low income, minority, part-time, and adult are but a few of the common traits exhibited by today’s community college students. The existing college student success models were not developed for use with the highly diverse community college student population. It is the responsibility of higher education scholars to formulate and test valid and reliable measures which will assist community college leaders in providing these diverse students with institutional policies and instructional strategies that promote student success.

This study adds to the student success literature by drawing upon multiple constructs from interactional, sociological, and psychological student success literature to form a robust model of community college student success. This study proposes and assesses an integrated model for studying community college student success which includes the key components of traditional college impact models and adds critical measures shown to be predictive of student success and persistence in nontraditional students. The central element of this study is to determine the extent to which noncognitive variables enhance student success models and their application to community college students, particularly early in the first semester of college.

There is limited research on student success in community colleges and fewer studies investigating success in community college developmental mathematics. The research that does exist is descriptive in nature, typically limited to grades in the class or performance on a common assessment and
subsequent registration in the next mathematics course in the sequence. This study provides valuable insight into pre-college attributes, experiences, and behaviors and their impact on developmental mathematics course performance and subsequent persistence in college. Implications for academic advisors as well as educational and institutional policy makers are discussed.

**Brief Methodology**

The population for this study was students enrolled in Elementary Algebra during the fall 2009 semester at a large public Midwestern community college. Data were collected directly from students three times during the semester. The mathematics department administers two common pretests to all Elementary Algebra students during the first week of the semester. The first is a fifteen question multiple-choice pretest measuring a student’s mathematical knowledge of prealgebra and the second is a fifteen question multiple-choice pretest measuring a student’s comprehension of core concepts in elementary algebra. These two pretests, measuring prealgebra and elementary algebra knowledge and ability, constitute the initial measures of student mathematical ability.

Within the first three weeks of the semester students completed a self administered paper survey during one regularly scheduled class session. In most cases I personally attended the class to request student participation and administer the survey. The survey collected student data motivated by one of the three lines of inquiry for this research: traditional predictors of student success as identified by Astin (1970a, 1970b, 1993), Pascarella (1985), and Tinto (1975, 1993); predictors Bean and Metzner (1985) indicated are necessary for
understanding success and persistence of nontraditional students; and noncognitive constructs which Bean and Eaton (2000) encouraged scholars to include in future research and which Sedlacek (2004) and Tracey and Sedlacek (1984, 1985, 1987) declared predictive of success in many nontraditional student populations. I asked students if they had taken college classes at any institution prior to the fall 2009 semester to separate new and returning students. The traditional measures included on the survey are age, gender, race, disability, family income, and parent education. I also measured the degree of preparation or planning for college with items such as type of advising utilized, educational goal, certainty of educational goal, amount and type of financial aid received, number of credits attempted, and intention to work off campus. I measured prior mathematics achievement with the two department pretests for prealgebra and elementary algebra content and also the highest math course completed in high school. The survey also includes several questions derived from Cooperative Institutional Research Program (CIRP) follow-up studies of college student engagement (Astin, 1993). Because my study was conducted before students had much interaction with the college environment, I had to rewrite the questions to ask students to anticipate the extent to which they anticipated being involved in a variety of academic, social, and work-related activities during the semester, following an approach recommended by Astin (1993). Sedlacek’s NCQ constituted the final component of the survey. This instrument measures student experiences and perceptions in eight different noncognitive constructs. Previous
research has documented the reliability and validity of the NCQ with a number of different nontraditional student populations.

The mathematics department requires the use of a common final exam in Elementary Algebra. The exam contains 32 multiple-choice questions covering the key concepts of the course. Each student’s score on the final exam was used as a posttest measure of mathematical ability, one of the key dependent measures in this study.

The primary outcome variables in this study are persistence in college and student success. Persistence is measured in two ways: enrollment at the institution in spring 2010 semester and enrollment in a mathematics course in the spring 2010 semester. Student success is measured in four ways: the score earned on the departmental final exam, whether each student passed or failed Elementary Algebra, the percent of attempted credits completed, and first semester GPA.

Results include descriptive statistics for each dependent and independent variable, bivariate correlations, and analyses of missing data. I also conducted two factor analyses with the items requiring students to anticipate their engagement in academic, social, and work activities. Next I described my final model and then applied both linear and logistic regression to investigate each of my six research questions.

**Research Questions**

RQ1. Is there a significant relationship between scores on noncognitive constructs and first semester GPA after controlling for student
demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ2. Is there a significant relationship between scores on noncognitive constructs and the percent of credits attempted in the first semester that are completed after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ3. Is there a significant relationship between scores on noncognitive constructs and passing Elementary Algebra after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ4. Is there a significant relationship between scores on noncognitive constructs and persistence to the spring semester at the institution after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ5. Is there a significant relationship between scores on noncognitive constructs and the score on the Elementary Algebra final exam after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ6. Is there a significant relationship between scores on noncognitive constructs and persistence in mathematics after controlling for
student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

Limitations

This study is limited to data collected in the fall 2009 semester from students enrolled in sections of Elementary Algebra, a single developmental mathematics course, with a face-to-face component. Furthermore the study is limited to subjects who are first-time students attending a single public Midwestern community college. Because the focus of this research is to identify pre-college attributes which impact early student success, little attention is given to in-college experiences. Student success and persistence are measured over one academic semester, so further research is necessary to determine the long-term impact of noncognitive variables.

Like all research which includes a self-administered survey, this study is limited by missing data and self-report error. One noteworthy design strategy aimed at minimizing the impact of these biases is an in-class administration of the survey. By providing class time I expect response rates were dramatically higher than if I sent the instrument home with students. Furthermore I expect fewer items were skipped and filled in without reading the items because of the group setting. There may have been some error due to perceived socially appropriate or desirable answers, particularly to the anticipated engagement items. I attempted to minimize this bias by administering the survey very early in the semester and also by ensuring students that their responses were for
research purposes only and would not be reported to instructors or impact their grade in any way.

An additional limitation is my requirement that students complete both the department pretests and the survey to be included in the sample. Undoubtedly some students were omitted from the sample because they missed one of these two critical data collections. This issue was compounded because of an institutional policy which allows students to add and change course registration through the first week of classes. The department requests that faculty administer the pretests on the first day of class, therefore any student adding the course after the first day of classes would likely not complete the pretests and thus not be included in my sample.

A final limitation to consider is the relative lack of diversity exhibited by students participating in this study. Many American community colleges, particularly those serving large urban areas, may have significantly more minority students, returning adult students, part-time students, and non-native English speaking students than the host institution. While the NCQ was designed to minimize the impact of race on scores for each variable, it is still necessary to keep differences in these demographic variables in mind when comparing results to other institutions.

**Delimitations**

I have delimited this study in several ways. First the decision to only use students taking Elementary Algebra limits the ability to generalize the findings to students taking other developmental mathematics courses, developmental
courses in other disciplines, and college-level mathematics courses. Second, only students enrolled in a section of Elementary Algebra with a face-to-face instructional component are included in the study. This limits the utility of the findings for internet and correspondence delivery modes. Third, only first-time students were surveyed so returning students are not represented in the study. Fourth, students were selected from a single, public Midwestern community college. Students attending private two-year institutions, four-year institutions, or community colleges with different student characteristics may find noncognitive variables have varying degrees of impact on predicting success of their students.

Summary

The existing college student success models are inadequate to address the diverse student population found in American community colleges. Scholarship focused on increasing the level of understanding about student attributes which impact success is necessary. One logical starting point for this research is mathematics because nearly every college student is required to complete a mathematics requirement. Furthermore mathematics is an area with a high incidence of remediation. Improving student success in mathematics is advantageous for several reasons. First, students who initially experience success are more likely to persist in college. Second, mathematics often acts as a gatekeeper for many college majors. Students who conquer deficiencies in mathematics and experience success are much more likely to feel empowered as learners and therefore be more successful in future educational endeavors. Third, developmental mathematics is likely the area where success research and
policy implementation can impact the greatest number of students. The sheer magnitude of mathematics remediation justifies the importance of this study.

Student success research has largely ignored community college students. The studies of community college students that exist are primarily descriptive in nature and do little to add to the current body of knowledge. An additional source of concern is the improper use of theory such as Tinto’s interactionalist model which was not intended for use with nontraditional populations. These findings suggest there is a clear need for a theoretically sound, empirically supported model of nontraditional student success. Bean and Metzner (1985) offer guidance for such a model. As compared to Astin, Pascarella, and Tinto, Bean and Metzner shift the emphasis away from social and academic integration of students and instead recommend an increased awareness of the impact of the external environment on success. Additionally, Bean and Metzer introduce the construct of psychological outcomes as a probable influence on nontraditional student success.

More recently Bean and Eaton (2000) provided an outline of a psychological model of student success as a response to Braxton et al. (1997) finding which indicated a lack of empirical support for Tinto’s interactionalist theory. Bean and Eaton’s central argument is that Tinto’s model neglects to consider any individual, psychological explanation for the decision to persist in or withdraw from college. Their position is that persistence in college is a behavior and that individual attitudes and perceptions have an impact on behavior. Therefore student attitudes, perceptions, and behaviors may hold the key to
further understanding of student success in college. Furthermore, these attitudes, perceptions, and behaviors are likely different for various groups of students and likely have differential impacts on the decision making patterns of students. What Bean and Eaton do not provide is an instrument to assess the psychological constructs they identified.

Tracey and Sedlacek (1984, 1985, 1987) and Sedlacek (2004) created and validated the NCQ, an instrument which has consistently and positively correlated with the success and persistence of many nontraditional student groups. The NCQ measures constructs which map relatively closely to the constructs identified by Bean and Eaton.

The present study addresses gaps in the student success literature by developing and testing an integrated model of nontraditional student success which includes a significant component measuring the noncognitive attributes students possess upon matriculation in college. This model is utilized to study a population of first-time community college students enrolled in a developmental mathematics course in order to identify those noteworthy attitudes, behaviors, skills, and other attributes which may positively impact early student success. The analyses provide insights which may lead to improved early intervention policies and instructional practices as well as the advancement of future research in this underrepresented area.

In the following chapter I provide a detailed critical review of the student success literature which frames this study. I begin with an analysis of the major works which provide the theoretical framework for the majority of research on
student success and explain why these models are insufficient for this study. Empirical evidence fails to strongly support many of the propositions outlined in some of the most frequently utilized models. The strength and quantity of support is further reduced when nontraditional student populations are examined. I then detail research designed for use with nontraditional student populations which employs both cognitive and noncognitive indicators of success. Finally I review the few studies specifically addressing student success in community colleges and developmental mathematics.
CHAPTER 2: LITERATURE REVIEW

Introduction

There is no clear choice for a theoretical framework to use when studying community college student populations. Instead researchers interested in better understanding the factors which influence persistence decisions in community college students are left to choose from several models, each of which has one or more significant weaknesses when applied to such a diverse population. The primary objective of the following literature review is to inform the development of a student success model conceptualized specifically for use with community college populations.

The first section of this chapter provides a detailed critical analysis of Tinto’s (1975, 1993) interactionalist theory of student attrition. This theory is employed as the theoretical framework for more student success studies than any other model, yet serious concerns exist as to the amount and degree of empirical support for each of Tinto’s propositions. I conclude this section with a review of Bean and Eaton’s (2000) recommendation for improving Tinto’s model.

The second section offers an analysis of Bean and Metzner’s (1985) theory for nontraditional student success. I illustrate how this model improves Tinto’s (1975, 1993) model by more closely aligning with the constructs shown to be particularly salient for research with nontraditional populations. This section also examines how Bean and Metzner’s theory can be improved by the recommendations put forth by Bean and Eaton (2000).
In the third section of this literature review I analyze Astin’s (1970a, 1970b, 1977, 1993) I-E-O model and identify the components which inform this study. Astin’s work offers significant contributions to the creation of an integrated model for studying community college student success.

The fourth section of this literature review offers a significant analysis of psychologically-oriented student success literature. Many different researchers have employed noncognitive variables to address student success in numerous academic settings. Unfortunately this robust branch of educational psychology has enjoyed minimal infusion of mainstream student success research in higher education. The work of Tracey and Sedlacek (1984, 1985, 1987), recently updated by Sedlacek (2004), provides the centerpiece for this section.

The final section of this literature review examines the few studies occurring in community colleges, focused on developmental mathematics students, and employing noncognitive variables. I conclude by articulating the major gaps in the existing literature and how this study aims to address those deficiencies by drawing together the key constructs from each of the previous sections of the literature review which encompass an integrated model of community college student success.

Tinto’s Interactionalist Theory: Exploration and Critique

Tinto (1975, 1993) states that students enter college with a host of individual characteristics which impact the decision to depart from college. These background characteristics include family socioeconomic status, parental education level, parental expectations, high school characteristics, high school
academic achievement, academic ability, race, and gender. According to Tinto, entry characteristics influence the degree of initial commitment to the institution and the goal of college graduation. This initial institutional commitment along with the goal of graduation affects the extent to which a student becomes integrated into the academic and social systems of the institution. The degree of academic and social integration impacts the subsequent commitment to the institution as well as commitment to the goal of graduation. As one might expect, there is a direct relationship between social and academic integration and institutional commitment. Further, as institutional commitment increases so does the likelihood of persistence to graduation.

Tinto’s theory yields fifteen testable propositions for which Braxton et al. (1997) assessed the level of empirical support. These propositions are as follows:

1. Student entry characteristics affect the level of initial commitment to the institution.
2. Student entry characteristics affect the level of initial commitment to the goal of graduation from college.
3. Student entry characteristics directly affect the student’s likelihood of persistence in college.
4. Initial commitment to the goal of graduation from college affects the level of academic integration.
5. Initial commitment to the goal of graduation from college affects the level of social integration.
6. Initial commitment to the institution affects the level of social integration.
7. Initial commitment to the institution affects the level of academic integration.
8. The greater the level of academic integration, the greater the level of subsequent commitment of the goal of graduation from college.
9. The greater the level of social integration, the greater the level of subsequent commitment to the institution.
10. The initial level of institutional commitment affects the subsequent level of institutional commitment.
11. The initial level of commitment to the goal of graduation from college affects the subsequent level of commitment to the goal of college graduation.
12. The greater the level of subsequent commitment to the goal of college graduation, the greater the likelihood of student persistence in college.
13. The greater the level of subsequent commitment to the institution, the greater the likelihood of student persistence in college.
14. A high level of commitment to the goal of graduation from college compensates for a low level of commitment to the institution, and vice versa, in influencing student persistence in college.
15. A high level of academic integration compensates for a low level of social integration, and vice versa, in influencing student persistence in college.
Braxton et al. (1997) identified propositions three, eight, nine, twelve, and thirteen as “fundamental to Tinto’s theory because they postulate a direct influence on student departure decisions (3, 12, 13), or because interactions between the individual and the formal and informal academic and social systems of a college or university are of pivotal importance (8,9)” (p. 112). Therefore particular attention must be paid to the research findings regarding these five fundamental propositions. Because the focus of my research is to understand first-time student success and persistence in developmental mathematics at a community college, I paid particular attention to the empirical evidence which Braxton et al. (1997) reported for each of the fifteen propositions based on both single-institution and multi-institution research conducted at two-year colleges. “Strong support” was defined as at least 66% of the three or more tests of a given proposition proved to be statistically significant. “Moderate support” required between 34% and 65% of the three or more tests of a given proposition to be statistically significant. The researchers reported “weak support” if 33% or less of the three or more tests of a proposition were statistically significant. In the situation where each of the two or more tests of a given proposition report statistically insignificant findings, the researchers reported “no support.” If only two tests of a given proposition were identified, the strength-of-support categories included “strong support,” “moderate support,” and “no support.” Finally if only one test of a given proposition was identified the researchers
reported “indeterminate support” support regardless of the statistical significance
achieved in the cited study.

Braxton et al. (1997) reported strong support based on multi-institution
research at two-year colleges for the first, second, third, and twelfth propositions;
moderate support for propositions eight and nine; weak support for proposition
thirteen; indeterminate support for proposition fourteen; no support for
propositions four, five, six, seven, and ten. The researchers were unable to
locate any multi-institution tests of propositions eleven or fifteen. Multi-institution
studies exhibited strong support for only two of the five core propositions while
two others received moderate support and the fifth received weak support. While
Tinto’s interactionalist theory is perhaps the most widely accepted model for
explaining college student departure, these findings suggest a more accurate
model is necessary.

The findings of single-institution studies of community college students are
an even greater cause for concern because very few studies exist. Braxton et al.
(1997) reported only proposition three received strong support from single-
institution research. Propositions eight, nine, eleven, twelve, and thirteen
received indeterminate support which indicates the researchers were only able to
identify one study testing each of the propositions. Finally no research was
located to test propositions one, two, four, five, six, seven, ten, fourteen, or
fifteen.

Collectively the findings reported by Braxton et al. (1997) suggest a gross
lack of understanding of the extent to which Tinto’s interactionalist theory applies
to community college students. No determination as to the theoretical fit of Tinto’s model to community college students can be made for four of the five fundamental propositions based on single-institution research in community colleges. Furthermore, only two receive strong support from multi-institution research. Only proposition three, “student entry characteristics directly affect the student’s likelihood of persistence in college” garnered support through both single-institution and multi-institution research. Multi-institution research suggests entry characteristics also affect the level of commitment to graduation from college and likelihood of persistence in college. Additionally multi-institution research provides strong support for the notion that higher levels of subsequent commitment to the goal of college graduation correspond with an increased likelihood of student persistence in college.

Braxton et al. (1997) emphasized the overall lack of empirical support for many of Tinto’s propositions. There is undoubtedly much more research based on Tinto’s interactionalist model conducted in four-year colleges and universities than in community colleges despite the fact that nationwide more than forty percent of all college students attend a community college. It seems clear from this research that community college students differ in many key aspects when compared to their counterparts attending four-year institutions. Furthermore, the small number of studies and minimal support for Tinto’s propositions emphasize the need for additional research regarding both the success and persistence of community college students.
Tinto’s theory of student departure has several shortcomings with regard to community college students. In fact, Tinto himself identified two-year colleges as an example of the imperfect or uninformed application of the theory (Tinto, 1986). Despite the mediocre fit of Tinto’s theory the majority of scholars offering critiques and recommendations for future research suggest revision rather than abandonment as the most appropriate course of action.

Bean and Eaton (2000) offer one promising recommendation for revising and enhancing Tinto’s model. Their critique centers on Tinto’s failure to include individual attitudes and behaviors as potential sources of influence on persistence decisions. Bean and Eaton call for the use of a psychological model for student retention and identify eight constructs they suggest should be included in an improved student retention model. The variables include past behavior, personality, initial self-efficacy, initial attributions, normative beliefs, coping strategies, motivation to attend, and skills and abilities. According to Fishbein and Ajzen (1975) and Bentler and Speckart (1979), beliefs and past behaviors lead to attitudes about behaviors, which lead to intentions to perform behaviors, which lead to behaviors. Beliefs are influenced by both expectations of consequences for a behavior as well as an understanding of the normative beliefs about a behavior. Past behavior, then, can offer insight to prior attitudes and beliefs which may impact a student’s ability to persevere and be successful in college.

Bandura (1977) proposed self-efficacy theory as an explanation for behavioral change. Self-efficacy is defined as an individual’s self assessment of
their ability to “successfully execute the behavior required to produce the outcomes” (Bandura, 1977, p. 193). Bandura suggests that expectations of one’s abilities determine whether or not individuals will attempt certain activities as well as which coping behaviors are employed and the extent to which individuals will persevere. People tend to avoid threatening situations when they judge their coping skills are inadequate, whereas they get involved in, and persist through, activities in which they believe they are prepared to handle. Certainly past experiences impact self-efficacy, and therefore future behaviors.

Bean and Eaton also include coping strategies as a psychological construct. Coping is defined as “the collection of behaviors an individual uses in order to adapt” (Bean & Eaton, 2000, p. 51). As students begin college, they are bombarded with new people, processes, expectations, beliefs, and experiences. The extent to which these students possess mechanisms to cope with such environmental change are indicative of their ability to adapt to, and persist in, college.

Another variable Bean and Eaton incorporate into their model is initial attributions. Based on Weiner’s (1986) attribution theory, this construct focuses on locus of control. Locus of control is operationally defined as a student’s ability to provide an internal or external rationale for past experiences and outcomes. Students with an internal locus of control are more likely to attribute successes or failures to individual traits such as time studying, academic ability, or effort. Those exhibiting an external locus of control more likely attribute successes or failures to luck or some other characteristic beyond their control. Students
possessing an internal locus of control are much more likely to possess the motivation and drive to achieve necessary to persist in college. Further, acclimation to a new environment is accelerated when students believe they have the ability to influence the outcomes.

The three remaining constructs, skills and abilities, personality, and motivation to attend, are also theorized to impact student success. Consistent with nearly all theories of college student success, the skills and abilities students possess as they enter college significantly impact their experiences and likelihood of success in college. Additionally, personality has an effect on the student’s expectations of college and goals for college. Personality also influences the ability to accept or resist change as a result of interaction with many social, academic, and external environmental agents commonly encountered early in the college experience. Students with clear, realistic personal goals associated with their attendance in college are more likely to experience success and therefore persist in college.

While it seems quite obvious that a model of student success must include individual psychological measures, Bean and Eaton do not provide an instrument to measure their recommended constructs. In order to assess the extent to which psychological variables can improve the utility of a student success model, researchers must either create or borrow an instrument. I have identified one promising instrument which measures similar constructs to those Bean and Eaton recommend and which is addressed at length in a subsequent section.
Bean and Metzner (1985) offer an empirically-based model of nontraditional student attrition. The model is “derived from models of traditional student attrition and other behavioral theories, and the substance comes from an extensive review of the literature on nontraditional students” (Bean & Metzner, 1985, p. 486). Bean and Metzner offer three criteria which must be considered to identify nontraditional students: place of residence, age, and enrollment status. Nontraditional students usually do not live in college owned housing and therefore must commute to classes. Since commuters spend much less time on campus they are less likely to be significantly impacted by the socializing agents on campus, including peers and instructors. Instead, the external environment has a greater influence on educational goals and behaviors. The second trait differentiating traditional and nontraditional students is age. Older students are typically further along in the maturation process and therefore their values and beliefs are often more stable and less susceptible to external influences. Older students are regularly more focused on obtaining specific skills which will lead directly to employment opportunities. The third characteristic identifying nontraditional students is part-time attendance. Older students are more likely to be employed, have families, or other obligations which restrict time for college. Enrolling in fewer classes diminishes the number of hours on campus and therefore the number of contacts with students and faculty. Based on these three criteria, Bean and Metzner (1985) offer the following definition of a nontraditional student:
A nontraditional student is older than 24, or does not live in a campus residence (e.g., is a commuter), or is a part-time student, or some combination of these three factors; is not greatly influenced by the social environment of the institution; and is chiefly concerned with the institution’s academic offerings (especially courses, certification, and degrees). (p. 489)

The most significant difference between Bean and Metzner’s model and traditional models of student attrition has to do with the role of the institutional environment as a socializing agent. Astin (1970a, 1970b), Spady (1970), Pascarella (1985), Tinto (1975, 1993), and Weidman (1989) all identify socialization as an integral component in college persistence. There is a large body of evidence to suggest the focus on social integration is appropriate for traditional college students; however nontraditional students interact with the college environment both less frequently and less intensely. As a result, Bean and Metzner deemphasize the affect of socialization on student persistence decisions and instead offer an enhanced focus on environmental variables and psychological outcome variables. It is important not to confuse psychological outcome variables, which are dependent measures, with the emphasis in my study of psychological or noncognitive variables used as independent measures. The central theme of my research is to understand the impact of the characteristics students possess, beyond their academic ability and demographics, which impact their success early in college. Psychological
outcomes such as satisfaction and utility are important and interesting, but not the focus of my research.

Like the traditional student success models offered by Astin, Pascarella, and Tinto, Bean and Metzner introduce background and defining variables early in the model. Important characteristics including age, enrollment status, and residence as well as educational goals, high school performance, ethnicity, and gender are all expected to affect the interaction between nontraditional students and the institution.

Bean and Metzner suggest that age is often not a major factor, though there tends to be a direct relationship between age and family responsibilities and hours of employment. Enrollment status is an important predictor of persistence, with part-time students much more likely to withdraw than full-time students. Enrollment status is also expected to be related to hours of employment and family responsibilities. Residence is the most important distinction between traditional and nontraditional students. Commuter students spend less time on campus than traditional students and therefore typically have less contact with faculty as well as with other students, both academically and socially. Nontraditional students are often more concerned about financing their education and acquiring skills which they perceive will improve their employment opportunities.

Numerous researchers have concluded high school academic performance as measured by high school grade point average and scores on standardized tests of academic ability are among the best predictors of
persistence in college. Another important set of variables include measures of educational goals such as the highest level of college education sought, the importance of earning a college degree, and the likelihood of completing a degree at the current institution.

For community college research the likelihood of completing a degree at the current institution is quite problematic. Many students choose not to remain at a community college to earn an Associate of Arts (AA) degree, but instead transfer to a four-year institution after some amount of time at the community college. To some students, the AA degree is sometimes seen as unnecessary in the pursuit of a Bachelor’s degree. Depending upon the major, the AA may have several additional course requirements which are not necessary for transferring to, and completing a Bachelor’s degree at, a four-year institution. Who could blame a student that foregoes an AA degree because of an additional twelve credits of coursework which will not count towards a Bachelor’s degree? Therefore, instead of measuring what Tinto identified as institutional commitment, community college researchers should consider strategies to measure degree commitment or motivation to accomplish one’s educational goals.

Most research Bean and Metzner utilized in the development of their model failed to report significantly different rates of retention based on ethnicity. Nevertheless, ethnicity is included in the model primarily because of anticipated indirect effects on GPA due to the poorer secondary education often provided for minority students. Like ethnicity, little empirical support for effects of gender on persistence of nontraditional students was available. Researchers studying
traditional populations often estimate attrition models separately for males and females because of different interactions between variables. Using traditional models as a guide and because of the prevalent gender-based roles in the external environment, gender is included in the model.

Bean and Metzner did not include parental education or family socioeconomic status (SES) as background variables in the model because of a lack of empirical support based on studies of nontraditional students at commuter institutions. Bean and Metzner (1985) reported "no study was located that investigated the effect of parents' educational level on the persistence of students who had been independent of their primary family for a substantial period" (p. 499). Using Bean and Metzner's definition, many students attending community colleges would be identified as nontraditional because of their living arrangements and enrollment status rather than age. As Bean and Metzner suggest, categorizing students as traditional or nontraditional is not a binary outcome, instead there may be degrees of “nontraditionalness.” It seems likely that traditional-aged students may be influenced by parental education and income in ways more like their counterparts attending four-year residential institutions than adult students returning to the community college. However, because of the incredible diversity exhibited in community college populations, variables measuring parental education and family SES will be included in the present study.

Guided by models of traditional student attrition, Bean and Metzner include several academic variables in their model including study habits and
skills, absenteeism, academic advising, and major certainty. Students with better study habits are less likely to withdrawal from college. Higher levels of absenteeism further reduce the interaction with faculty and students and may suggest less commitment to both the institution and to one’s educational goals. Further it seems reasonable to expect rates of absenteeism to be positively correlated to both hours of employment and level of family responsibility. Bean and Metzner found some evidence that both the use of academic advising as well as the perceived quality of advising was positively related to persistence in college. The relationship between advising and retention may be even more important at a community college because community college students are more likely to be first-generation college students and therefore less familiar with the expectations and requirements of an academic major. Bean and Metzner identified numerous findings which indicated major certainty was positively related to persistence. The concern for community college research is that persistence in college does not always equate to persistence at the institution. Higher levels of major certainty may in fact correlate to lower within-institution persistence rates because of clearly defined course requirements and articulation agreements. Bean and Metzner referred to this notion as opportunity to transfer. If a student is very certain of pursuing a major for which the community college has a well-defined articulation agreement with a four-year institution, the student will probably only remain at the community college as long as needed to accumulate the necessary coursework prior to transferring. Given the clarity of
the articulation path, this student may stay fewer semesters at the community college than a student with less concrete academic goals.

The most significant contribution Bean and Metzner’s model makes to the present study is with the increased emphasis on environmental variables when compared to the models of traditional student persistence. Because nontraditional students spend less time interacting with the institutional environment, their external environments likely exhibit a greater impact on the decision to persist in college. Both the ability to pay for college and hours of employment have been shown to impact persistence decisions. While limited off-campus work may have a positive impact on students, “most researchers agreed that employment in excess of 20-25 hours per week was negatively related to persistence” (Bean & Metzner, 1985, p. 503). Another key environmental variable is outside encouragement. Several studies indicated a positive relationship between the degree of parental encouragement to remain in college and college persistence. For adult students, outside encouragement from a spouse or significant other may be more influential. Additionally, encouragement from an employer can have a noteworthy impact. In addition to psychological support, employer encouragement may be exhibited by flexibility of work hours, tuition and textbook reimbursement policies, and promotion opportunities.

The final block of variables in Bean and Metzner’s model are identified as social integration variables. Social integration refers to the duration, frequency, and quality of student’s interaction with the social system of the institution (Bean
& Metzner, 1985). Both Tinto and Astin purport a high degree of social integration increases the likelihood that a student will remain enrolled at the institution. Typical measures of social integration include extent of participation in extracurricular activities, peer friendships on campus, contact with faculty outside of class, and student perception of the quality of these experiences. Global measures of overall satisfaction with the social opportunities at the institution and satisfaction with one's social life are other common assessments of social integration. Since most nontraditional students are on campus less time than traditional students, they will likely experience, and desire, fewer social interactions within the institutional environment and instead derive more of their social network from their external environment. For this reason, Bean and Metzner anticipate a minimal influence of social integration on nontraditional student persistence decisions.

The blocks of variables pertaining to background characteristics and academic variables are intended to be measured prior to students arriving on campus, or very shortly after their arrival. Tinto, Astin, and Bean and Metzner all agree that these pre-college characteristics have an influence on future college persistence decisions. The next two blocks of variables, environmental variables and social integration, include a combination of pre-college and in-college measures. The quality and quantity of outside encouragement and family responsibilities may be different once the student begins college than what was originally expected. All of the student success models considered in this literature review suggest both the pre-college and early in-college variables
influence both academic outcomes and psychological factors which in turn influence a student’s decision to persist in college. As Astin (1993) suggested, institutional influence take time to impact student behavior. Further, not all college environmental variables occur simultaneously, instead some factors may “cause” later environmental variables. For instance, the degree of participation in student organizations may influence the number of opportunities for students to “party” or to “tutor another student.” Therefore some environmental variables may be treated as intermediate outcomes.

Academic outcomes are most commonly measured by college GPA. There is significant research to suggest a positive relationship between first semester GPA and persistence in college (Bean & Metzner, 1985; Pascarella & Terenzini, 2005; Tinto, 1993). In their synthesis of recent student success research, Pascarella and Terenzini (2005) reinforced the significance of early academic achievement with their finding that “good grades in the first year being particularly important to subsequent academic success and degree completion” (p. 618). It is not clear what, if any difference GPA has on persistence decisions for nontraditional students when compared to traditional students. Bean and Metzner reported conflicting findings on the influence of GPA on persistence in a range of nontraditional students.

Psychological factors play a significant role in Bean and Metzner’s model. Aside from academic outcomes, measures of utility, goal commitment, satisfaction, stress, and intent to leave were found to significantly influence the persistence decisions of nontraditional students. Because nontraditional
students are frequently focused on the relationship between education and employment, their perceptions of the usefulness of a college education are expected to influence persistence. Goal commitment refers to the salience of earning a college degree. Students who view a college degree as important or valuable are more likely to persist than those who place less value on their education. Spady (1970), Pascarella and Chapman (1983), and Tinto (1975, 1993) reported a positive relationship between students’ prematriculation goal commitment and college persistence. Pascarella and Chapman (1983) found the influence to be stronger at community colleges than at a four-year residential or commuter institutions. As might be expected, intent to leave has a significant negative effect on persistence. Students who intend to leave, regardless of the reasons, are more likely to do so than students who expect to remain at the institution. Intent to leave is a common phenomenon in community colleges, and while it makes retention studies more difficult, it is not necessarily bad. Many students view a community college as a first step in the pursuit of a college degree. If transferring prior to degree completion is the student’s goal when they begin at the community college, then researchers must account for this in persistence studies. Just because a student leaves an institution does not mean the student failed to achieve their goals or is leaving higher education.

Bean and Metzner include stress and satisfaction as psychological factors, though student success literature typically does not adequately explore the source or result of stress and satisfaction levels. Sources of stress may include a lack of study habits, inadequate academic preparation for college subjects,
ability to pay for college, family or work responsibilities, transportation to college, a lack of time to devote to studies, and personal problems. Stress is inevitable. Instead of simply measuring the levels and sources of stress, researchers need to measure how students respond to stress. One way to accomplish this is by asking students how they dealt with stressful situations in their past. Students with clearly defined goals and effective strategies to manage stress should be expected to persist in college at higher levels than students with less-developed coping mechanisms. Higher levels of motivation, perseverance, and self-discipline are often indicative of student success. Further, students who possess higher levels of satisfaction with their education and with being a student should be more likely to persist in college.

Despite all indications of Bean and Metzner’s model as a good fit for community college student success research, few scholars have tested its effectiveness. Stahl & Pavel (1992) applied the model to a sample of nearly 600 urban community college students enrolled in beginning reading, English, and mathematics courses. The authors reported that the Bean and Metzner model was “an extremely weak fitting model” (Stahl & Pavel, 1992, p. 19) based upon their analysis of data using structural equation modeling. The researchers continued on to propose a community college retention model which “explain the data of this study more accurately” (Stahl & Pavel, 1992, p. 29). Interestingly the proposed model retained all the original variables introduced by Bean and Metzner except age, race/ethnicity, and gender because these attributes “cannot be changed by interaction with the college environment” (Stahl & Pavel, 1992, p.
Their factor analysis resulted in some difference in the association of variables, but overall the two models are quite similar. The goal of theory should not be to explain a particular set of data, but instead provide a framework which researchers can employ to build a body of evidence supporting the claims of the theory. The apparent dismissal of Bean and Metzner’s theory and subsequent proposal of a very similar, albeit rearranged theory seems misguided. Perhaps most unsettling was a data collection for a persistence study during the fourteenth week of the spring semester and then defining persistence as being enrolled at the institution the following fall semester. It seems relatively clear that the survey methodology resulted in significant truncation of variance within the sample, and therefore the findings are of minimal value in assessing Bean and Metzner’s model. If any conclusion can be drawn from this study, it seems that the data does offer modest support for Bean and Metzner’s model of nontraditional student attrition. Certainly additional research on community college students must be conducted before any assessment of the utility of Bean and Metzner’s can be made.

**Astin’s I-E-O Model**

Astin (1970a, 1970b) proposes the input-environment-outcome (I-E-O) model as a conceptual guide for studying the impact of college on students. “The basic purpose of the model is to assess the impact of various environmental experiences by determining whether students grow or change differently under varying environmental conditions” (Astin, 1993, p. 7). Inputs refer to student characteristics at the time of initial entry into the institution; environment
references the many institutional programs and policies, peers and faculty, and educational experiences to which students are exposed; and outcomes refers to student characteristics after exposure to the educational environment (Astin, 1993). Astin’s (1977) original model was detailed in his book *Four Critical Years* and subsequently updated with the publication of *What Matters in College?* in 1993. Both works benefited from extensive data collection by the CIRP freshman questionnaire. Initiated in 1966, the freshman questionnaire was designed “specifically to collect input data that would make it possible to apply the I-E-O model to a national study of student outcomes in American higher education” (Astin, 1993, p. 14). For Astin, the primary purpose of measuring input characteristics was to act as controls to minimize the bias of measuring environmental variables. One significant set of outcome measures was collected by CIRP with the completion of an extensive follow-up survey in 1989 to samples of students originally completing the freshman questionnaire in 1985. Retention information from colleges and universities as well as data obtained from national testing organizations including SAT and ACT test scores taken before students entered college, and Graduate Record Examination (GRE), Law School Admission Test (LSAT), Medical College Admission Test (MCAT), and National Teacher Examination (NTE) taken by the same students four years later completed the outcome measures.

Astin’s research does not directly address the central theme of the present study for several reasons. First, the research for both *Four Critical Years* and *What Matters in College?* focused primarily on experiences of recent high school
graduates attending college on a full-time basis. Astin himself suggested that
part-time and adult students are a worthy population to study, but since
environmental factors would likely influence adult and part-time students
differently than full-time traditional-age students, mixing these populations would
be ill-advised. Second, the input characteristics of the current population are
more challenging to measure because the institution requires very little
information to make admission decisions. A significant number of community
college students do not take standard college admission exams such as ACT or
SAT. Even if a student does have an ACT or SAT score, the institution may not
have a systematic approach to collect and record this information. Third, the
primary outcomes of the present study are persistence from the first to second
semester at the institution and in mathematics as well as success in the first
semester as measured by first semester GPA, percent of attempted credits that
are completed, posttest score, and successful completion of a developmental
mathematics course. Many of the outcomes Astin measured were of much
longer duration, including graduation from college and entrance into graduate or
professional programs or more complex constructs such as liberalism, feminism,
cultural awareness, and critical thinking.

Astin’s (1977, 1993) work highlights the problem of studying community
college students. When compared to students attending four-year institutions,
very little is known about community college students. The present study is an
attempt to address this information gap by measuring a subset of input
characteristics identified by Astin at a single two-year institution. Perhaps before
the I-E-O model can be effectively employed in a study of community college impact, we must identify the extent to which the input characteristics of community college students are similar to those of four-year college students.

Despite the lack of direct application of the I-E-O model to community college populations, Astin’s work identifies a number of input characteristics which should be accounted for in student success research. According to Astin, where possible input characteristics should be measured prior to or very soon after the student begins college. Astin (1993) identified three types of input items: pretests of outcome measures, self-predictions of future outcomes, and personal characteristics including age, race, academic preparation that may affect outcomes. For those input characteristics that do not lend themselves to pretesting, Astin (1993) recommends “obtaining student’s predictions or expectations with respect to the outcome measure in question” (p. 14). One of the major outcomes of the present study is persistence in college. Because there is no pre-test measure for persistence, I included several questions asking students to predict or anticipate the extent to which they would engage in a variety of academic, social, and work activities.

Researchers including Astin (1977) and Pascarella and Terenzini (1991) have shown student outcomes can be affected by a number of input characteristics besides cognitive pretests such as the ACT and SAT. Astin (1993) summarized the importance of measuring input characteristics with the following:
Since many of these input characteristics are also related to the kinds of environments to which students are exposed, the possibility remains that any observed correlation between an environment and an outcome measure may reflect the effect of some input characteristic rather than the effect of the college environment. In other words, our assessments of how outcomes are affected by environments will be biased unless we measure and control for as many student input characteristics as possible. (p. 13-14)

Using data from the 1989 CIRP follow-up questionnaire, Astin determined that self-reported expectations of future behaviors are valid measures of actual behaviors. Students were asked to indicate the likelihood certain events would occur in college. Response categories ranged from no chance to very good chance. In every case, the likelihood of the event actually occurring was higher than the predicted likelihood of occurrence. Furthermore, student expectations have “considerable predictive validity: for each event, the chance of its actual occurrence increases as the student’s estimated probability increases” (Astin, 1993, p. 168).

The fundamental issue in the current study is the extent to which different input characteristics change the prediction of outcomes related to success in developmental mathematics and persistence from the first to second semester at a community college. When studying the effects of input characteristics on student outcomes including college retention one cannot entirely dismiss the potential impact of the environment on outcomes. Consider the following
scenario: Three students enter the institution and enroll in Elementary Algebra during the first semester. One student drops out of the class after four weeks, a second student successfully completes the course but chooses not to remain at the institution the following semester, the third student successfully completes the course and persists to the second semester at the institution. While differences in entrance characteristics may explain some variation in the outcomes, it would be inappropriate to assume that all variation in the outcomes could be explained solely by differences in input traits. Certainly experiences with individuals, both peers and college personnel, as well as family support, degree of curricular and extracurricular involvement, the extent to which the institution meets the student’s academic and professional needs, and many other institutional or environmental factors will likely play a role in the ultimate decision to persist. Therefore a significant effort to control for environmental factors will be built into the current study. Unfortunately time and other logistical constraints make a follow-up data collection impossible, so controls for environmental variables will be limited to student predictions of academic, social, and work experiences.

Astin’s (1993) work highlighted the complexity of predicting college student retention by noting that thirty-three different student input characteristics had significant correlation coefficients in predicting degree completion. Consistent with several other research findings, Astin (1993) identified high school GPA and scores on college admission tests as the strongest individual predictors. Furthermore he identified numerous involvement variables which
positively impact retention. These variables include student-student and student-faculty interaction, hours per week spent socializing with friends, partying, talking with faculty outside of class, being a guest at a professor’s home, receiving vocational or career counseling, and giving presentations in class. All of the variables identified by Astin suggest a positive correlation between persistence in college and interaction with students, faculty, and academic work. Using Tinto’s (1975, 1993) language these same measures suggest the likelihood of retention increases with a high degree of integration into both the academic and social environments of the institution.

Since the 1970s much of the college student success research has been guided by the theories of Astin and Tinto. As a result nontraditional students have been both understudied and potentially misrepresented. The number of older and part-time college students has increased dramatically since 1970, yet researchers have been slow to turn their attention to studying this distinct population. According to Cohen and Brawer (2003) by the late 1990s the median age of a student attending a community college was twenty-three. Recall the median is not sensitive to outliers, so we can conclude that less than half of all students enrolled in a community college graduated from high school within the past five years. While the age of a typical community college student is increasing, the number of credit hours attempted is decreasing. In 1970, slightly more than half of community college students were full-time; by 1985 only one-third were full-time (Cohen & Brawer, 2003). The percent of full-time students has remained fairly constant since the mid-1980s.
Noncognitive Variables

The central theme of the literature reviewed so far is that the majority of research on student success considers a set of background variables along with measures of aptitude and previous academic experiences. Much of the existing literature heavily weighs the impact of in-college experiences on the success of individuals. The general consensus indicates standardized achievement tests such as the ACT and SAT are the best single predictor of college grades and retention, yet much variance remains unexplained (Larose, Robertson, Roy, & Legault, 1998; Mouw & Khanna, 1993; Schmitt et al., 2007; Ting, 1997; Ting & Robinson, 1998). Some studies have concluded test scores such as the ACT and SAT are either not effective or of limited value as predictors of academic success in college (Arbona & Novy, 1990; Sedlacek & Adams-Gaston, 1992). Other research suggests standardized measures of academic ability better predict grades and persistence for white students than for minority students (Arbona & Novy, 1990; Sedlacek, 2004; Tracey & Sedlacek, 1984, 1985, 1987). Several researchers suggest using both traditional and noncognitive predictors of college success and persistence to account for a greater amount of variance in student behavior (Abbott, 1994; Mouw & Khanna, 1993; Noonan, Sedlacek, & Veerasamy, 2005; Robbins et al., 2004; Robbins, Allen, Casillas, Peterson, & Le, 2006).

Sternberg (1985) identified three types of intelligence which all individuals possess. Componential intelligence is the ability to organize and interpret information in an ordered, unchanging context. Componential intelligence is
associated with traditional educational experiences. Students with high GPAs and those who perform well on standardized tests often have this type of intelligence. Experiential intelligence is the ability to interpret information in changing contexts. Experiential intelligence could also be interpreted as creativity. Finally, contextual intelligence is the ability to adapt to a changing environment. Experiential and contextual intelligence are typically not part of standardized tests, yet research indicates these alternative forms of demonstrating intelligence are perhaps more important and accurate when assessing the abilities and potential of nontraditional students.

Mouw and Khanna (1993) reviewed 36 studies that identified 65 models purporting to predict first-semester or first-year academic success, most often defined by student GPA. Models were categorized as using high school performance indicators, entrance exams, or personal characteristics including numerous measures of noncognitive variables. One-third of the models used only entrance exams to make predictions while one-quarter only used high school performance measures. Another 14 models used a combination of high school performance and entrance exams. Eight models made exclusive use of personal characteristics and the final five models used some other combination of measures. Mouw and Khanna (1993) commented “models using personal characteristics as predictors were too few and too sporadic to characterize” (p. 332). In their conclusion, Mouw and Khanna declared while academic success does require some minimum set of academic skills, “willingness is, quite probably, at least half of the battle” (p. 334). It seems evident at least prior to the
early 1990’s that very few, if any studies considered the possibility of enhancing models to predict academic success with noncognitive variables.

Because Astin and Tinto based their theories of student persistence largely on the extent to which students become integrated into the college environment, most studies of student success include measures of both attributes students possess prior to beginning college and experiences students gain while in college. However on community college campuses it seems student persistence is “more a function of academic than social integration” (Pascarella & Terenzini, 2005, p. 395). Thus it seems appropriate to follow the suggestion of Bean and Metzner and conduct a study without an emphasis on in-college environmental measures. The research seems relatively clear that precollege student attributes have a significant effect on student success and persistence. First generation students are less likely to persist than students who have at least one parent with some college education (Pascarella & Terenzini, 2005). There is a direct correlation between family SES and college persistence. Adult students are less likely to persist than younger students, largely due to non-academic factors such as child care, job constraints and other family obligations.

Scholars must explore mechanisms to improve and tailor the existing models to community college students for at least two critical reasons. First the existing models fail to adequately capture student behaviors and attitudes which undoubtedly contribute to student success. Second, the existing models are a poor fit for students who do not attend four-year residential institutions, do not attend college full-time, are not of traditional college age, do work a significant
number of hours per week off campus, and are from a racial or ethnic minority. Nearly all community college students fit into several of the categories for which the existing models are ill-equipped to address.

Several student success studies employed noncognitive measures in addition to or instead of environmental and other in-college measures. The majority of these studies suggested the inclusion of noncognitive variables increased the validity of student persistence models as compared to traditional models only measuring academic and aptitude factors. Pascarella and Terenzini (1991) suggested that aside from academic ability and intelligence, “grades at the individual level are significantly influenced by such factors as personal motivation, organization, study habits, and quality of effort” (p. 388). As such, grades not only reflect academic ability but also suggest quality work habits and attitudes. It may be more important to measure noncognitive variables for student populations that differ in significant ways from those for which the traditional models of student success were initially developed.

A substantial body of literature exists on the psychological factors which influence success. The theories of this literature are wide-reaching in name, scope, application, and influence in the research community. Conceptual confusion occurs when defining college success and its determinants. A good example is the long-standing tradition within the educational literature of referring to noncognitive predictors as “anything but standardized academic achievement and aptitude tests and school-based academic performance” (Robbins et al., 2004, p. 261). Psychosocial, non-intellectual, and noncognitive are all names
used in the literature to describe individual attributes not included in traditional measures of academic achievement and aptitude which may affect college success and persistence decisions. A large number of studies exist which have examined many diverse groups of students at different educational levels using a wide array of noncognitive variables. Included in the studies were variables measuring adjustment, motivation, and student perceptions (Sedlacek, 2004; Tracey & Sedlacek, 1984, 1985, 1987), psychological, cultural, and social aspects of an individual (Ting, 1997), an individual's background and life history (Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004), interests, background experiences, and motivational characteristics (Schmitt et al., 2007), perception of certain beliefs, emotional reactions, and behaviors in learning situations (Larose & Roy, 1995) and sense of identity (Lounsbury, Huffstetler, Leong, & Gibson, 2005). Measures of constructs including motivation, self-esteem, identity, attitudes and life experiences were common in these studies. Many of these theories lack an instrument to measure the identified constructs or the instrument has not been widely applied to higher education. Therefore these theories are useful in identifying constructs which may be particularly salient in the study of community college student success, but are not appropriate for enhancing and extending the existing student success models to more diverse populations. Oswald et al. (2004) developed a model using twelve dimensions of student performance that universities valued and claimed to be developing in students. These dimensions included knowledge and mastery of general principles, continuous learning and intellectual interest and curiosity, artistic and cultural
appreciation, appreciation for diversity, leadership, interpersonal skills, social responsibility and citizenship, physical and psychological health, career orientation, adaptability and life skills, perseverance, and ethics and integrity. Shivpuri, Schmitt, Oswald, and Kim (2006) then narrowed the twelve noncognitive variables studied by Oswald et al. (2004) down to the five most relevant measures they felt were predictive of academic growth in college over time. The variables used included knowledge and mastery of general principles, continuous learning, perseverance, adaptability, and interpersonal skills. Data were collected from a sample of 537 students at a single university. Results indicated students’ cognitive ability as well as skill in gaining knowledge and mastery of general principles predicted their initial success. Continuous learning and adaptability were effective predictors of the rate of academic growth over time.

Schmitt et al. (2007) recognized the potential for noncognitive variables which measure interests, background experiences, and motivational characteristics to increase the validity of traditional cognitive measures including college admissions tests and high school GPA. Using the noncognitive instruments developed by Oswald et al. (2004), Schmitt et al. (2007) completed a study of university students using a large sample drawn from institutions across the United States to provide geographical and racial diversity. Their results indicated career orientation was significantly negatively correlated with first-year college GPA while the other ten noncognitive variables had a significant positive correlation with first-year college GPA. Noncognitive variables proved to be
more predictive than traditional measures of high school GPA and ACT and SAT scores when considering various outcomes related to student retention.

The studies conducted by Oswald et al. (2004), Shivpuri et al. (2006) and Schmitt et al. (2007) provide an example of potential positive influence noncognitive variables can have on the understanding of college student success. The findings suggest further research with noncognitive variables has merit. My study is centered on measuring noncognitive variables at the beginning of the college experience whereas many of the variables analyzed by these research teams clearly measure the impact the college experience has on students.

In a study of high school seniors throughout the Canadian province of Quebec, Ratelle, Larose, Guay, and Senécal (2005) considered the affect of parental involvement and parental autonomy support on science achievement and persistence. Parental involvement refers to spending time with the child, being interested and attentive to the child, and providing emotional resources. Parental autonomy support includes acknowledging the child’s perspective, encouraging independent thinking, and allowing the child to make choices. Results indicated both parental involvement and parental autonomy support were positively correlated with science achievement. Student perception of parental autonomy support was positively associated with persistence in science through at least the first year of college. This finding indicates that parental involvement should be considered as a potential influence on student success and warrants further research. The extent to which perceived parental support impacts student
success for older students is unclear. To have the greatest impact on nontraditional student populations it may be important to reconceptualize parental support as generalized support from an individual holding a prominent role in the student’s life.

Larose and Roy (1995) developed the Test of Reactions and Adaptation in College (TRAC) to measure students’ perception of certain beliefs, emotional reactions, and behaviors in learning situations. TRAC measured nine noncognitive traits including examination anxiety, fear of failure, examination preparation, quality of attention, assistance from peers, giving priority to studies, seeking help from teacher, belief in effective work methods, and belief in easiness. Results from the TRAC predicted student academic achievement during the first semester of college. Larose et al. (1998) employed the TRAC with a sample including first-year students from a French-speaking college in Quebec and high-risk students enrolled in a special learning center at an American college. Key findings included the enhanced predictability of college success when noncognitive variables were included in the models. That is, noncognitive variables added a unique and significant contribution to college success prediction above and beyond a student’s academic and intellectual disposition. Moreover this study demonstrated the utility of noncognitive variables with both low-risk and high-risk populations and with both French and English speaking students.

Robbins et al. (2004) conducted a meta-analysis of studies including at least one noncognitive measure and a college success outcome (either GPA or
After reviewing 109 studies, the researchers determined the best predictors of academic success as measured by cumulative GPA were academic self-confidence and achievement motivation. Further, the meta-analysis suggested relationships between retention and academic goals, academic self-efficacy, and academic-related skills. This conclusion provides additional support for Bean and Eaton’s (2000) recommendation to include initial self-efficacy and motivation in a psychological model of student success. My study includes a broad conceptualization of student goals and a realistic evaluation of one’s self-confidence and self-efficacy as related to academic ability. Robbins et al. (2006) utilized the Student Readiness Inventory (SRI) to measure motivational, skill, social engagement, and self-regulatory constructs. The ten different scales measure academic discipline, academic self-confidence, commitment to college, communication skills, emotional control, general determination, goal striving, social activity, social connection, and study skills. A total of 14,464 first-year students from 48 two-year and four-year institutions in 42 states took part in this study which tried to identify significant predictors of first-semester and first-year grades as well as retention. The sample was sufficiently large for analyses at two-year and four-year institutions to be completed separately. The results indicate a low to moderate, but significant, relationship between academic discipline, commitment to college, academic self-confidence, and general determination and student performance outcomes. After accounting for standardized achievement scores and institutional effects, the strongest predictors of first-year GPA were academic discipline and general determination.
SRI scales offered incremental prediction for first-semester and first-year GPA at both two-year and four-year institutions. Logistic regression results for retention after the first year show the SRI scales of commitment to college, social connection, and academic discipline to be the major predictors at four-year institutions. Commitment to college and academic discipline proved to be the major predictors of retention at two-year institutions. Consistent with Bean and Metzner’s (1985) argument for minimizing the role of environmental influence when studying nontraditional student success, the results of this nationally-representative study indicate that social connection was a significant predictor of first-year GPA at four-year institutions but not at two-year institutions. The researchers noted that overall SRI scales appeared to have stronger relationships with retention at two-year institutions, once again reinforcing the need for noncognitive variables with diverse student populations. Even though the correlation between the SRI and student retention was higher at two-year institutions, less variance was accounted for by the model for two-year institutions as compared to four-year institutions. This finding suggests that student populations at two-year and four-year institutions may be significantly different and therefore it is necessary to develop specific models of student success for each population.

Several other researchers have included a range of other noncognitive variables in studies of college student persistence including short-range planning and time management skills (Britton & Tesser, 1991); giving priority to college studies (Larose & Roy, 1995); the tendency to believe learning is an intrinsic
ability, knowledge is discrete and certain, and learning is a relatively linear process that should be accomplished easily (Schommer, 1993); perseverance in completing projects and meeting deadlines (Shivpuri et al., 2006); and the ability to adapt to a new college environment (Fuertes & Sedlacek, 1994; Larose et al., 1998). Research has shown family support, particularly parental involvement, can offer assistance in “helping young adults to successfully adapt to college or university by buffering the negative effects of transition” (Ratelle et al., 2005, p. 286). While these results provide guidance to my study, no single perspective provides a comprehensive set of noncognitive constructs, along with a validated instrument, which come close to matching up with the constructs put forth by Bean and Eaton (2000).

Sedlacek (1977) recognized that many minority students did not have equal access to higher education because traditional admission criteria including standardized tests and high school grades were less predictive of academic aptitude and ability of black students than white students. As a result, Tracey and Sedlacek (1984, 1985, 1987) identified a set of noncognitive constructs which research indicated were related to student success and persistence in college. The original form of the Noncognitive Questionaire (NCQ) contained two nominal items on educational expectations, eighteen Likert-type items regarding college expectations and self-assessment, and three open-ended questions to collect information about goals, previous accomplishments, and group membership and leadership (Tracey & Sedlacek, 1984). Using a variety of diverse student samples, Tracey and Sedlacek refined their model and
instrument by adding an additional 38 Likert-type statements in an effort to improve reliability and validity (Tracey & Sedlacek, 1987). Eventually they settled on a model including eight constructs measuring different noncognitive variables their work indicated were correlated with student success. The variables in the current model are positive self concept, realistic self-appraisal, successfully handling the system, preference for long-term goals, availability of strong support person, leadership experience, community involvement, and knowledge acquired in a field. Sedlacek (2004) recently published his book Beyond the Big Test: Noncognitive Assessment in Higher Education which provides easier access to two decades of valuable research. Included in the book are three versions of the NCQ, each of which gather self-reported measures on the extent to which individuals possess characteristics associated with the eight noncognitive variables Tracey and Sedlacek identified.

Tracey and Sedlacek’s (1984, 1985, 1987) extensive work with noncognitive variables along with the recent enhancements by Sedlacek (2004) offer several advantages over the other psychologically-oriented theories reviewed. First, this theory is robust. The eight identified constructs encompass a diverse set of characteristics numerous researchers have reported are meaningful in measuring the success and persistence of college students. Second, the original intent of the NCQ was to measure skills associated with college success in a more equitable fashion for nontraditional student groups. Researchers have employed the NCQ with nontraditional groups as defined by race (Arbona & Novy, 1990; Chung & Sedlacek, 1999; Fuertes & Sedlacek,
1994; Ting & Robinson, 1998; Ting, 2000; Tracey & Sedlacek, 1984, 1985, 1987, 1989), international students (Boyer & Sedlacek, 1988), at-risk students (Ting, 1997, 1998; White & Sedlacek, 1986), gender (Ancis & Sedlacek, 1997), student-athlete (Sedlacek & Adams-Gaston, 1992), and community college students (Noonan et al., 2005). Third, this theory is focused directly on student success as opposed to the impact of college on students. In order for college to make a significant impact on students, they must experience some degree of success in college, particularly early in college. This is perhaps even more critical for nontraditional students. Fourth, the instrument has been tested, revised, and retested. The NCQ has been used in many different settings and has been shown to be a reliable and valid instrument. Fifth, the variables measured by the NCQ map closely to the constructs identified by Bean and Eaton (2000). Recall Bean and Eaton advocated for enhancement of student success models by including measures of psychologically-oriented variables. What Bean and Eaton did not provide was a mechanism by which to measure the constructs they identified. In this study, I evaluate the extent to which Tracey and Sedlacek’s NCQ fulfills the need for an instrument to measure psychological variables and therefore extend and enhance current student success models. Furthermore the NCQ was developed to more precisely measure skills and attributes of nontraditional students; a perfect fit for enhancing Bean and Metzner’s (1985) model of nontraditional student attrition.

Over the past two decades the NCQ has been used to predict the academic achievement of numerous nontraditional student groups. Sedlacek
(2003) defined nontraditional students as those “who have not received a white, middle-class or upper-middle-class, heterosexual, Eurocentric experience as their base socialization prior to application to higher education” (p. 265).

Sedlacek (1994) established two criteria used to identify nontraditional groups: (1) whether the group is a target of prejudicial attitudes by others and (2) if the NCQ systematically correlates more with the success of members of a given group than it does for traditional white men. While race/ethnicity is clearly the focus of Sedlacek’s definition of nontraditional, it does not exclude the NCQ from use with other nontraditional student groups. My study postulates that community college students differ from traditional four-year college students in many significant ways. Racial and ethnic minorities are more likely to attend community colleges as are students from lower income-level families. The basis for Bean and Metzner’s (1985) model is that traditional success models are ill-equipped to effectively predict student success with nontraditional populations. Bean and Metzner include psychological outcomes in their model, but do not consider measuring psychological constructs as inputs to the model. My research extends Bean and Metzner’s model by including noncognitive variables as input variables. Moreover the focus of this study is to assess the effectiveness of psychological constructs as early indicators of student success. Hopefully the results of this research will assist in the creation of early warning policies whereby community college personnel can intervene before a student experiences serious, negative academic consequences.
Composition of the NCQ

This section of the literature review provides a context for each construct in the NCQ. Several of the variables originate from motivational theories. When applicable, I examine the historical origins and uses of the variables. After a construct is described, I review the literature employing each variable in student success research. Particular attention is given to outcomes related to grades and student persistence, two commonly measured dependent variables in student success research.

Expectancy-value theory provides a solid grounding for several of the constructs included in the NCQ. Expectancies are “people’s beliefs and judgments about their capabilities to perform a task successfully” whereas values refer to “the beliefs students have about the reasons they might engage in a task” (Schunk, Pintrich, & Meece, 2008, p. 44). Student success is dependent on both expectancies and values. Students who expect to do well but do not find value in a task are less likely to engage in it. Similarly, students may identify an activity of interest or importance, but unless they feel reasonably confident they can perform well, they will not engage in it. Two cognitive theories with significant influence on expectancy-value theories are Lewin’s level of aspiration and Atkinson’s achievement motivation.

Lewin (1935) proposed that decision-making processes could be understood by considering both expectancy and value components. Level of aspiration is described as “the goal or standard that individuals set for themselves in a task, based on past experience and familiarity with the task”
Lewin had three research findings with implications for college student success. First, participants felt more successful meeting their own goals than an objective goal set by someone else. Second, an individual's future level of aspiration was directly correlated with prior experience with the task. Prior success typically led to increases in level of aspiration, while failure generally lowered the level of aspiration. Third, the research indicated that individual and group differences exist in level of aspiration. Individuals with higher levels of ability tended to set higher levels of aspiration than those lower in ability.

Atkinson (1957, 1964) proposed behavior was a function of three components: motives, probability for success, and incentive value. Motives included "learned but stable and enduring individual differences or dispositions and included two basic achievement motives: to seek success and to fear failure" (Schunk et al., 2008, p. 46). Probability for success, much like Lewin's expectancy construct, is the individual's subjective belief about the likelihood of success on a task. Incentive value measures the sense of accomplishment or value in completing a task. Atkinson hypothesized and later empirically confirmed that achievement motivation is highest with tasks of intermediate difficulty. If the task is simple, the probability for success is high but the resulting sense of accomplishment would be relatively low. If the task is extremely challenging, the likelihood for success is quite low but, if successful, the sense of accomplishment would be very high. With the basic motives of seeking success and fearing failure in mind, individuals are less likely to partake in either of these
later situations since the easy task would lead to little sense of success and the challenging task presents a high likelihood of failure.

Another important motivational theory central to both Tracey and Sedlacek’s noncognitive variables and Bean and Eaton’s psychological input variables is attribution theory. Attribution theory makes two general assumptions. First, individuals are motivated by a goal of understanding and mastering their environment and themselves. Second, people try to understand the causal determinants of the behaviors of themselves and others (Schunk et al., 2008; Weiner, 1986). At the heart of attribution theory is the struggle to understand the causes of behavior. The causes for a particular behavior are preceded by environmental and personal factors. Attribution theory further identifies three dimensions of the perceived causes for behavior: stability, locus, and control. Stability refers to how stable the attribution is over time. A stable attribute would likely remain consistent even when a student moves from one institution to another, as in graduation from high school and enrolling in college, or as applied to a variety of subjects such as mathematics and history. An unstable attribute is more likely to change depending upon the situation or circumstances. Locus refers to causes being either internal or external to the individual. Rotter (1966) stated that individuals with an internal locus believe there is a significant relationship between their behavior and outcomes. Individuals with an external locus perceive the lack of a strong correlation between their behavior and outcomes. Finally control refers to whether or not an individual has control of the
causes for a behavior. The three causal dimensions directly influence expectancies for success, self-efficacy, and actual behaviors.

Expectancy-value theory and attribution theory collectively lead to a better understanding of student success. Attribution theory suggests that an individual’s prior interaction with their educational environments as well as the influence of personal characteristics impact the perceived causes for a behavior. The extent to which individual perceptions of causes are stable, internally or externally oriented, and controllable determines the level of aspiration and individual self-efficacy students have for themselves on particular tasks. In addition, level of aspiration must be preceded by positive experiences and a belief system which values the task. These expectancies and values directly impact the level of achievement and success in college.

Expectancy-value theory and attribution theory provide a clear rationale for measuring personal beliefs and values as well as environmental perceptions at the beginning of college. Because student behaviors and values are directly impacted by previous experiences as well as individual traits, we must measure these attributes early in the college experience and determine the impact these perceptions have on student success. The first semester of college is crucial for student success. Previous experiences, values, and beliefs will play a significant role in the level of success students attain in college, but we must also recognize the potential for engaging in and experiencing success. Entering college perhaps offers the greatest opportunity to shed negative experiences and behaviors in favor of more positive ones. Only by assessing the incoming
attributes of students and determining those with the greatest impact on student success can we inform college personnel of those attributes most in need of management and modification.

Four of Tracey and Sedlacek’s eight constructs assessed by the NCQ can be directly credited to expectancy-value theory and attribution theory. Positive self-concept is constructed to “assess the applicant’s confidence, self-esteem, independence, and determination” (Sedlacek, 2004, p. 50). A student’s self-concept will positively impact the level of aspiration. Level of aspiration is predictive of the amount and quality of effort put forth. Students with higher levels of self-concept likely perceive their probability of success to be high. They may be less fearful of failure and instead accept failure as an inevitable part of the learning process. High levels of confidence and self-esteem are particularly important for students to possess as they begin college. There are many new experiences and challenges as students prepare for, and begin college. A strong self-concept is important for all students to possess, though “it becomes even more so for those with nontraditional experiences because of the added complexity of dealing with a system that was not designed for them” (Sedlacek, 2004, p. 39). Without some willingness to risk failure, the potential for growth and success are substantially limited. At the same time, students must have a realistic understanding of their own abilities. Recognizing and accepting one’s strengths and deficiencies is crucial for success in college. This self-awareness plays a significant role in determining one’s level of aspiration and the value placed on achieving goals. Tracey and Sedlacek include realistic self-appraisal
in the NCQ to assess the student’s “ability to recognize and accept his or her strengths and deficiencies, especially in academics, and works hard at self-development to broaden his or her individuality” (Sedlacek, 2004, p. 50).

A third construct in the NCQ which draws from expectancy-value theory and attribution theory is successfully handling the system. Sedlacek (2004) included this variable to assess the student’s “ability to understand the role of ‘the system’ in life and to develop a method of assessing the cultural or racial demands of the system and respond accordingly/assertively” (p. 51). Bean and Eaton encourage the inclusion of coping strategies in a psychological model. They define coping as “a wide-ranging form of adaptive behavior used to deal with all stressful situations” (Braxton, 2000, p. 51). Both Tracey and Sedlacek and Bean and Eaton identify the need to carefully consider student experiences and behaviors in the face of adversity. Examining situations where students faced challenges in their life can provide clues to the student’s ability to persevere and achieve under less-than-ideal conditions. These experiences can help expose student’s value systems and their willingness to establish, maintain, and aspire to meet goals.

A related construct in the NCQ measures a student’s preference for long-term goals. “This variable assesses the applicant’s persistence, patience, long-term planning, and willingness to defer gratification and success in college” (Sedlacek, 2004, p. 52). According to attribution theory, the extent to which an individual values completing a task and gains a sense of accomplishment after achieving a self-determined goal is preceded by environmental and personal
factors. Furthermore, valuing task completion is a strong indicator of the level of aspiration and degree of effort an individual will put forth to reach their goal.

Bean and Eaton encourage measurement of student expectancies and values with the constructs of personality, initial self-efficacy, and initial attributions. Self-concept and self-efficacy are similar constructs. Self-efficacy and self-concept both refer to an individual’s “judgments of their capabilities” however self-efficacy takes a “more specific and situational view of perceived competence” (Schunk et al., 2008, p. 139). Furthermore Bandura (1986) defined self-efficacy to include the organizing and execution of courses of action needed to attain certain goal-specific outcomes. A high level of self-efficacy requires a student not only to have a generally positive self-concept about one’s ability in school, but also to possess knowledge of specific skills necessary to be successful in school.

Three other constructs in the NCQ, leadership experience, community involvement, and availability of a strong support person, are all related to an individual’s ability to interact with and relate to others. Similarly, Bean and Eaton include normative beliefs in their psychological model of student success. Sharing a common purpose with others can facilitate individual goal formation and allow students to experience the rewards and sense of accomplishment that come with success. Working with others, particularly in a leadership capacity, can also teach compassion, understanding, and perseverance. These experiences impact student’s values, beliefs and attitudes which, according to
theory, help shape future behaviors. Therefore it is appropriate to probe these constructs for evidence of support for student success.

**Empirical Support for the NCQ**

Several studies using the NCQ have identified a significant relationship between a student’s positive self-concept and their grades in college as well as the likelihood to persist in college. Tracey and Sedlacek (1984, 1985, 1987) found positive self-concept positively correlated to grades in college for both black and white students. Positive self-concept was found to have a significant positive correlation with early college grades in a study of student-athletes (Sedlacek & Adams-Gaston, 1992) and community college health science students (Noonan et al., 2005). Fuertes and Sedlacek (1994) found a positive correlation between positive self-concept and cumulative GPA in each of the first three years of college in a study of Asian American university students. Boyer and Sedlacek (1988) found a significant positive correlation between cumulative GPA and positive self-concept in a study of international students during each of the eight semesters they examined. White and Sedlacek (1986) found positive self-concept to significantly contribute to predicting student GPA in the second and fourth semesters in a study of specially admitted university students. Positive self-concept was also significantly correlated to persistence in college for black and white students (Tracey & Sedlacek, 1984, 1985, 1987), Asian American students (Fuertes & Sedlacek, 1994), international students (Boyer & Sedlacek, 1988) and at-risk students admitted to a university (White & Sedlacek, 1986).
House (1995a) investigated the predictive relationship of measures of academic self-concept on achievement in an introductory college chemistry course. He found that student self-ratings of overall academic ability, drive to achieve, mathematical ability, self-confidence in intellectual ability, and expectation of graduating with honors were all positively correlated with the course grade students earned.

Tracey and Sedlacek (1984, 1985) found realistic self-appraisal to be positively correlated with GPA throughout the college experience for both black and white students. The same researchers found realistic self-appraisal to be predictive of persistence in college for black and white students (Tracey & Sedlacek, 1985, 1987). Ancis and Sedlacek (1997) found a significant positive correlation between realistic self-appraisal and cumulative GPA in university studies of women throughout their college career. Boyer and Sedlack (1988) reported realistic self-appraisal was significantly correlated to persistence throughout college for a population of international students.

Even more valuable results for my study are the many studies which indicate a strong positive relationship between realistic self-appraisal and student persistence and GPA very early in college. Realistic self-appraisal was positively correlated with student success in a study of Asian American students in each of the first three years of college (Fuertes & Sedlacek, 1994); first-year Asian American students (Ting, 2000); international students during the first year of college (Boyer & Sedlacek, 1988); and student-athletes (Sedlacek & Adams-Gaston, 1992). Ting and Robinson (1998) found a significant positive correlation
between realistic self-appraisal and first semester GPA for all students at one university. Noonan et al. (2005) found a positive correlation between realistic self-appraisal and early GPA in a study of community college health science students. Collectively these results suggest that all students, but especially students of color and women, are more likely to succeed in school if they are able to realistically evaluate their abilities. It is important to notice that only one study reported findings from a community college population, and that was from a very specialized program. My study assesses the relationship between realistic self-appraisal and student success of a much more diverse set of community college students.

The constructs of positive self-concept and realistic self-appraisal show the strongest relationship to student success over a wide range of students at various institution types. This should not come as a surprise since these two constructs are most closely associated with attribution and expectancy-value theory.

A third construct drawing from attribution and expectancy-value theories is successfully handling the system which includes simple ideas such as following directions on college application materials as well as more complex issues including racism or sexism. Students who understand and are prepared to deal with these types of discrimination are more likely to persist and be successful in college (Sedlacek, 2004). Several studies determined the ability to navigate the system positively impacted grades and persistence in a number of college student populations including white students (Tracey & Sedlacek, 1984); black
students (Tracey & Sedlacek, 1985); Asian American students (Fuertes & Sedlacek, 1994); international students (Boyer & Sedlacek, 1988); specially admitted students (White & Sedlacek, 1986); and community college health science students (Noonan et al., 2005).

Preference for long-term goals assesses a student’s “persistence, patience, long-term planning, and willingness to defer gratification and success in college” (Sedlacek, 2004, p. 52). Students with a preference for long-term goals are more likely to be successful in college because they show a willingness to exert a significant amount of effort over an extended period before reaching the desired sense of accomplishment. The willingness to delay gratification may suggest a student’s level of aspiration and perceived probability of success are relatively high. Students with a high fear of failure would be less likely to put forth effort to achieve satisfaction. Because nontraditional students often take longer to adjust to a college environment and likely have fewer role models to help them understand the relationship between current efforts and future outcomes, the existence of goals is perhaps more important in predicting nontraditional student outcomes. Long-term goals are often indicative of high aspirations and more concrete plans (Sedlacek, 2004).

The preference for long-range goals was significantly correlated to GPA in studies of black and white students in the first two years of college (Tracey & Sedlacek, 1984, 1985); specially admitted white university students (Ting, 1997); first-generation students from low-income families (Ting, 1998); and community college health science students (Noonan et al., 2005). Ting and Robinson (1998)
found a significant positive correlation between preference for long-term goals and first semester GPA for all university students. Researchers also identified a positive relationship between the preference for long-range goals and early college persistence in a variety of nontraditional populations including black students (Tracey & Sedlacek, 1985, 1987); specially admitted white university students (Ting, 1997); and international students (Boyer & Sedlacek, 1988).

Availability of a strong support person “assesses the applicant’s having a strong support network, help, and encouragement, and the degree to which the applicant relies solely on her or his own resources” (Sedlacek, 2004, p. 52). The availability of a strong support person to provide advice as well as comfort and direction is important for the success of students in college. Students who have identified an individual to turn to for help in difficult circumstances are more likely to persist. Bean and Eaton identified coping behaviors as an important construct to include in a student success model. Because humans are social beings, it is important to be able to call upon a caring individual for support during a difficult or stressful situation. Building relationships with compassionate individuals is perhaps even more important for first generation college students since their families and close friends are less likely to be familiar with the college experience.

Researchers found the availability of a strong support person to be positively correlated with first semester grades in a study of student-athletes (Sedlacek & Adams-Gaston, 1992); specially admitted white students (Ting, 1997); first-generation students from low-income families (Ting, 1998); and all
university students (Ting & Robinson, 1998). The availability of a strong support person also positively influenced persistence in a study of black students (Tracey & Sedlacek, 1984, 1985); specially admitted university students (White & Sedlacek, 1986); and Asian American university students (Fuertes & Sedlacek, 1994). The benefits of having a strong support person still exist later in college. White and Sedlacek (1986) found the availability of a strong support person significantly contributed to predicting student GPA in the fourth semester in a study of specially admitted university students while Ancis and Sedlacek (1997) reported a similar relationship for university women at the end of their academic careers. Boyer and Sedlacek (1988) found a positive correlation for both grades and persistence throughout the college experience in a study of international students. Noonan et al. (2005) found the availability of a strong support person to be positively correlated with GPA and cumulative GPA in a study of community college health science students.

Sedlacek (2004) also suggested leadership experience and community involvement positively impact college success. Leadership experience in both formal and informal organizations offers a student the opportunity to establish and work towards goals deemed important by a group. Community involvement assesses “the applicant’s identification with a cultural, geographic, or racial group and his or her demonstrated activity within that community grouping” (p. 53). Particularly for nontraditional students, community is often based on racial, cultural, or gender issues, which can provide support vital to academic success (Sedlacek, 2004). These relationships can help a student navigate the system
as well as provide a support network. Bean and Metzner (1985) suggest that nontraditional students are less likely to be influenced by the academic and social environments of the institution. Instead, involvement in one’s community is more likely to provide leadership experiences and a support network. The relationships and experiences students have within their community contribute significantly to the formation of beliefs and values. Assessing community involvement and leadership experience serves as a reasonable proxy for Bean and Eaton’s (2000) normative beliefs construct.

Research has shown leadership in formal or informal groups to be positively correlated with student success for all students (Ting & Robinson, 1998) and white students (Tracey & Sedlacek, 1984, 1985) as well as a variety of nontraditional and underrepresented college student populations including black students (Tracey & Sedlacek, 1987); Asian American students (Fuertes & Sedlacek, 1994; Ting, 2000); international students (Boyer & Sedlacek, 1988); female university students (Ancis & Sedlacek, 1997); community college health science students (Noonan et al., 2005); specially admitted university students (Ting, 1997; White & Sedlacek, 1986); and first-generation students from low-income families (Ting, 1998).

Community involvement was positively correlated with college grades and persistence for both black and white students (Ting & Robinson, 1998; Tracey & Sedlacek, 1984, 1985, 1987a); women (Ancis & Sedlacek, 1997); first-semester student-athletes (Sedlacek & Adams-Gaston, 1992); Asian American university students (Fuertes & Sedlacek, 1994; Ting, 2000); and specially admitted white
university students (Ting, 1997). First-generation students from low-income families who reported being active in their community earned higher college grades (Ting, 1998). Boyer and Sedlacek (1988) found international students were more likely to persistence in college if they were involved in their community. Noonan et al. (2005) found community involvement to be the most significant predictor of semester GPA and cumulative GPA in a study of community college health science students.

Dewey (1913) suggested the individual and environment interact to raise interest in particular activities. Thorndike (1935) stressed that learning is affected by an individual’s interests and the value placed on the task. One way to foster a desire to learn certain tasks is by gaining experience in an area of interest through volunteer or part-time job opportunities. Participation in extra-curricular activities related to academic subjects such as debate or an engineering club are additional occasions for the environment and individual to interact and increase interest. Tracey and Sedlacek include a construct to measure the knowledge acquired in the field to assess the student’s “experiences gained in a field through study and beyond the classroom. It pays particular attention to how the applicant gains nontraditional, perhaps culturally or racially based, views of the field” (Sedlacek, 2004, p. 54). Acquiring knowledge in a field increases the likelihood of success in college. Often this is accomplished by holding a part-time job, volunteering, or participation in extra-curricular activities related to formal academic subjects. These nontraditional educational experiences allow students to discover new information in a comfortable, perhaps unexpected way.
that will enhance their formal learning. Experiences which allow students to apply their learning help increase motivation and signify movement towards completion of long-term goals.

Research indicates a positive relationship between knowledge of a field and student success. Awareness of the relationship between academics and an interest area positively influenced first semester grades of specially admitted white students (Ting, 1997); first-generation students from low-income families (Ting, 1998); and all university students (Ting & Robinson, 1998). Noonan et al. (2005) reported similar findings in a study of community college health science students. The relationship between knowledge in a field and student success persisted throughout the college experience with multiple college student populations including women (Ancis & Sedlacek, 1997); international students (Boyer & Sedlacek, 1988); Asian American university students (Fuertes & Sedlacek, 1994); and black and white students (Tracey & Sedlacek, 1985).

Arbona and Novy (1990) studied the predictive power of the NCQ for black, Mexican American, and white students at a predominantly white southern university. Their results suggested the noncognitive variables were not predictive of grades or persistence for black students or Mexican American students but did correlate significantly to white student success in the first year of college. Rather than question the utility of the NCQ with diverse student populations, these findings serve as a reminder of the necessity for a diligent data collection process. I have several methodological concerns with this study which may account for the lack of significant findings among minority groups. Arbona and
Novy’s (1990) study included only 95 black students and 96 Mexican Americans; a smaller sample than many other studies with significant findings. Second, data were collected from students attending summer orientation as well as via mail after fall registration for those students who did not attend orientation. Likely the students attending orientation differed in several key attributes from those who did not attend. No data is provided regarding the racial composition of the students who did not attend summer orientation and thus received the questionnaire by mail. The researchers reported mailing out 816 questionnaires but only receiving 123 back, resulting in a 15% response rate. The researchers offered no details of a follow-up survey and it appears they failed to conduct a missing data analysis to assess the return rate by race as compared to the composition of the original mail-survey sample. Finally, the researchers did not attempt to control for any precollege characteristics such as academic achievement or high school coursework. It is possible that the NCQ did in fact identify key attributes indicative of success, but because several confounding variables were unaccounted for, the differences did not reach statistical significance. Rather than consider this study a contradictory finding, future research should bear in mind the need to control for as many independent measures as possible and use caution in developing and carrying out strategies for data collection.

The research detailed in this section clearly illustrates the potential value of noncognitive variables as indicators of student success. Tracey and Sedlacek derive the constructs included in the NCQ from well-documented and researched
theories of motivation. The resulting theory is robust in coverage of potential domains which can impact student success, however one glaring omission remains. Neither Tracey and Sedlacek nor any of the researchers employing the NCQ account for prior academic aptitude of students in a meaningful way. Because other individual traits such as academic ability are not measured and controlled for, the findings of these researchers are potentially biased. Research has documented the ability of the NCQ to identify attributes beyond those measured in traditional theories which impact student success. Furthermore, the NCQ includes constructs which reasonably measure the constructs recommended by Bean and Eaton (2000) to improve upon Tinto’s student success model.

**Application of Noncognitive Variables in Community Colleges and Mathematics**

Researchers are beginning to recognize the need to study community college students. Unfortunately many community college student persistence studies are designed using only the college success models developed by Tinto and Astin and often do not employ noncognitive variables. Both Tinto and Astin assert that the environment has a significant impact on persistence decisions yet most community college students are not residential students and therefore are impacted less by environmental variables. Additionally these models have not been found to be particularly predictive of nontraditional student behaviors. Amey and Long (1998) applied Astin’s I-E-O model to a sample of community college students and found significant differences in successful and unsuccessful
underprepared students. The study indicated successful underprepared students were more likely to begin developmental coursework in the first semester and were more likely to be enrolled full-time than unsuccessful underprepared students. By assessing noncognitive variables, the authors may have been better able to identify the root causes of the extent to which students were successful. Knowing what helps students be successful should be a central goal of all student success research. Noncognitive variables will help identify and clarify the key traits students possess which make an immediate impact on success.

Noonan et al. (2005) employed the NCQ in a study of community college health science students. The study indicated a modest but significant correlation between scores for each construct in the NCQ and course grades. The authors failed to collect placement scores or other measures of academic preparedness and therefore were unable to control for any prior academic ability.

A large amount of research exists on college students in mathematics courses, yet the vast majority of existing research fails to include a set of noncognitive variables as independent measures. The majority of student success research in developmental mathematics is focused on four-year institutions and frequently the primary outcomes are graduation rates of college-ready mathematics students as compared to developmental mathematics students (see Hagedorn et al., 1999). Umoh and Eddy (1994) conducted a study of community college developmental mathematics students using Tinto’s (1993) conceptual framework. The study failed to identify any significant relationships
between success in developmental mathematics and student characteristics, academic integration, or commitment to graduation. This is a perfect example of the misfit between population and theory that Braxton et al. (1997) identified. Bean and Eaton’s (2000) recommendation of a psychological model of student attrition would be a much more appropriate model for this population.

Recently Bahr (2007, 2008, 2010) has conducted multiple studies on developmental mathematics students in the California community college system. Consistent with prior research, Bahr’s findings illustrate key differences between community college students and their four-year college counterparts, particularly in terms of remedial needs. Furthermore his findings underscore the importance of mathematics remediation for community college student success. Bahr (2007) determined that the depth of mathematics remediation was more closely related to student success than was the breadth of remedial need. Level of English competency did diminish the likelihood of completing a college-level mathematics course for students who required relatively little mathematics remediation, however students with significant levels of mathematics remediation were equally unlikely to complete a college-level mathematics course regardless of their level of English competency. In other words the initial level of mathematics placement was more important, in terms of predicting student success, than the number of subjects for which a student needed remediation. Bahr (2008) also determined that students who did successfully remediate in mathematics enjoyed success rates equivalent to those who did not need remediation in mathematics, however the majority of students who started
mathematics remediation never completed it successfully. Overall Bahr (2008) found that three-quarters of remedial math students do not remediate successfully. Of those who do not complete mathematics remediation 81.5% did not earn a credential from the community college and did not transfer.

Bahr’s (2007, 2008, 2010) work fills a crucial gap in the community college and student success literature; however it differs from this study in several key characteristics. First, Bahr’s primary dependent variables include completion of remedial mathematics and earning a credential from the community college or transferring to a four-year institution. The majority of independent variables can be categorized as traditional success indicators including age, race/ethnicity, gender, SES, and amount of grants received. Academic goals, use of advising, and performance in first math course were also included. These are similar to some of the noncognitive variables included in this study. Perhaps the most useful conclusion from Bahr’s work is that when mathematics remediation works, it works very well, however all too often students do not successfully complete mathematics remediation. For these noncompleters, the data suggests little chance of success in college. These findings further amplify the need to increase successful mathematics remediation.

Relatively few studies include attitudinal, experiential, or other noncognitive variables as predictor variables in models (House, 1995b). House (1995b) found noncognitive variables to be significant predictors of university student grades in college mathematics. Stage and Kloosterman (1995) suggested beliefs have a significant impact on behavior. Behaviors, particularly
those related to attending class and putting in time and effort to learn mathematical concepts, undoubtedly impact student success in mathematics coursework. The ideas of Stage and Kloosterman are similar to Bandura’s (1977) self-efficacy construct. Self-efficacy is a predictor of both the quality and quantity of effort displayed by the individual as well as the degree of persistence likely exhibited by the individual related to a task. Mathematics self-efficacy is a “situational or problem-specific assessment of an individual’s confidence in her or his ability to successfully perform or accomplish a particular task or problem” (Hackett & Betz, 1989, p. 262). Results of one study suggest a moderately strong positive correlation between mathematics self-efficacy and performance in a mathematics course (Hackett & Betz, 1989).

Grimes and David (1999) collected data from 500 degree-seeking students entering a Florida community college using the CIRP. The CIRP includes many noncognitive variables, focused on experiential and attitudinal constructs including degree aspirations, goals and values, self ratings of abilities, previous activities, and student opinions. Additionally placement test scores for reading, English, and mathematics were collected. Analysis of the CIRP, placement data, and other institutional measures including enrollment data, GPA, and graduation suggested that underprepared and college-ready students differed significantly by ethnicity, types of high school coursework, high school GPA, degree aspirations, reasons for attending college, ability ratings, prior activities, goals and values, opinions, and academic performance and persistence. One major concern regarding this study is the seemingly low
requirements to be classified as college-ready. Students who attained the statewide cutoff scores in both reading and English and had a pre-algebra or higher mathematics placement were deemed college-ready. Pre-algebra placement is not suggestive of being ready for college-level mathematics. Most research I encountered during this literature review identified pre-algebra, elementary algebra, and often intermediate algebra as developmental. College algebra is the first course or placement commonly identified as college-ready.

Only one study was identified that employed noncognitive variables to a study of mathematics with a community college student population. The study focused on student attitudes towards mathematics in college algebra. The results suggested besides prior mathematics achievement, self-concept in mathematics was a significant predictor of student grades (Wheat et al., 1991). Additional research is necessary to identify those noncognitive variables which offer the greatest insight into future student success.

Summary of Literature Review

Community college students deserve equal attention from higher education scholars yet just a handful of studies including community college student data are among the more than twenty-five hundred reports cited by Pascarella and Terenzini in their volume How College Affects Students (1991). NCES reported 42.9% of all students enrolled in post-secondary education attend a community college (NCES, 2008b). Bahr (2007, 2008) found that successful mathematics remediation was crucial for credential attainment at the community college or transfer to a four-year institution. Understanding and
improving the success of these students is essential. The traditional models of student success were developed primarily for use at four-year residential institutions and therefore are useful in community college research only to the extent that the student populations are similar. Several researchers including Bean and Metzner, Bean and Eaton, and Tracey and Sedlacek offer compelling research which suggests nontraditional student success is influenced by different variables and with different levels of influence than traditional students. The student body of American community colleges is the most diverse in higher education. Community colleges serve large numbers of adult students, part-time students, first-time students, and racial and ethnic minorities. And yet, there are a huge number of full-time, recent high school graduates – very much like those starting at four-year institutions – who elect to begin their college career at a community college. The range of academic abilities, educational goals, goal commitment, family SES, and a host of other measures shown to relate to student success are wider than at other institutional types. While many students at community colleges do satisfy the definition of nontraditional offered by Bean and Metzner (1985) or Tracey and Sedlacek (1984), it is important to remember that students cannot simply be categorized as traditional or nontraditional; instead degrees of nontraditionality exist. The purpose of my research is to enhance and extend existing student success models to better fit community college students. My emphasis is on developing an integrated model of community college student success particularly salient for use early in the first semester. I have accomplished this by modifying the models put forth by Tinto
(1975, 1993) and Astin (1993) based upon the recommendations of Bean and Metzner (1985) and Bean and Eaton (2000). The centerpiece of my model is the addition of an extensive set of noncognitive constructs which research has shown uniquely contributes to the understanding of student success, particularly for nontraditional students. Developmental mathematics is an appropriate venue to begin studying community college student success. Mathematics is the area with the greatest need for remediation. Virtually every student attending college must complete a mathematics requirement. By identifying key characteristics necessary for success early in college, this study has the potential to influence institutional policy decisions to positively impact huge numbers of students.

The central tenet of Tinto’s (1975, 1993) theory is student success in college is primarily dependent upon the interaction between the student and the college academic and social environment. In a review of the literature testing Tinto’s theory, Braxton et al. (1997) identified several propositions receiving little empirical support. There were glaring concerns when empirical evidence specific to community colleges is considered. The majority of propositions either had not been tested in a community college setting or received weak or inconclusive support. Braxton et al. concluded that researchers should consider substantially revising Tinto’s theory to more accurately model college student success. Numerous authors responded to Braxton et al.’s critique with their own recommendations for extending and enhancing Tinto’s model. Bean and Eaton (2000) presented one promising perspective for extending Tinto’s model. Bean and Eaton argued that student success, particularly student persistence, is
behaviorally driven and individual attitudes, values, and beliefs precede behavior. Therefore to better understand individual behaviors pertaining to student success, a model should focus on understanding the variables which impact the antecedents of behavior.

Like Tinto, Astin (1977, 1993) places considerable emphasis on the interaction between the individual and the social and academic environment of the institution. Because the central focus of his work was to identify the environmental impact an institution has on the student, Astin concentrated on measuring a robust set of precollege attributes to use as controls. These include pretests of outcome measures, self-predictions of future outcomes, and personal characteristics including age, race, and academic preparation. For those input characteristics that do not lend themselves to pretesting, Astin recommends “obtaining student’s predictions or expectations with respect to the outcome measure in question” (Astin, 1993, p. 14). Astin determined self-reported expectations of future behaviors are valid measures of actual behaviors. Students were asked to indicate the likelihood certain events would occur in college and found in every case the likelihood of the event actually occurring was higher than the predicted likelihood of occurrence. Further student expectations have “considerable predictive validity: for each event, the chance of its actual occurrence increases as the student’s estimated probability increases” (Astin, 1993, p. 168). Astin’s work provides a good theoretical basis for measuring precollege attributes, far more robust than those employed by Tinto.
Like Tinto, Astin’s research primarily targets full-time traditional-aged students attending four-year institutions. Astin acknowledged that part-time and adult students are a worthy population to study, but since environmental factors would likely influence adult and part-time students differently than full-time traditional-age students, mixing these populations would be ill-advised. Many of the outcomes Astin studied were of much longer duration, including graduation from college and entrance into graduate or professional programs or more complex constructs such as liberalism, feminism, cultural awareness, and critical thinking. Studying community college student success necessitates a shorter duration for the research effort since many students intend to remain at the institution two years or less, and graduation from the community college is not necessarily the final educational goal. My emphasis is to identify key attributes which impact student success in the first semester of college. An understanding of what initially effects student success is an obvious precursor to identifying attributes which impact later student success. What value is there in knowing the influences of student behaviors late in college if half of the students fail to persist past their first year?

Bean and Metzner’s (1985) model of nontraditional student attrition provides a crucial theoretical framework for my study. Similar to Tinto and Astin, this model includes background traits and measures of academic preparation as core components of a success model. The key difference that results from a focus on nontraditional students is the minimization of the socializing impact the institution has on students and instead increasing the relative importance of
external influences. Because nontraditional students are often older, enrolled in fewer classes, and live off campus, the academic and social environments of the institution are less likely to have a significant impact on student success. To account for this loss of institutional influence, Bean and Metzner offer an enhanced set of external environmental variables including employment, family responsibilities, and sources of encouragement. Bean and Eaton (2000) offer a compelling argument for the inclusion of psychological input variables in an enhanced student success model. Their recommendation seems particularly relevant when the intended audience is community college students. Combining the ideas of Bean and Metzner (1985) with Bean and Eaton (2000), it seems apparent that a model of nontraditional student success should include a comprehensive set of noncognitive input variables and such a model would be appropriate for studying community college students. The primary shortcoming of Bean and Eaton’s work is the lack of a reliable instrument to assess the noncognitive variables.

Tracey and Sedlacek (1984, 1985, 1987) and Sedlacek (2004) designed and validated the NCQ, an instrument used to assess a set of noncognitive variables which map reasonably well to the constructs identified by Bean and Eaton. The NCQ was originally designed to assess nontraditional student abilities in an effort to minimize admission biases which often result when standardized tests are the primary basis by which students are assessed. Although there has been limited use of the NCQ with community college
populations, there is considerable empirical evidence which shows the NCQ correlates with success in a variety of nontraditional student populations.

My study contributes to the sparse body of community college student success literature by enhancing Tinto’s theory of student attrition through the use of psychological input variables as recommended by Bean and Eaton (2000). Tracey and Sedlacek’s (1984, 1985, 1987) NCQ was used to assess the noncognitive variables. Assessments of pre-college aptitude, demographics, and family variables occurred very early in the first semester of college. Following Astin’s (1993) guidance, variables that do not have a reasonable pretest measure were initially assessed by asking students to anticipate their behaviors through a number of survey items. Furthermore, as directed by Bean and Metzner (1985), the impact of social integration via interaction with the institution is minimized in favor of influences by the external environment. The switch from internal to external environmental influence seems particularly appropriate for community college student success research given the large number of students who do not live on campus, are beyond the traditional age of college students, and/or attend college part-time.
CHAPTER 3: METHODOLOGY

Introduction

Compared to four-year institutions, community colleges collect relatively little information about their students. Furthermore, community college students are exceptionally diverse and often decide very late to attend a community college; sometimes only a few days before classes begin. This combination of a diverse student body and very little background information makes identifying and helping students in need very challenging. The purpose of this study is to identify pre-college behaviors and attributes which impact student success and persistence early in college. It is important to better understand what factors, both cognitive and noncognitive, impact a student’s early success in college before the environment has an opportunity to affect the student. Particularly salient and important potential policy-related outcomes for this study include better advising strategies for incoming students and the development of an early warning system to identify students at-risk of dropping out early – within the first semester.

This chapter includes a presentation and explanation of the study design, sample, and data analysis techniques employed to determine the extent to which noncognitive variables increased the understanding of student success in community college developmental mathematics. The data sources, survey items, and associated independent and dependent variables are discussed. Finally linear regression or logistic regression equations are presented for each research question.
Survey Design

A survey is a “systematic method for gathering information from (a sample of) entities for the purposes of constructing quantitative descriptors of the attributes of the larger population of which the entities are members” (Groves et al., 2004, p. 2). The quantitative descriptors, or statistics, allow for both descriptive and analytical analyses of the sample. There are several advantages to using a survey instrument for this study. One is the ability to reach a large number of students and collect data from each subject quickly and inexpensively. Optical scanners make surveys more efficient because data entry is done electronically, thus providing for quicker results and less potential for errors related to scoring and data manipulation. The quantitative nature of survey data allows for merging of records from multiple sources. This study also provides the opportunity to examine the validity of the NCQ for a community college sample.

I used several strategies recommended by quantitative methodologists (e.g., Dillman, 2000; Groves et al., 2004; Schumacher & McMillan, 2001) to minimize errors in my data collection. Students completed the survey during class time within the first three weeks of the semester. Hopefully administering the survey during class time highlighted the importance of this research to students and also improved the response rate. To minimize experimenter effects, I personally administered the survey when possible. When I was unable to personally administer the survey, I provided a detailed script to the instructor explaining the purpose of the instrument and the process for completing the survey.
Population and Sample

The target population of this research is first-time college students taking Elementary Algebra, a developmental mathematics course, at a large public Iowa community college serving a mixture of rural and urban constituents. The majority of students enrolled in Elementary Algebra either intend to earn an AA degree or transfer to a four-year institution; both of which require a college-level mathematics course. There are only a few technical programs in which students can satisfy the mathematics requirement by successfully completing Elementary Algebra. Therefore successful students can reasonably be expected to persist in mathematics at the institution.

Elementary Algebra has the largest enrollment of all developmental mathematics course offered at the study institution and also enrolls the most first-time students. In the fall 2009 semester, a total of 1119 students enrolled in Elementary Algebra, 584 (52.2%) of whom were first-time college students.

There are four formats for students to choose from when registering for Elementary Algebra: traditional, traditional-at-a-distance, correspondence-packet, and correspondence-online. The traditional option consists of meeting one, two, or three times per week for a total of three hours of class time. These sections are typically limited to 30-35 students and have a single instructor who is responsible for all instruction and assessment.

Traditional-at-a-distance classes are offered via a live audio and video broadcast of each class session. Typically a group of students is with the instructor at the origination site and there are multiple remote sites. These
sections often reach 50 students, though several sites may only have a few students. Each remote site has a proctor responsible for overseeing exams and administration of other assessments. Materials are distributed via a college courier service.

The correspondence-packet format is conducted through the mail. Students receive a guidebook at the beginning of the semester which includes a timeline for completing the course and all necessary assignments. Students complete the paper-and-pencil assignments and mail them to the instructor. The instructor grades the work and returns the assignment. Students are required to take exams in a proctored testing environment. Contact with the instructor is almost exclusively over the telephone or email.

Correspondence-online uses an online course management system to provide students with an electronic textbook, view video clips and animations of examples, and homework and quiz assignments. The time and location for completing work is flexible as all the materials are available via the internet. Students complete a set of online homework assignments and take either online or proctored exams depending on the instructor. Instructor contact is often limited to email or telephone.

The primary purpose of this study is to understand student attributes and behaviors which increase the likelihood of success in the first semester of attendance at a community college; more specifically the pre-college experiences, behaviors, attitudes, beliefs, and values which positively impact success in Elementary Algebra. Since generalizability of the findings to a
population is of secondary importance, convenience sampling is an acceptable choice for conducting this research (McMillan & Schumacher, 2001). All students registered for Elementary Algebra in the fall semester in a format including a traditional lecture-style component were eligible for inclusion in the study. The predominant reason for this decision is access to students. The two correspondence formats have limited direct student-instructor contact, and never in a group setting. Each correspondence format would require a unique data collection procedure significantly different than the one employed for the formats including a traditional lecture component. Not only would multiple survey formats significantly complicate the study, but it would likely introduce additional measurement error (Dillman, 2000). Further, in fall 2009 only 149 of 1119 (13.3%) Elementary Algebra students were enrolled in either the correspondence-packet or correspondence-online formats. Additionally only 44 of the 149 (29.5%) correspondence students were first-time college students.

I contacted each faculty member teaching Elementary Algebra in the traditional or traditional at-a-distance format to explain the purpose of my research and to solicit permission to use one class session during the first three weeks of the semester to administer the survey. I received access to all sections of the course and administered the survey to a total of 967 students, 496 of whom indicated they were first-time college students.

For inclusion in the sample for this study, students had to meet the following criteria: (1) be first-time community college students; (2) be enrolled in a section of Elementary Algebra with a face-to-face component in the fall 2009
semester; (3) complete the Elementary Algebra Student Success Survey (EASSS); and (4) complete the two Mathematics department pretests. A total of 434 students satisfied all four of these criteria. The application of listwise deletion resulted in an analytical sample of n=385 students. This full sample is used to estimate models and generate findings to answer four of the six research questions for the study. Two smaller samples used for analyses related to the remaining two research questions are derived from this analytical sample.

Instrumentation

Data were collected from students three separate times during the fall 2009 semester. Two data collections, a self-administered survey and two departmental pretests were completed during the first three weeks of the fall 2009 semester. The third data collection occurred at the end of the fall semester when students completed the departmental final exam.

Astin (1993) recommends measuring input characteristics prior to, or very soon after, the student begins college. Furthermore, for those input characteristics that do not lend themselves to pretesting, he recommends “obtaining student’s predictions or expectations with respect to the outcome measure in question” (Astin, 1993, p. 14). Because the central focus of this study is to identify key pre-college attributes which impact student success early in college, I measured a wide variety of input characteristics very early in the student’s college experience. The primary instrument used to collect data from participants was the self-administered Elementary Algebra Student Success Survey (EASSS) composed of items from three sources: Tracey and Sedlacek’s
(1984, 1985, 1987) noncognitive variables; anticipatory questions based upon CIRP follow-up survey items (Astin, 1993); and demographic characteristics.

One significant component of the EASSS is Tracey and Sedlacek’s eight constructs which measure attributes associated with college persistence and college success that are independent of academic ability. There is a significant body of evidence which suggests individual noncognitive attributes may increase the likelihood of success in college. To determine the extent to which noncognitive variables are associated with developmental mathematics success and persistence at a community college, participants in the study completed the entire Alternate Form B: Noncognitive Questionnaire (NCQ-B) supplied in Appendix 4 of Sedlacek’s *Beyond the Big Test: Noncognitive Assessment in Higher Education*. I selected Alternate Form B because the questions fit better with a community college population. For example, Form B is the only form with “Associate’s degree” as an option to the question “How much education do you expect to get during your lifetime?” Furthermore, Form B is the only form which does not use “university” in the statements for students to rate their agreement with.

With the exception of the three open-ended questions, the survey is formatted so data collection can be done via optical scanner. The NCQ-B includes one question to collect the amount of education each individual expects to obtain during their lifetime. Another question asks about the most likely cause of leaving the institution before completing a program. There are thirty one statements asking students to indicate the extent to which they agree with each
using a five-point Likert scale. Examples of the statements include: “Once I start something, I finish it,” “My friends look at me to make decisions,” and “I enjoy working with others.” Scores range from 1 – “strongly agree” to 5 – “strongly disagree.”

The survey also includes three open-ended questions. The first question asks students to “Please list three goals that you have for yourself right now.” This response is scored twice; once for the Preference for Long Range Goals construct and a second time to measure Knowledge Acquired in a Field. “Please list three things that you are proud of having done” is scored for the Self Concept construct. The third question, “Please list groups belong to (formal or informal) and offices held (if any) in your high school or community” is scored three times: for Leadership Experience, Demonstrated Community Service, and Knowledge Acquired in a Field. The responses to each of the three open-ended questions were hand-scored using a rubric established by Sedlacek. The scoring rubric for the NCQ-B results in a continuous measure for each of the eight constructs assessed using the three open-ended questions. Complete scoring details for the NCQ-B – including the rubrics established by Sedlacek for scoring the open-ended items – are provided in Appendix B. A copy of the NCQ-B survey is also provided in Appendix A.

Tracey and Sedlacek (1984) reported all items from the NCQ have two-week test-retest correlations from .70 to .94, with a median of .85. Confirmatory factor analyses on the NCQ have determined the adequate construct validity of the NCQ (Arbona & Novy, 1990; Tracey & Sedlacek, 1984, 1989). Interrater
reliabilities for the three open-ended questions were reported between $r = .83$ and $r = 1.00$ (Tracey & Sedlacek, 1984).

A second key component in the EASSS is a set of anticipatory questions whereby students are asked to predict the extent to which they will partake in a variety of academic, social, and work-related activities. The items are derived from some of the 57 environmental measures of student involvement used in a large follow-up study conducted by CIRP (Astin, 1993). It was necessary to rewrite the items to ask students to predict their likely behaviors instead of report actual behaviors.

The third component of the EASSS is a set of items I wrote to collect other background and demographic characteristics from students either recommended by traditional college impact models (e.g., Astin, 1970a, 1970b; Pascarella, 1985; Tinto, 1975, 1993) or identified as important characteristics for nontraditional student success models (Bean & Eaton, 2000; Bean & Metzner, 1985).

Placement into Elementary Algebra occurs through a variety of pathways. Presently there is no stated prerequisite for Elementary Algebra and placement into the course is often a result of not satisfying placement requirements for a more advanced course. All prerequisites in mathematics courses above the level of Elementary Algebra are enforced. Students are required to either take the necessary prerequisite course (Elementary Algebra) or exhibit competency equivalent to Elementary Algebra by either an ACT score or Compass placement score less than two years old. Advisors and other college personnel encourage new students to either provide an ACT score or take the placement exam in
order to be appropriately placed in the mathematics curriculum. The existing policy provides incentive for students to do so since the highest level students can place themselves into without placement data on file is Elementary Algebra. Without question, some students self-select into Elementary Algebra based on their perceived mathematics ability and therefore find little value in providing a placement measure. Unfortunately ACT scores were available for less than one-third of students and only about 82% of my prospective sample had a Compass score on file. Therefore, using either ACT or Compass as a measure of prior academic or math ability proved too costly in terms of lost sample size. I did include an item about the academic advising sources used when students registered for courses. Fortunately, students’ scores on two mathematics pretests were available as measures of pre-college academic math ability.

The two mathematics pretests, administered during the first week of the semester, constituted the second significant data collection. The mathematics department requires instructors in every section of Elementary Algebra with a face-to-face component to administer the two mathematics pretests within the first week of the semester. The pretest format includes thirty multiple choice questions: fifteen questions represent the prealgebra pretest and fifteen questions represent the elementary algebra pretest. Each prealgebra question has five answer choices, only one of which is correct. Since these questions address prerequisite knowledge, students are expected to score relatively high on the prealgebra portion of the pretest. The remaining fifteen questions address material central to the Elementary Algebra course. Each of these questions has
four answer choices of which one is correct. The fifth answer category is "I have no idea" and students are encouraged to use this answer choice rather than guess. The prealgebra pretest is provided in Appendix D and the elementary algebra pretest is provided in Appendix E. It is important to keep in mind that students are not forewarned about the pretests. In the directions students are advised that the purpose of the pretests are to measure their knowledge before starting Elementary Algebra as well as to further ensure students are placed in the correct course. Instructors score the pretests and return the results to students in the next class session. In doing so, instructors are able to make contact with students they deem ill-prepared for the course and students have an opportunity to switch courses within the first week of the semester. There are no mandatory advising guidelines which instructors must follow upon returning the two pretest scores to students. Some instructors use the opportunity to meet with students with marginal results or with very high scores while others simply report the scores to students and then turn the pretests into the department. Over the last five years, mean scores have consistently been about 9 out of 15 on the prealgebra pretest and 5.5 out of 15 on the elementary algebra pretest. The prealgebra and elementary algebra pretests were collected for every student and used as independent variables measuring previous mathematical abilities. Because of the unavailability of Compass and ACT scores for sufficient numbers of students, the two pretest variables are the only non-self reported measures of prior mathematics achievement and ability used in my study.
The third instrument used in this study is a posttest written by the mathematics department and administered to all Elementary Algebra students during final exam week. This exam is composed of 32 multiple choice questions covering the central concepts in the course. Each question has five answer choices, one of which is correct. The number of questions correctly answered on the posttest was used as one of my six dependent variables. A copy of the posttest is provided in Appendix F.

The fourth source of data for this study is institutional records. Demographic information such as student age, gender, race, and transfer credits (as evidence of prior college experience), was collected from the institution and compared to the survey responses. Collecting and comparing data from the EASSS and institutional records minimizes missing data and also improves the accuracy of data. When discrepancies occurred between EASSS and institutional data, I used institutional data. Institutional records were also used to determine family income and the amount and source of financial aid. I also collected the following fall 2009 enrollment information for each student in the sample: the number of attempted credit hours, student grades for each course, and semester GPA. Additionally I collected whether or not each student attempted any credits at the institution for the spring 2010 semester and if so, whether or not they registered for a mathematics course.

Variables

The survey items used to measure the key constructs in this study come from three primary sources: Sedlacek’s (2004) NCQ-B; Astin’s (1993) discussion
of environmental variables from CIRP follow-up surveys of college student engagement; and items I constructed to measure demographic and background characteristics. Items from all three sources are combined in a single survey, the EASSS (see Appendix G), that was administered to all participating students. Other data was collected from institutional and departmental sources. The source of each variable is identified in Table 1.

Independent Variables

Each of the five blocks of independent variables used in this study are presented and described in detail in this section. The first block of variables is student demographic characteristics (see Table 1). Age is a continuous variable ranging from 16 to 59. The remaining five variables use standard dichotomous coding: females are compared to males (Female); students with a family income of $50,000 or more are compared to students with a family income less than $50,000 (FamIncomeHigh); students with a disability are compared to those who do not have a disability (HaveDisability); minority students (African American, Asian American, Hispanic, or Multi-racial) are compared to white and other students (Minority); students with at least one parent with some college experience are compared to students with neither parent ever attending college (ParentEducBinary).

The second block of variables is related to college planning. Three dichotomous variables identify the type of advising sources used in preparing and registering for one’s first semester of courses. AdvisorCnslrTchr compares students who received advising from a high school teacher/counselor, special
Table 1
Independent Variables, Variable Type, Coding, and Data Source

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Coding</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1: Demographics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Continuous</td>
<td>[16, 59]</td>
<td>EASSS, Institution</td>
</tr>
<tr>
<td>FamIncomeHigh</td>
<td>Binary</td>
<td>0 = Less than $50,000; 1 = $50000 or more</td>
<td>EASSS, Institution</td>
</tr>
<tr>
<td>Female</td>
<td>Binary</td>
<td>0 = Male; 1 = Female</td>
<td>EASSS, Institution</td>
</tr>
<tr>
<td>HaveDisability</td>
<td>Binary</td>
<td>0 = No; 1 = Yes</td>
<td>EASSS</td>
</tr>
<tr>
<td>Minority</td>
<td>Binary</td>
<td>0 = White or Other; 1 = African American, Asian American, Hispanic, or Multiple Races selected</td>
<td>EASSS, Institution</td>
</tr>
<tr>
<td>ParentEducBinary</td>
<td>Binary</td>
<td>0 = No college for either parent; 1 = Some college for at least one parent</td>
<td>EASSS</td>
</tr>
<tr>
<td>Block 2: College Plans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AdvisorCnsIRtchr</td>
<td>Binary</td>
<td>0 = Didn’t seek advising from High school or Special education teacher or Veteran, Vocational, or Rehabilitation counselor; 1 = Did seek advising from at least one of these sources</td>
<td>EASSS</td>
</tr>
<tr>
<td>AdvisorCollege</td>
<td>Binary</td>
<td>0 = Didn’t seek advising from College staff or website; 1 = Did seek advising from at least one of these sources</td>
<td>EASSS</td>
</tr>
<tr>
<td>AdvisorPersonal</td>
<td>Binary</td>
<td>0 = Didn’t seek advising from friends or family; 1 = Did seek advising from friends or family</td>
<td>EASSS</td>
</tr>
<tr>
<td>CertainGoal</td>
<td>Continuous</td>
<td>0 = Not at all Certain; 1 = Somewhat certain; 2 = Pretty certain; 3 = Very certain</td>
<td>EASSS</td>
</tr>
<tr>
<td>F09_Cr_Attempt</td>
<td>Continuous</td>
<td>[0, 17]</td>
<td>Institution</td>
</tr>
<tr>
<td>F09TotalGrantSchlrship</td>
<td>Continuous</td>
<td>[0, 6.88] (thousands of dollars)</td>
<td>Institution</td>
</tr>
<tr>
<td>F09TotalLoan</td>
<td>Continuous</td>
<td>[0, 5.73] (thousands of dollars)</td>
<td>Institution</td>
</tr>
<tr>
<td>PrimEdGoal_DegreeRelated</td>
<td>Binary</td>
<td>0 = Not clearly related to degree attainment; 1 = Clearly related to degree attainment</td>
<td>EASSS</td>
</tr>
</tbody>
</table>
Table 1 (continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>WorkOffCmpsBinary</td>
<td>Binary</td>
<td>0 = Did not anticipate working off campus; 1 = Anticipate working off campus</td>
<td>EASSS</td>
</tr>
<tr>
<td>Block 3: Prior Mathematics Achievement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HighMathBinary</td>
<td>Binary</td>
<td>0 = Highest course completed in high school was Prealgebra, Elementary Algebra, Basic Math, or Algebra I; 1 = Highest course completed in high school was Geometry, Discrete Math, Algebra II, Statistics, Trigonometry, or Calculus</td>
<td>EASSS</td>
</tr>
<tr>
<td>PreTestElemAlg</td>
<td>Continuous</td>
<td>[0,15]</td>
<td>Math department</td>
</tr>
<tr>
<td>PreTestPreAlg</td>
<td>Continuous</td>
<td>[0,15]</td>
<td>Math department</td>
</tr>
<tr>
<td>Block 4: Anticipated Experiences/Interactions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TimeperCredit</td>
<td>Continuous</td>
<td>[0,6] (hours per week per attempted credit)</td>
<td>EASSS, Institution</td>
</tr>
<tr>
<td>OftenAcademic</td>
<td>Continuous</td>
<td>0 = Never; 1 = Occasionally; 2 = Often; 3 = Very Often</td>
<td>EASSS</td>
</tr>
<tr>
<td>OftenPleasure</td>
<td>Continuous</td>
<td>0 = Never; 1 = Occasionally; 2 = Often; 3 = Very Often</td>
<td>EASSS</td>
</tr>
<tr>
<td>OftenSocial</td>
<td>Continuous</td>
<td>0 = Never; 1 = Occasionally; 2 = Often; 3 = Very Often</td>
<td>EASSS</td>
</tr>
<tr>
<td>Block 5: Noncognitive Variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CommService</td>
<td>Continuous</td>
<td>[3,18]</td>
<td>EASSS</td>
</tr>
<tr>
<td>HandleSystem</td>
<td>Continuous</td>
<td>[8,40]</td>
<td>EASSS</td>
</tr>
<tr>
<td>KnowledgeField</td>
<td>Continuous</td>
<td>[5,21]</td>
<td>EASSS</td>
</tr>
<tr>
<td>LeaderExp</td>
<td>Continuous</td>
<td>[3,18]</td>
<td>EASSS</td>
</tr>
<tr>
<td>LongRangeGoals</td>
<td>Continuous</td>
<td>[6,28]</td>
<td>EASSS</td>
</tr>
<tr>
<td>RealAppraisal</td>
<td>Continuous</td>
<td>[3,14]</td>
<td>EASSS</td>
</tr>
<tr>
<td>SelfConcept</td>
<td>Continuous</td>
<td>[7,26]</td>
<td>EASSS</td>
</tr>
<tr>
<td>SupportPerson</td>
<td>Continuous</td>
<td>[3,15]</td>
<td>EASSS</td>
</tr>
</tbody>
</table>
education teacher/counselor, vocational/rehabilitation counselor or veterans vocational/rehabilitation counselor to students who did not receive advising from any of these professionals. AdvisorCollege compares students who received advising from a college staff member, college website, or advisor from a different college/university to students who did not use any of these advising sources. AdvisorPersonal compares students who received advising from family or friends to students who did not receive advising from family or friends. One additional binary variable compared students who anticipated working any amount of hours off campus during the semester to those who did not expect to work off campus during the semester (WorkOffCmps).

In addition, students were asked to indicate their primary educational goal while at the institution (PrimEdGoal_DegreeRelated). Students with a primary educational goal clearly focused on obtaining a degree or job (certification/licensure, change career, improve skills for present job, prepare to enter job market, or transfer to another college) are compared to those who with a goal less focused on obtaining a degree or job (explore for career, personal interest, self improvement/improve basic skills, or undecided/unknown). CertainGoal asks students to indicate how certain they are of their educational goal using a four-point Likert scale from 0 (not at all certain) to 3 (very certain).

The remaining three variables in the second block are continuous variables measuring the number of credits attempted in the fall 2009 semester (F09_Cr_Attempt), the number of thousands of dollars of grants and scholarships
received in the fall 2009 semester (F09TotalGrantSchlrship), and the number of thousands of dollars of loans received in the fall 2009 semester (F09TotalLoan).

My third block of variables measures a student’s prior mathematics achievement and ability. Prealgebra and elementary algebra knowledge was estimated using results from the two departmental pretests administered during the first week of classes (PreTestPreAlg and PreTestElemAlg). Each measure included 15 questions; a student’s score on the measure is the number of items answered correctly. The highest math course completed in high school, the third variable in this block, was recoded into a binary outcome HighMathBinary. Students who reported Geometry, Discrete Math, Algebra II, Statistics, Trigonometry, Precalculus or Calculus as their highest mathematics course completed in high school are compared to students who reported Prealgebra, Elementary Algebra, Basic Math, or Algebra I as their highest mathematics course completed in high school.

The fourth block of variables includes questions asking each student to anticipate their degree of involvement during the semester in a variety of academic, social, and work activities both within and outside the community college environment. Astin (1993) suggests asking students to predict their level of participation in activities for which there is no feasible pretest. In this study student expectations of involvement in academic, social, and work activities constitute an effort to control for actual engagement in these activities.

The EASSS includes nineteen items asking students to anticipate how likely they are to engage in a variety of academic, social, and work activities
during the semester. Responses are based on a four-point Likert scale ranging from “not at all likely” to “very likely.” A second set of eighteen items asks students to anticipate how often they expect to participate in a variety of academic, social, and work activities during the semester. Responses are based on a four-point Likert scale ranging from “never” to “very often.” I conducted a factor analysis with each set of items and extracted six variables for consideration in my final model. In the data analysis section of this chapter I provide significant detail of the factor analysis process and results, however for completeness in identifying and describing independent variables in this section, I will describe the variables included in the model here.

Factor analysis resulted in the inclusion of three anticipatory factors: OftenAcademic, OftenSocial, and OftenPleasure. Scores for each variable range from 0 to 3 and were derived by finding the mean of responses for each item in the factor. OftenAcademic includes the following items: talk with instructors outside of class about coursework; talk with instructors outside of class about topics other than coursework; receive tutoring in courses; participate in volunteer activities; and tutor another student. OftenPleasure includes three items: party; drink alcoholic beverages; and watch television. OftenSocial includes five items: study or do homework with friends; exercise or workout; play sports; socialize with friends; socialize with someone from another racial or ethnic group.

Students were asked to estimate the number of hours they would spend studying or doing homework in a typical week. The eight response categories ranged from “none” to “26 or more hours.” Measuring a student’s anticipated
academic engagement or quality of effort is essential in a study of student success; according to Pascarella (1985) “student effort is an undeniably central element in academic learning” (p. 24). Without accounting for the number of enrolled credits, the results from this item could lead to some interpretation and measurement issues, therefore I elected to normalize this variable.

TimeperCredit is defined as the midpoint of the selected interval for planned study hours divided by the number of credits attempted in the fall semester.

The fifth and final block of variables included in this study measures noncognitive constructs using the NCQ-B (Sedlacek, 2004). Multiple forms of the NCQ have been developed. For the basic NCQ, Tracey and Sedlacek (1984) reported two-week test-retest reliability estimates on NCQ scores ranging from .74 to .94, with a median of .85. Sedlacek (2004) reported test-retest reliability estimates “in the .80s” (p. 55) for the NCQ-B and a median congruent validity of r=.79 for samples from the basic NCQ. An explanation of each of the eight constructs along with the survey items are presented below. Students are asked to identify the extent to which they agree with each statement using a five-point Likert scale, with 1 = “strongly disagree” and 5 = “strongly agree.”

Positive self-concept “assesses the applicant's confidence, self-esteem, independence, and determination, all vital components of future achievement and success” (Sedlacek, 2004, p. 50). The positive self-concept construct is composed of six items from the NCQ-B. Possible scores for this variable range from 7 to 26. Students report the degree to which they agree with the following three questions using a five-point Likert scale: (1) There is no use in doing things
for people; you only find that you get it in the neck in the long run (reverse coded); (2) People can pretty easily change me even though I thought my mind was already made up on the subject (reverse coded); (3) I enjoy being a student. The fourth item used to determine the positive self-concept variable is “How much education do you expect to get during your lifetime?”

Sedlacek’s original item included five levels of education: Associate’s degree; college, but less than a Bachelor’s degree; Bachelor of Arts or equivalent; one or two years of graduate or professional study (Master’s degree); or doctoral degree such as M.D. or Ph.D. This item proved problematic for several reasons. First the scoring rubric refers to the other NCQ forms which do not include associate’s degree, therefore no value for associate’s degree is recommended. Second, the rubric scored no response as a 2, the same score as bachelor’s degree or equivalent. Third, the response category “college, but less than a bachelor’s degree” suggests there is a desirable, attainable educational status between an associate’s degree and a bachelor’s degree. After piloting this item with a focus group and consulting members of my dissertation committee, we determined the response category needed to be changed. The resulting item includes five mutually exclusive levels of education: less than an associate’s degree; associate’s degree; bachelor’s degree or equivalent; 1 or 2 years of graduate study (master’s degree); doctoral degree such as M.D. or Ph.D. Based on the spirit of Sedlacek’s scoring rubric, I coded less than an associate’s degree, associate’s degree, and no response as a 1;
bachelor’s degree or equivalent as a 2; 1 or 2 years of graduate study (master’s degree) as a 3; and doctoral degree such as M.D. or Ph.D. as a 4.

The fifth item included in self concept is “About 50% of college students typically leave before finishing a program. If this should happen to you, what will be the most likely cause?” There are nine response categories: absolutely certain that I will finish (score = 4); to accept a good job (score = 2); to enter military service (score = 2); it would cost more than my family or I could afford (score = 2); marriage (score = 2); disinterest in study (score = 2); lack of academic ability (score = 2); insufficient reading or study skills (score = 2); other (score = 2). Additionally, no response is scored as a 2.

The final item used to create the positive self concept score is “Please list three things that you are proud of having done.” Each of the three responses was scored according to Sedlacek’s (2004) rubric: score as a 1 if at least 75% of applicants to the institution could have accomplished it (for example, “graduated from high school,” “held a part-time summer job”); score as a 2 if at least 50% of applicants to the institution could have accomplished it (for example, “played on an intramural sports team,” “was a member of a school club”); score as a 3 if only the top 25% of applicants to the institution could have accomplished it (for example, “won an academic award,” “was captain of football team”). Then, the score for this item was determined by finding the mean of the scores for each response and rounding to the nearest integer. Per direct communication with Dr. Sedlacek, when students provided only one or two responses, the score was determined as the mean of the provided responses.
Realistic self-appraisal “assesses the applicant’s ability to recognize and accept his or her strengths and deficiencies, especially in academics, and works hard at self-development to broaden his or her individuality” (Sedlacek, 2004, p. 50). This construct is composed of three items from the NCQ-B. Possible scores for this variable range from 3 to 14. Students report the degree to which they agree with the following two questions using a five-point Likert scale: (1) I expect to have a harder time than most students here (reverse coded); (2) I am as skilled academically as the average applicant here. The final item used to measure realistic self-appraisal is “How much education do you expect to get during your lifetime?” Scoring is precisely the same as for the positive self-concept variable.

Successfully handling the system “assesses the applicant’s ability to understand the role of ‘the system’ in life and to develop a method of assessing the cultural or racial demands of the system and respond accordingly/assertively” (Sedlacek, 2004, p. 51). Successfully handling the system includes simple ideas such as following directions on college application materials as well as more complex issues including racism or sexism. Students who understand and are prepared to deal with these types of discrimination are more likely to persist and be successful in college (Sedlacek, 2004). This construct is measured by eight items from the NCQ-B: (1) I expect I will encounter racism at this school; (2) I want a chance to prove myself academically; (3) I am uncomfortable interacting with people from other races or cultures (reverse coded); (4) I think many people see racism where it doesn’t exist (reverse coded); (5) I expect to get picked on by
other students and faculty because of my background (reverse coded); (6) Everyone must work toward improving social conditions; (7) It is more important to study than to get involved in campus activities (reverse coded); and (8) I expect to have little contact with students from other races (reverse coded). For each of the eight items, students report the extent to which they agree using a five-point Likert scale. Possible scores for this construct range from 8 to 40.

Preference for long-term goals “assesses the applicant’s persistence, patience, long-term planning, and willingness to defer gratification and success in college” (Sedlacek, 2004, p. 52). Students with a preference for long-term goals are more likely to be successful in college as they are often indicative of high aspirations and more concrete plans (Sedlacek, 2004). This construct is measured by six items from the NCQ-B. Possible scores for this variable range from 6 to 28. The following five items ask students to determine the extent to which they agree with each statement using a five-point Likert scale: (1) Once I start something, I finish it; (2) I often make lists of things to do; (3) I prefer to be spontaneous rather than to make plans (reverse coded); (4) I usually note important dates on my calendar; and (5) The best way to avoid problems is to take things one day at a time (reverse coded). The final item used to measure the preference for long-term goals is “Please list three goals that you have for yourself right now.” Each of the three responses for this item was scored using Sedlacek’s (2004) rubric: score as 1 if response is a vague and/or immediate, short-term goal (for example, “to meet people,” “to get a good schedule,” “to gain self confidence”); score as 2 if response is a specific goal with a stated future
orientation that could be accomplished during undergraduate study (for example, “to join a sorority so I can meet more people,” “to get a good schedule so I can get good grades in the fall,” “to run for a student government office”); score as 3 if response is a specific goal with a stated future orientation that would occur after undergraduate study (for example, “to get a good schedule so I can get the classes I need for graduate school,” “to become president of a Fortune 500 company”). The score for this item was determined by finding the mean of the scores from each response and rounding to the nearest integer.

Availability of a strong support person “assesses the applicant’s having a strong support network, help, and encouragement, and the degree to which the applicant relies solely on her or his own resources” (Sedlacek, 2004, p. 52). The availability of a strong support person to provide advice as well as comfort and direction is important for the success of students in college. This construct is measured by three items from the NCQ-B: (1) My friends and relatives don’t feel I should go to college (reverse coded); (2) I expect the faculty to treat me differently from the average student here (reverse coded); and (3) I sometimes need help from others. For each of the three items, students report the extent to which they agree using a five-point Likert scale. Possible scores for this construct range from 3 to 15.

Leadership experience “assesses the applicant’s skills developed (or influence exercised) from his or her formal and informal leadership roles” (Sedlacek, 2004, p. 53). Experience, particularly related to race or gender, prior to college enrollment is positively correlated with college persistence. A
particularly important aspect of leadership is assertiveness. Students who employ passive methods of relating with others are much less likely to reap the benefits of the college environment or initiate a conversation with college personnel to get a product or service they need (Sedlacek, 2004). This construct is assessed by four items from the NCQ-B. Possible scores for this variable range from 4 to 18. The following three items ask students to determine the extent to which they agree with each statement using a five-point Likert scale: (1) I am sometimes looked up to by others; (2) My friends look at me to make decisions; and (3) I am not good at getting others to go along with me (reverse coded).

The fourth item used to measure leadership experience is “Please list groups belonged to (formal or informal) and offices held (if any) in your high school or community.” Each response is scored using Sedlacek’s (2004) rubric: score as 1 if the response is an ambiguous group or there is no clear reference to the activity performed (for example, “helped in school”); score as 2 if the response indicates membership in a group, but there is no formal or implied leadership role. It must be clear that the group is a functioning group and, unless the criteria are met for a score of 3 as described below, all groups should be coded as 2 even if the rater is not familiar with the group (for example, “Fashionettes,” “was part of a group that worked on community service projects through my church”). Finally score as 3 if the response indicates that leadership was required to fulfill the individual’s role in group (for example, officer or implied initiator, organizer, or founder) or entrance into the group was dependent upon
Community involvement “assesses the applicant’s identification with a cultural, geographic, or racial group and his or her demonstrated activity within that community grouping” (Sedlacek, 2004, p. 53). Particularly for nontraditional students, community is often based on racial, cultural, or gender issues, which can provide support vital to academic success (Sedlacek, 2004). These relationships can help a student navigate the system as well as provide a support network. Community involvement is measured by four items from the NCQ-B. Possible scores for this variable range from 4 to 18. The following three items ask students to determine the extent to which they agree with each statement using a five-point Likert scale: (1) I enjoy working with others; (2) I keep pretty much to myself (reverse coded); and (3) I have done work in many community projects. The fourth item used to measure community involvement is “Please list groups belonged to (formal or informal) and offices held (if any) in your high school or community.” Each response is scored using Sedlacek’s (2004) rubric: score as 1 if no community service performed by group, or vague or unclear in relation to community service (for example, “basketball team”); score as 2 if some community service involved, but it is not the primary purpose of the group (for example, “Scouts”); score as 3 if the group’s main purpose is community service (for example, “Big Brothers/Big Sisters”). After each response is coded,
the score for this item is determined by finding the mean of the scores for each response and rounding to the nearest integer.

    Acquiring knowledge in a field "assesses the applicant’s experiences gained in a field through study and beyond the classroom. It pays particular attention to how the applicant gains nontraditional, perhaps culturally or racially based, views of the field" (Sedlacek, 2004, p. 54). Acquiring knowledge in a field increases the likelihood of success in college. This construct is measured by five items from the NCQ-B. Possible scores for this construct range from 5 to 21. Students report the degree to which they agree with the following three questions using a five-point Likert scale: (1) I try to find opportunities to learn new things; (2) I have already learned something in my proposed major field outside of high school; (3) I have studied things about my major field on my own. The last two items used to measure knowledge acquired in a field are “Please list three goals that you have for yourself right now” and “Please list groups belonged to (formal or informal) and offices held (if any) in your high school or community.” Each response provided for these items is scored according to Sedlacek’s (2004) rubric: score as 1 if the response is not at all academic or school-related or is vague or unclear (for example, “to get married,” “to do better,” “to become a better person”); score as 2 is the response is school related, but not necessarily or primarily education-oriented (for example, “to join a fraternity,” “to become student body president”); score as 3 if the response is directly related to education (for example, “to get a 3.5 GPA,” “to get to know my teachers”). After
each response is coded, the score for the respective item is determined by finding the mean scores from each response and rounding to the nearest integer.

I used theory and prior research to determine the order of entry for the five blocks of independent variables. This hierarchical strategy allowed me to identify the covariates instead of a computer program using statistical criteria for entry order. The primary advantage of controlling the order of variable entry is that several independent variables may account for the same variance in the dependent variable, but only the variable entered first actually gets credit for doing so (Meyers, Gamst, & Guarino, 2006). Recall the purpose of this study is to integrate traditional student success models with theories that focus on nontraditional students to more thoroughly examine community college student success. In particular, this study focuses on student behaviors and attributes which positively impact success early in the first semester of community college attendance. Following traditional models of student success I entered demographic characteristics followed by college planning variables and then measures of prior mathematics achievement. After controlling for these characteristics I then entered the block of variables measuring anticipated experiences and interactions in the first semester. Controlling for differences in expected social and academic engagement was important to examine the unique contribution of the noncognitive variables.

**Dependent Variables**

The six dependent variables measured in this study are described in Table 2. Three dependent variables are continuous: score on department final exam;
Table 2
Dependent Variables, Variable Type, Coding, and Data Source

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Coding</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2009 GPA</td>
<td>Continuous</td>
<td>[0,4]</td>
<td>Institution</td>
</tr>
<tr>
<td>Percent of fall 2009 enrolled credits that were completed</td>
<td>Continuous</td>
<td>[0,100]</td>
<td>Institution</td>
</tr>
<tr>
<td>Pass Elementary Algebra (D- or higher in course)</td>
<td>Binary</td>
<td>0 = No; 1 = Yes</td>
<td>Institution</td>
</tr>
<tr>
<td>Persist at Institution spring 2010</td>
<td>Binary</td>
<td>0 = No; 1 = Yes</td>
<td>Institution</td>
</tr>
<tr>
<td>Posttest Score</td>
<td>Continuous</td>
<td>[0,32]</td>
<td>Math department</td>
</tr>
<tr>
<td>Persist in Mathematics spring 2010</td>
<td>Binary</td>
<td>0 = No; 1 = Yes</td>
<td>Institution</td>
</tr>
</tbody>
</table>

fall 2009 GPA; and percent of fall 2009 attempted credits that were completed.

The department final exam consists of 32 multiple choice items. I obtained scores for each student who completed the final exam from the mathematics department. I collected fall 2009 semester GPA, number of credits each student enrolled in, and number of credits completed (earned grade of A through D-) from the institution. The other three dependent variables have a binary outcome: pass Elementary Algebra; persist to spring 2010 at the institution; and persist to spring 2010 in mathematics. I obtained course grades for all students in Elementary Algebra to categorize them as either passing (grade of A through D-) or failing the course. Official enrollment is determined after the tenth day of the semester. For each student in my sample, I requested spring 2010 enrollment information from the institution to determine if each student was enrolled at the institution and if the student was enrolled in a mathematics course at the institution.

**Missing Data Analysis**

I employed a variety of strategies to minimize the amount of missing data for each item. Initially I reviewed each survey with missing data to determine whether the item was left blank or mismarked and the scanner was not able to
pick up the response. Occasionally students made a note on the survey that enabled me to reasonably code the missing item. Highest math course completed in high school and racial or ethnic identification allowed students to write-in a response if necessary. These responses were used to recode the items for analysis. I also collected some data from the institutional research department of the host institution. This data was used to fill in missing data on the survey. When both institutional data and survey data were available I compared the values to ensure validity.

Once the data set was as complete as possible, I determined the number and percent of missing data for each independent variable. Some variables such as ACT score and HSGPA had far too much missing data to be useful in the analyses and were subsequently dropped from the models for the study. Overall, for all variables included in the models for the study, only 49 students (11.3%) from the full sample were missing at least one piece of data, however only three of the 30 independent variables included in the models for the study were missing data on 1% or more of the sample, and no variable was missing more than 4.4%. Similarly, 9.6% of students in the posttest sample and 11.5% of students in the math persistence sample were missing data on at least one variable. Like the full sample, neither of the smaller samples was missing data on more than 4.4% of students for any single variable.

To contend with the missing data in my samples, I used listwise deletion in all of my models. Listwise deletion simply means if a subject is missing data for any variable in the analysis then that subject is excluded from the analysis.
While listwise deletion is simple to use, it may also present some statistical challenges including larger standard errors and possibly biased estimates of regression coefficients. Fortunately “if the probability of missing data on any of the independent variables does not depend on the value of the dependent variable, then regression estimates using listwise deletion will be unbiased” (Allison, 2001, p. 7). I conducted a full set of Chi-square and T-tests to determine whether or not patterns of missing data behavior on any of the independent variables was significantly related to the value of any of the dependent variables. This analyses only uncovered one instance where students missing data on an independent variable had significantly different values on the dependent variable: students not reporting the highest math course completed in high school were significantly less likely to pass Elementary Algebra. In this instance, only 11 students in the full sample were missing highest math course completed in high school. The use of listwise deletion in my analyses may result in some small bias in regression estimates, however in general it seems a robust strategy to manage the missing data in my study.

The application of listwise deletion resulted in an analytical sample of n=385 students; where the full sample is used to estimate models and generate findings to answer four of the six research questions for the study. The other two smaller samples used for analyses related to the remaining two research questions are derived from this full sample. The math persistence sample (n=323) is necessarily delimited to include only those students from the full sample who persisted from the first to the second semester and then either did or
did not elect to take another math course. And the posttest-only sample (n=255) necessarily includes only those students from the full sample who completed the posttest examination.

**Institutional Review Board Approval**

I presented my research proposal, survey instrument (EASSS), and list of likely data requests to the Human Subjects Office at both the University of Iowa and the institution hosting my research. The University of Iowa deferred judgment to the host institution, which approved my research. I have followed all guidelines for the ethical treatment of both the subjects of my research and security of the data they provided.

**Pilot Study**

I piloted the EASSS with nine volunteer students enrolled in Elementary Algebra at the host institution in the summer 2009 semester. The pilot sample included males and females, recent high school graduates and returning adult students, and American-born and international students. I timed the volunteers to estimate the amount of class time necessary to complete the instrument and then asked a set of questions regarding clarity of the directions, confusing items or response categories, interest level in the subject, and overall impression of survey design. I used the feedback to clarify and improve the final design of the instrument.

**Data Analysis**

Descriptive statistics including means, standard deviations, minimum and maximum scores were calculated for all dependent and independent variables.
Using SPSS 12, factor analysis was employed to examine the factorial structure of the anticipatory items included in the EASSS. I used both multiple regression and logistic regression to analyze my six research questions. The goal of multiple regression is to create a linear equation that identifies the best weighted combination of independent variables to optimally predict the dependent variable based on the ordinary least squares (OLS) criterion (Meyers, Gamst, & Guarino, 2006). Similarly, logistic regression uses a set of independent variables to predict a dichotomous dependent variable. The results of logistic regression are typically expressed as an odds ratio, that is, the odds of being in one category are, for example, 2.5 times greater than the odds of being in the other category (Meyers, Gamst, & Guarino, 2006).

**Multiple Regression Analysis**

The primary purpose of this study is to identify key characteristics students possess prior to entering college which positively impact first-semester student success. My research questions enable a thorough examination of the integrated model of community college student success proposed in this study by operationalizing success and persistence in a variety of ways. Multiple regression is appropriate to analyze the following three research questions.

**RQ1.** Is there a significant relationship between scores on noncognitive constructs and first semester GPA after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?
RQ2. Is there a significant relationship between scores on noncognitive constructs and the percent of credits attempted in the first semester that are completed after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ5. Is there a significant relationship between scores on noncognitive constructs and the score on the Elementary Algebra final exam after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

For each question the predicted value of first semester GPA, percent of credits attempted in the first semester that are completed, and posttest score is determined by the regression equation $Y = a + \sum_{i=1}^{5} b_i X_i$ where $X_1$ is a vector of student’s background characteristics, $X_2$ is a vector of college planning measures, $X_3$ is a vector of measures of prior mathematics achievement, $X_4$ is a vector of measures of anticipated engagement in academic, social, and work-related activities during the semester, and $X_5$ is a vector of student’s scores from each of the eight constructs measured in the NCQ-B. The coefficients $b_i$ represent the amount of change in the dependent variable for one unit of change in vector $X_i$ of independent variables. A positive value for $b_i$ represents a direct relationship between the measured and predicted variables whereas a negative value for $b_i$ suggests an inverse relationship exists. The constant value $a$ represents the $Y$-intercept of the line, mathematically that is the value of the
dependent variable if each vector of independent variables, $X_i$, included only zeros.

*Logistic Regression Analysis*

I used logistic regression for the remaining three research questions because each one has a binary output.

RQ3. Is there a significant relationship between scores on noncognitive constructs and passing Elementary Algebra after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ4. Is there a significant relationship between scores on noncognitive constructs and persistence to the spring semester at the institution after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ6. Is there a significant relationship between scores on noncognitive constructs and persistence in mathematics after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

Logistic regression equations are similar to linear regression equations except that the dependent variable is not a predicted value but instead is a measure of the likelihood of occurrence. Conceptually, logistic regression and multiple regression are very similar. Both methods result in an equation used to predict a dependent variable based upon one or more independent variables.
Whereas linear regression strives to minimize the sum of the squared distance between the data points and the regression line, logistic regression uses maximum likelihood estimation to compute the coefficients in the equation. Maximum likelihood estimation is an iterative process which seeks to find coefficients that are most likely to model the observed pattern in the sample data. According to (Meyers et al., 2006), logistic regression requires the following assumptions to be satisfied: (1) There must be an absence of perfect multicollinearity; (2) There must be no specification errors (i.e., all relevant predictors are included and irrelevant predictors are excluded); (3) The independent variables must be measured at the summative response scale, interval, or ratio level although binary-coded dichotomous variables are also allowed.

Remember when employing logistic regression the actual value of the dependent variable is either 0 or 1 (i.e., the student was either not successful or successful), however the logistic regression equation provides an estimate of the likelihood of a student being successful. This estimate can be represented as a probability of an event occurring, the odds of an event occurring, or an odds ratio. The most useful form for the outcome of the logistic equation is an odds ratio. To determine the odds ratio, we begin with the logistic regression equation

\[ \ln \left( \frac{P}{1-P} \right) = a + \sum_{i=1}^{5} b_i X_i \]

where \( P \) is the probability of an event occurring. The odds of the event occurring are given by \( \frac{P}{1-P} \). To solve the logistic regression equation for the odds, we must exponentiate both sides of the equation.

Therefore \( \frac{P}{1-P} = e^{a+\sum_{i=1}^{5} b_i X_i} \), or using rules of exponents, \( \frac{P}{1-P} = e^{a} \prod_{i=1}^{5} e^{b_i X_i} \)
(Pampel, 2000). The product symbol, $\prod$, is the multiplicative equivalent of the summation symbol $\sum$. In this formula each $e^{b_i}$ is an odds ratio, that is the ratio of the odds of the event occurring divided by the odds of the event not occurring. Because there are multiple independent variables in each logistic equation, the odds ratio is called an adjusted odds ratio to indicate the contribution of one variable when the other variables are held constant (Meyers et al., 2006).

The logistic regression equation needed to answer research questions 3, 4, and 6 is $\ln \left( \frac{p}{1-p} \right) = a + \sum_{i=1}^{5} b_i X_i$ or $\frac{p}{1-p} = e^a \cdot \prod_{i=1}^{5} e^{b_i X_i}$ where $X_1$ is a vector of student’s background characteristics, $X_2$ is a vector of college planning measures, $X_3$ is a vector of measures of prior mathematics achievement, $X_4$ is a vector of measures of anticipated engagement in academic, social, and work-related activities during the semester, and $X_5$ is a vector of student’s scores from each of the eight constructs measured in the NCQ-B. Each value $e^{b_1}, e^{b_2}, e^{b_3}, e^{b_4},$ and $e^{b_5}$ is an odds ratio. If the value is larger than 1, the effect of an increase in the independent variable is to make it more likely that the event will occur than not occur. If the value is less than 1, the effect of an increase in the independent variable is to make it less likely that the event will occur than not occur.

**Factor Analysis**

Factor analysis is a strategy to identify a relatively small number of themes from a larger set of variables. To reduce the number of variables to be included in subsequent analyses, I employed factor analysis on the eighteen items from the EASSS which asked students to anticipate "During the current semester, how
often do you expect to do each of the following?” Each item asks students to anticipate the frequency of participation or engagement in a variety of experiences and interactions during the semester using a four-point Likert scale ranging from “never” to “very often.” I similarly employed factor analysis separately on the nineteen items from the EASSS which asked students “During the current semester, how likely is it you will do each of the following?” Items asked students to anticipate the likelihood they would engage in a variety of activities during the semester using a four-point Likert scale with response categories ranging from “not at all likely” to “very likely.” In each instance I used data for all students who met the four criteria for inclusion in the sample for the factor analysis. This application of factor analysis was exploratory in nature; I was attempting to uncover any latent themes within the set of items. This analysis was not intended to be confirmatory as I did not have a priori expectations of relationships among any particular items. However, based upon prior research I did anticipate that at least one factor would center on social integration and a second on academic integration.

I used SPSS 12.0 to complete a principal components analysis of the eighteen “often” items with a varimax orthogonal rotation. Using listwise deletion, there were a total of 423 subjects included in the factor analysis for the often items. To arrive at my final factor analytic solution, I employed the scree plot, eigenvalue criteria, and the amount of variance explained to determine the number of factors to extract. Additionally I computed Cronbach’s alpha to determine the internal consistency of the items in each factor.
It is important to recognize that the final solution to a factor analysis is subjective as Cronbach (1970) clearly stated: “There is no one ‘right’ way to do a factor analysis any more than there is a ‘right’ way to photograph Waikiki Beach” (p. 315). The SPSS default is to extract all factors with an eigenvalue greater than one. The result included five factors; however these factors were not all theoretically viable. Both the scree plot and the amount of variance explained suggested either three or four factors were most appropriate. I forced SPSS to extract four factors and then three factors. After analyzing the factor structure of each model, I determined the four-factor solution to be the most theoretically sound. The four-factor solution accounted for 46.8% of the variance. I next computed Cronbach’s alpha to determine the internal consistency of the items in each factor. Three of the four factors were empirically valuable, had theoretical support, and the Cronbach’s alphas were sufficiently high (\( \alpha > .6 \)) for use in the model. Because the fourth factor had a low Cronbach’s alpha (\( \alpha = .48 \)) and less theoretical support, this factor was not included in the model. Table 3 presents the factor loadings and Cronbach’s alphas for each construct extracted from the eighteen often items.

The first construct represents students’ anticipated social interaction and engagement. The scale was constructed using responses to items that asked students how often they expected to exercise or workout, play sports, socialize with friends, study or do homework with friends, and socialize with someone from another racial or ethnic group. Factor loadings ranged from .58 to .68 and the scale had a Cronbach alpha reliability of .68. I labeled this scale OftenSocial.
### Table 3

#### Factor Analysis: Often Items

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OftenSocial</strong></td>
<td></td>
</tr>
<tr>
<td>Exercise or workout</td>
<td>0.676</td>
</tr>
<tr>
<td>Play sports</td>
<td>0.623</td>
</tr>
<tr>
<td>Socialize with friends</td>
<td>0.586</td>
</tr>
<tr>
<td>Study or do homework with friends</td>
<td>0.585</td>
</tr>
<tr>
<td>Socialize with someone from another racial or ethnic group</td>
<td>0.575</td>
</tr>
<tr>
<td><strong>α= .68</strong></td>
<td></td>
</tr>
<tr>
<td><strong>OftenAcademic</strong></td>
<td></td>
</tr>
<tr>
<td>Talk with instructors outside of class about coursework</td>
<td>0.697</td>
</tr>
<tr>
<td>Talk with instructors outside of class about topics other than coursework</td>
<td>0.669</td>
</tr>
<tr>
<td>Receive tutoring in courses</td>
<td>0.609</td>
</tr>
<tr>
<td>Participate in volunteer activities</td>
<td>0.509</td>
</tr>
<tr>
<td>Tutor another student</td>
<td>0.441</td>
</tr>
<tr>
<td><strong>α= .64</strong></td>
<td></td>
</tr>
<tr>
<td><strong>OftenPleasure</strong></td>
<td></td>
</tr>
<tr>
<td>Party</td>
<td>0.791</td>
</tr>
<tr>
<td>Drink alcoholic beverages</td>
<td>0.755</td>
</tr>
<tr>
<td>Watch television</td>
<td>0.469</td>
</tr>
<tr>
<td><strong>α= .63</strong></td>
<td></td>
</tr>
</tbody>
</table>

Response Categories for each item: 0 = Never, 1 = Occasionally, 2 = Often, 3 = Very Often

The second construct represents students' anticipated academic interaction and engagement. The items in this scale ask students how often they anticipated talking with instructors outside of class about coursework, talking with instructors outside of class about topics other than coursework, receiving tutoring in courses, participating in volunteer activities, and tutoring another student. Factor loadings ranged from .44 to .70 and the construct had a Cronbach alpha reliability of .64. I labeled this scale OftenAcademic.
The third construct represents students’ anticipated frequency of engagement in activities which may detract from the positive social and academic interactions that promote institutional engagement. These items ask students how often they expect to party, drink alcoholic beverages, and watch television. Factor loadings ranged from .47 to .79 and the scale had a Cronbach alpha reliability of .63. I labeled this scale OftenPleasure.

Next I completed a principal components analysis of the nineteen likely items using the same strategy as described for the often items. Using listwise deletion, there were a total of 409 subjects included in the factor analysis for the likely items. Again I identified three viable factors: one about anticipated social interaction; the second related to expected academic interaction; and the third related to students’ anticipated need for academic assistance. Table 4 reports the factor loadings for each item.

The first factor represents students’ likelihood of participating in a variety of social interactions. The items in this factor ask students how likely they are participate in student clubs and organizations, act as a leader in a student group, volunteer, hold a part-time job on campus, participate in intramural activities, and attend a cultural diversity event. Factor loadings ranged from .47 to .73 and the factor had a Cronbach alpha of .73. I labeled this scale LikelySocial.

The second factor represents students’ likelihood of participating in a variety of academic experiences. The items ask students how likely they are to ask a question about an instructor’s feedback on a graded assignment, talk with instructors outside of class about coursework, discuss course content with
Table 4  
Factor Analysis: Likely Items

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>LikelySocial</td>
<td></td>
</tr>
<tr>
<td>Participate in student clubs or organizations</td>
<td>0.732</td>
</tr>
<tr>
<td>Act as a leader in a student group</td>
<td>0.680</td>
</tr>
<tr>
<td>Volunteer your time</td>
<td>0.640</td>
</tr>
<tr>
<td>Hold a part-time job on campus</td>
<td>0.544</td>
</tr>
<tr>
<td>Participate in intramural activities</td>
<td>0.534</td>
</tr>
<tr>
<td>Attend a cultural diversity event</td>
<td>0.465</td>
</tr>
<tr>
<td>α = .73</td>
<td></td>
</tr>
<tr>
<td>LikelyAcademic</td>
<td></td>
</tr>
<tr>
<td>Ask a question about an instructor's feedback on a graded assignment</td>
<td>0.730</td>
</tr>
<tr>
<td>Talk with instructors outside of class about coursework</td>
<td>0.620</td>
</tr>
<tr>
<td>Discuss course content with students outside of class</td>
<td>0.566</td>
</tr>
<tr>
<td>Tutor another student</td>
<td>0.508</td>
</tr>
<tr>
<td>Talk with instructors outside of class about topics other than coursework</td>
<td>0.379</td>
</tr>
<tr>
<td>α = .67</td>
<td></td>
</tr>
<tr>
<td>LikelySeekAcademicAssistance</td>
<td></td>
</tr>
<tr>
<td>Seek help with my study skills</td>
<td>0.811</td>
</tr>
<tr>
<td>Seek help with my writing skills</td>
<td>0.800</td>
</tr>
<tr>
<td>Seek help with my reading skills</td>
<td>0.749</td>
</tr>
<tr>
<td>Receive tutoring in courses</td>
<td>0.698</td>
</tr>
<tr>
<td>Receive vocational or career counseling</td>
<td>0.350</td>
</tr>
<tr>
<td>α = .81</td>
<td></td>
</tr>
</tbody>
</table>

Response Categories for each item: 0 = Not at all Likely, 1 = Somewhat Likely, 2 = Pretty Likely, 3 = Very Likely

students outside of class, tutor another student, and talk with instructors outside of class about topics other than coursework. The factor loadings for this scale ranged from .38 to .73 and it had a Cronbach alpha reliability of .67. I labeled this factor LikelyAcademic.
The third factor represents students’ likelihood to seek academic assistance in a variety of academic and career-related venues. The items ask students how likely they are to seek help with study skills, seek help with writing skills, seek help with reading skills, receive tutoring in courses, and receive vocational or career counseling. The factor loadings for this construct ranged from .35 to .81 and it had a Cronbach alpha reliability of .81.

As I expected, the three often factors and the three likely factors were all highly correlated with one another. Based on theory, it was important to have at least one measure of anticipated academic integration and one measure of social integration. Due to concerns both about multicollinearity and sample size, I ran a series of models to identify which individual factors provided the greatest chance of revealing significant findings. Specifically I included only one of the six often and likely factors in the model with all the other independent variables and looked at the results for each of the six dependent variables. This resulted in 36 analyses each with one of the six factors. Next I analyzed which variables were significant (\( p \leq .05 \)) and which variables were marginally significant (\( p \leq .10 \)).

Next I analyzed several models including two of the six factors using a similar strategy. Ultimately I determined the three factors OftenSocial, OftenAcademic, and OftenPleasure provided the best blend of coverage of theoretically crucial constructs while being attentive to concerns about multicollinearity, sample size and degrees of freedom.
Limitations

This study has several limitations. One limitation of most research is a lack of generalizability of the results. This study is no exception. Data were only collected from students enrolled in one developmental mathematics course (Elementary Algebra) with a face-to-face component at a single community college. The intent of this research is to begin creating of a model of community college student success which is sensitive to the diversity exhibited in community colleges around the country. Therefore this study should be replicated at other community colleges with varying student composition including race/ethnicity, family SES, age, and part-time/full-time student status. Second, my findings may not be indicative of students requiring remediation in other disciplines. This study should be conducted in other content areas with high enrollments of first-time students in remedial courses, particularly in composition. There may be significant differences based on the amount of remediation necessary both within mathematics as well as in other disciplines.

Another potential limitation is response bias. Because the survey was conducted in class it is possible that students with lower levels of interest in college or less well defined goals were more likely to miss class or not yet be registered for class (the institution allows registration up to the start of the second week of classes) and therefore have missed the survey administration. Two related limitations, particularly salient to the research questions related to persistence, are degree requirements and intent to transfer. There are a few programs at the institution which only require Elementary Algebra. These
students would likely not persist in mathematics because of the degree requirements, not because of lack of interest or any other reason. Similarly, it was not possible to ascertain the reason a student did not persist at the institution. Dropping out of college, changes in one’s personal or family life, or transfer to another institution are all recorded as nonpersistence. Researchers are advised to consider strategies to categorize nonpersisters, at a minimum to discern between those who transferred to another institution and those who stopped participating in the overall system of higher education institutions.

Other limitations of this study are derived from the nature of self-reported surveys. According to Groves et al. (2004) respondents skip more questions when completing a self-administered survey than a survey administered by an interviewer. Failing to answer a question may be because the respondent unintentionally skipped over the question, they didn’t understand the question, or were unwilling to provide the answer (but may have been willing to with interviewer encouragement). Furthermore social desirability bias, “the tendency to present oneself in a favorable light,” (Groves et al., 2004, p. 155) may be more common among certain groups of individuals. If all or most self-reporting error is similarly inflated, then this error is less problematic. As Dillman (2000) suggested, the “inability to get adequate answers to open-ended questions is often identified as a chief disadvantage of self-administered surveys” (p. 41). This was particularly evident with the three open-ended questions which inquired about student goals, things students were proud of having done, and group membership.
I expected to verify and supplement self-reported data with institutional data. Unfortunately there was very little institutional data available for all students. Particularly troubling was the lack of measures of prior academic achievement including high school GPA, ACT or other standardized test scores, and Compass placement scores. Each of these items was available for some students, but including this data in my analyses would have resulted in a substantial reduction in sample size. As it was, my sample size presented some limitations. I had hoped to examine levels of certain characteristics using design sets of dichotomous variables (for example, compare low income to lower-middle, upper-middle, and upper incomes). It is quite possible that differences do exist between the lowest and highest quartiles, but those potential differences are concealed in a single dichotomous variable. Future research should include sufficiently large samples to allow for such examination.

Additionally, further research should be completed to identify differences in college-ready students as compared to those requiring remediation. This study focuses on first-time community college students. Further research should be done to replicate this study with returning community college students. Research with students completing all or some of their college requirements online or via some other at-a-distance format would also be appropriate to ascertain the extent to which measures of psychological factors predict student success in a variety of instructional formats.

A final limitation is the lack of actual measures of in-college experiences. The anticipatory questions are used as a proxy for actual experiences during
college, however this is undoubtedly a source of some error. The purpose of this study is to integrate constructs from diverse theoretical perspectives to better understand the behaviors, perceptions, and attitudes which impact student success at a community college early in the first semester. The development of an early warning and intervention system to improve community college student success will necessarily have little reliance on the impact the institution has had on the student. Nevertheless, future research should include a follow-up survey to determine student’s actual level of interaction with the institution and their external environment as well as identifying any change in an individual’s college aspirations or intent to transfer. Additionally, it would be beneficial if the study were conducted longitudinally, being administered once per semester for a number of years.

**Summary**

This study seeks to identify those precollege attributes and behaviors – including both cognitive and noncognitive factors – which positively impact success early in the first semester of community college attendance. A sample of first-time community college students enrolled in Elementary Algebra, a developmental mathematics course, was studied to determine the extent and manner in which these factors are related to early success in Elementary Algebra at a community college. I completed three data collections for this study: prealgebra and elementary algebra pretests; student survey (EASSS); and department posttest. The pretests and posttest were developed by faculty in the mathematics department at the host institution. The pretests included 15 multiple
choice questions covering prerequisite or prealgebra material and an additional 15 multiple choice items addressing key concepts presented in Elementary Algebra. The posttest is a departmental final exam which includes 32 multiple-choice questions covering major concepts from Elementary Algebra. The EASSS, a self-administered survey, was administered during class time within the first three weeks of the semester. The survey includes numerous measures of student background characteristics which research suggests are related to student success and persistence. Because the crux of this study is to examine the pre-college attitudes, perceptions, and behaviors of students before the college environment impacts the student, several questions ask students to anticipate the frequency, duration, and likelihood of engaging in a variety of academic, social, and work-related activities. The third component of the survey is the NCQ-B, a theoretically sound instrument designed to measure key constructs from the psychosocial and affective domain which are independent of academic ability and that research suggests are predictive of student success and persistence in college.

The dependent variables of interest in this study that measure student success include semester GPA, percent of credits attempted which are completed, Elementary Algebra posttest score, and pass or fail Elementary Algebra. Key measures of another perspective on student success, student persistence, are enrollment at the institution the following semester and enrollment in a mathematics course the following semester. Descriptive statistics for all independent and dependent measures are presented. Factor analyses
were completed to analyze the anticipated engagement in social, academic, and work related activities with my community college student sample. I used both multiple regression and logistic regression to address each research question.

This study contributes to the knowledge of student success indicators for both community college students and developmental mathematics students; two areas underrepresented in the current literature. This study also answers the call by Bean and Metzner (1985) more than two decades ago for single-institution-based research of nontraditional populations.
CHAPTER 4: RESULTS

Introduction

The purpose of this study is to identify attributes and behaviors indicative of success in first-time community college students enrolled in developmental mathematics. Because very few studies of this type have been conducted with a community college sample and because the sample size for this study is relatively small, I will report marginally significant findings at the $p \leq .10$ level as well as those satisfying the traditional significance level of $p \leq .05$. Marginally significant results are reported for heuristic purposes and should be useful to scholars conducting further research with developmental community college populations. Specifically this study examined six measures of student success in terms of the following research questions:

RQ1. Is there a significant relationship between scores on noncognitive constructs and first semester GPA after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ2. Is there a significant relationship between scores on noncognitive constructs and the percent of credits attempted in the first semester that are completed after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ3. Is there a significant relationship between scores on noncognitive constructs and passing Elementary Algebra after controlling for
student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ4. Is there a significant relationship between scores on noncognitive constructs and persistence to the spring semester at the institution after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ5. Is there a significant relationship between scores on noncognitive constructs and the score on the Elementary Algebra final exam after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

RQ6. Is there a significant relationship between scores on noncognitive constructs and persistence in mathematics after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

In this chapter, the results of this study are presented in three primary sections. The first section summarizes the methodology for this study. The second section consists of descriptive statistics for all independent variables. The third section presents the results of the regression models that correspond to each of the six research questions listed above.
Summary of Methodology

This study includes students enrolled in Elementary Algebra, a developmental mathematics course, at a single Midwestern public community college in the fall 2009 semester. The sample for the first four research questions includes only first-time college students who completed both the departmental pretests and the EASSS. The remaining two research questions required additional data related to student persistence decisions for inclusion in the sample: a score on the posttest was required to be included in the sample for RQ5; and enrollment at the institution in the spring 2010 semester was required to be included in the sample for RQ6.

The primary data sources were the EASSS and the two departmental pretests: prealgebra and elementary algebra. Institutional data was also used for some variables as well as to fill in missing data from the EASSS when possible.

All six research questions conceptualize student success in a slightly different way. Some focus specifically on success in Elementary Algebra (RQ3 and RQ5), others focus more generally on academic performance in the first semester of college (RQ1 and RQ2), while others focus on persistence in college (RQ4) and persistence in mathematics (RQ6). Because the intention of this study is to understand early community college success I chose a single model to examine each of the six research questions. The variables included in this model are in five general blocks: demographic characteristics, college plans, prior mathematics achievement and ability, anticipated experiences and interactions, and noncognitive variables. The results presented in this chapter
focus on the full model with all five blocks of variables included. OLS regression was used for the three research questions with a continuous dependent variable (RQ1, RQ2, and RQ5). Logistic regression was employed for three research questions with a binary outcome variable (RQ3, RQ4, and RQ6).

**Descriptive Statistics: Full Sample**

Four of the research questions (RQ1, RQ2, RQ3, and RQ4) examined in this study used the same sample, herein referred to as the full sample. In order to be included in the full sample, students had to be enrolled in Elementary Algebra in the fall 2009 semester, identify themselves as first-time college students, complete the EASSS, and complete the two Mathematics department pretests. The remaining two research questions required additional criteria for inclusion in their respective samples. In addition to the full sample criteria, students had to complete the departmental final exam for inclusion in the posttest sample (RQ5). Finally, in addition to the full sample criteria, students had to persist at the institution in the spring 2010 semester for inclusion in the math persistence sample (RQ6). Frequencies, maximum and minimum values, means and standard deviations are reported for all variables in all three samples.

Table 5 provides frequencies, minimum and maximum values, means, and standard deviations for the full sample for each variable. In the table, those variables with a minimum value of 0 and a maximum value of 1 – such as FamIncomeHigh, Female, HaveDisability, etc., – are dichotomous or binary variables; and for each of these variables the mean represents the percent of the students in the sample who are coded 1 and therefore have high family income,
Table 5
Descriptive Statistics for Full Sample

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<th>Independent Variables</th>
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<th>Mean</th>
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are female and have a disability, and so on. The full sample included n=385 students with a mean age of 20.1 years old. Males constituted 54.8% of the sample, 11% were nonwhite, and 15.8% reported they had some type of disability. Nearly three of every ten students reported that neither parent had attended any college while the sample was almost equally split between family incomes above (49.6%) and below (50.4%) $50,000. The mean GPA for the fall 2009 semester was 1.94 and on average, students completed just under three-quarters of their attempted credits. Nearly 60% of students passed Elementary Algebra and 83.9% of students persisted to the spring 2010 semester at the institution.

The institution does not mandate advising under most circumstances. This study revealed that 74% of students received advising from college personnel, the college website, or an advisor from a different college. About one in seven students reported receiving advising from a high school teacher or high school, vocational, veterans, or rehabilitation counselor while one-third of students used family or friends as advisors.

The mean number of credits attempted was 11 while the majority of students (69.4%) attempted at least 12 credits, thus classifying them as full-time. The typical student had $1,074 in grants and scholarships and $1,281 in loans for the fall 2009 semester. Nearly 90% of students indicated a primary educational goal that was directly related to earning a degree while 78.2% of students indicated they were pretty certain or very certain of their educational
goal. More than three quarters (77.9%) of students expected to work off campus during the semester.

Nearly 80% of students in the sample indicated the highest math course they completed in high school was geometry, discrete math, algebra II, statistics, trigonometry, or calculus. Only 20% reported their highest math course in high school was equivalent to, or a lower level than Elementary Algebra. Results from the department pretests showed a mean of 9.0 out of 15 correct responses on the prealgebra pretest and 5.8 out of 15 on the elementary algebra pretest.

Students were also asked to anticipate the frequency of engagement in certain experiences and interactions. One measure of anticipated quality of effort used in this study is the expected amount of time studying per credit attempted. The sample mean for time studying per credit is 0.78 hours per week per credit. Fully three-quarters of students in the sample expected to study one hour or less per week per credit attempted. Factor analysis was used as a data reduction strategy with survey results of eighteen items asking students how often they expect to engage in a variety of academic, social and other activities. For each item, response categories ranged from “never” coded as 0 to “very often” coded as 3. The mean for OftenAcademic was 0.90 while the mean for OftenSocial was 1.76 and OftenPleasure was 1.29.

Means and standard deviations for each of the eight noncognitive variables are also included in Table 5. Four of the eight noncognitive variables were significant in at least one of the four models using the full sample. Those variables are HandleSystem (mean = 28.5), KnowledgeField (mean = 13.9),
LongRangeGoals (mean = 17.8), and SelfConcept (mean = 18.5). The remaining four noncognitive variables that did not reach statistical significance are CommService (mean = 10.7), LeaderExp (mean = 12.0), RealAppraisal (mean = 8.9), and SupportPerson (mean = 12.5). The correlation matrix showing all bivariate correlations for all pairs of independent variables is available in Appendix H.

**Descriptive Statistics: Posttest Sample**

Research question 5 required one additional criterion for inclusion in the sample: a score on the department final exam. Descriptive statistics for the posttest sample are presented in Table 6. In the table, those variables with a minimum value of 0 and a maximum value of 1 – such as FamIncomeHigh, Female, HaveDisability, etc., – are dichotomous or binary variables; and for each of these variables the mean represents the percent of the students in the sample who are coded 1 and therefore have high family income, are female and have a disability, and so on. This sample is significantly smaller than the full sample (N_{posttest} = 255 vs. N_{full} = 385), yet the mean values are similar. Because having a posttest score is actually a persistence measure itself, it is not surprising that the mean values for several variables are slightly higher for the posttest sample as compared to the full sample. The posttest sample includes higher percentages of females, students from high-income families, students using a college advising source, students with a primary educational goal related to obtaining a degree, and students whose highest math course was at a level above Elementary Algebra. The posttest sample has higher mean pretest scores
### Table 6
**Descriptive Statistics for Posttest Sample**

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<tr>
<th>Independent Variables</th>
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and a higher average number of credits attempted than the full sample. Additionally, the posttest sample includes a lower percentage of students with a disability, students from racial/ethnic minorities, and students who anticipated working off campus during the semester.

**Descriptive Statistics: Math Persistence Sample**

My sixth and final research question centered on persistence in mathematics in the spring 2010 semester. In order for a student to be included in this sample s/he needed to be enrolled at the institution in the spring 2010 semester in addition to the criteria for inclusion in the full sample. Table 7 provides descriptive statistics for the math persistence sample. In the table, those variables with a minimum value of 0 and a maximum value of 1 – such as FamIncomeHigh, Female, HaveDisability, etc., – are dichotomous or binary variables; and for each of these variables the mean represents the percent of the students in the sample who are coded 1 and therefore have high family income, are female and have a disability, and so on. As expected, this sample is smaller than the full sample ($N_{\text{math persistence}} = 323$ vs. $N_{\text{full}} = 385$) due to attrition. The mean values for the math persistence sample are very similar to the full sample with a few exceptions. Students who persisted in mathematics to the spring semester were slightly more likely to be from a high-income family and, on average, attempted a higher number of credits (11.7 vs. 11.0). Female students constituted a smaller percentage of the math persistence sample than the full sample as did students who used family and friends for advising.
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<tr>
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</tr>
<tr>
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<td>0.392</td>
</tr>
<tr>
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</tr>
<tr>
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<td>3</td>
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</tr>
<tr>
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<td>3</td>
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</tr>
<tr>
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<td>17</td>
<td>10.752</td>
<td>2.318</td>
</tr>
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<td>35</td>
<td>28.563</td>
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</tr>
<tr>
<td>KnowledgeField</td>
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<td>6</td>
<td>20</td>
<td>14.096</td>
<td>2.718</td>
</tr>
<tr>
<td>LeaderExp</td>
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<td>3</td>
<td>18</td>
<td>12.087</td>
<td>2.218</td>
</tr>
<tr>
<td>LongRangeGoals</td>
<td>323</td>
<td>9</td>
<td>27</td>
<td>17.954</td>
<td>2.865</td>
</tr>
<tr>
<td>RealAppraisal</td>
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<td>3</td>
<td>14</td>
<td>8.889</td>
<td>1.972</td>
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<tr>
<td>SelfConcept</td>
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<td>12</td>
<td>25</td>
<td>18.458</td>
<td>2.539</td>
</tr>
<tr>
<td>SupportPerson</td>
<td>323</td>
<td>6</td>
<td>15</td>
<td>12.480</td>
<td>1.563</td>
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<table>
<thead>
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<th>Dependent Variables</th>
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<th>Min</th>
<th>Max</th>
<th>Mean</th>
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<td>1</td>
<td>0.709</td>
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<tr>
<td>Valid N (listwise)</td>
<td>323</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A change in gender composition of the three samples is worth a special note. Females made up 45.2% of the full sample, 49.4% of the posttest sample, but only 44.0% of the math persistence sample. In other words, females were more likely to persist to the end of the semester yet less likely to persist to the next semester.

**Research Question Results**

In this section I present the statistical findings for each of my six research questions. The findings are organized by research question and further subdivided by the five blocks of variables: demographic characteristics, college plans, prior mathematics achievement, anticipated experiences and interactions, and noncognitive variables. It is important to remember that all analyses were completed with all five blocks of variables included. Therefore when discussing the results of any variable, all other variables in the model are being controlled for. I report both unstandardized and standardized coefficients as well as standard errors and significance levels. Remember because this study is exploratory in nature, for heuristic purposes I will report both marginally significant \(( p \leq .10 )\) and significant \(( p \leq .05 )\) findings. Effect sizes can be helpful to interpret the results of regression equations (Rosenthal & Rosnow, 1991). An effect size is the proportion of a standard deviation change in the dependent variable as a result of a one-unit change in the independent variable. Standardized coefficients can be interpreted as this type of effect size. According to Rosenthal and Rosnow (1991) an effect size of .10 or less is trivial,
between .10 and .30 is small, between .30 and .50 is moderate, and greater than .50 is large.

RQ1. Is there a significant relationship between scores on noncognitive constructs and first semester GPA after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

With my first research question I want to determine whether or not there is a significant difference in first-time student’s first semester GPA based upon their scores on the eight constructs measured by the NCQ. To investigate this question I employed OLS regression with data from the full sample. The five blocks of independent variables significantly predicted first semester GPA, F(30,354)=7.691, p<.001, with nine variables reaching statistical significance and one additional variable noted for heuristic purposes. The adjusted R squared value is .343, indicating that 34.3% of the variation in student’s first semester GPA is explained by the model. Table 8 presents both B, unstandardized coefficients, and β, standardized coefficients for each independent variable.

Unstandardized coefficients can be interpreted as the change in the dependent variable for each one-unit change in the independent variable. Both statistically significant findings (p ≤ .05) and marginally significant findings (p ≤ .10) are noted in the table. The unstandardized coefficient for age (p<.001) is B=.043 which means that for each one-year increase in age, the first semester GPA increases by .043 points. The standardized coefficient for age, β = .183, means for each one-year increase in age, the first semester GPA increases by about one-sixth of
### Table 8

**Multiple Regression Analysis Summary for Predicting First Semester GPA**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-1.708</td>
<td>0.832</td>
<td>0.183**</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.043**</td>
<td>0.012</td>
<td>0.183**</td>
</tr>
<tr>
<td>FamIncomeHigh</td>
<td>0.288*</td>
<td>0.123</td>
<td>0.117*</td>
</tr>
<tr>
<td>Female</td>
<td>0.304**</td>
<td>0.117</td>
<td>0.123**</td>
</tr>
<tr>
<td>HaveDisability</td>
<td>-0.143</td>
<td>0.154</td>
<td>-0.042</td>
</tr>
<tr>
<td>Minority</td>
<td>-0.219</td>
<td>0.170</td>
<td>-0.055</td>
</tr>
<tr>
<td>ParentEducBinary</td>
<td>0.080</td>
<td>0.118</td>
<td>0.029</td>
</tr>
<tr>
<td><strong>College Plans</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AdvisorCnslrTchr</td>
<td>-0.030</td>
<td>0.161</td>
<td>-0.008</td>
</tr>
<tr>
<td>AdvisorCollege</td>
<td>0.149</td>
<td>0.130</td>
<td>0.053</td>
</tr>
<tr>
<td>AdvisorPersonal</td>
<td>0.072</td>
<td>0.115</td>
<td>0.028</td>
</tr>
<tr>
<td>CertainGoal</td>
<td>-0.188**</td>
<td>0.073</td>
<td>-0.127**</td>
</tr>
<tr>
<td>F09_Cr_Attempt</td>
<td>0.136**</td>
<td>0.014</td>
<td>0.446**</td>
</tr>
<tr>
<td>F09TotalGrantSchlrship</td>
<td>-0.051</td>
<td>0.048</td>
<td>-0.052</td>
</tr>
<tr>
<td>F09TotalLoan</td>
<td>-0.019</td>
<td>0.042</td>
<td>-0.019</td>
</tr>
<tr>
<td>PrimEdGoal_DegreeRelated</td>
<td>0.403*</td>
<td>0.172</td>
<td>0.104*</td>
</tr>
<tr>
<td>WorkOffCmpsBinary</td>
<td>-0.185</td>
<td>0.130</td>
<td>-0.062</td>
</tr>
<tr>
<td><strong>Prior Mathematics Achievement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HighMathBinary</td>
<td>0.038</td>
<td>0.150</td>
<td>0.013</td>
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<tr>
<td>PreTestElemAlg</td>
<td>0.002</td>
<td>0.026</td>
<td>0.004</td>
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<tr>
<td>PreTestPreAlg</td>
<td>0.035*</td>
<td>0.021</td>
<td>0.083*</td>
</tr>
<tr>
<td><strong>Anticipated Experiences/Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TimeperCredit</td>
<td>0.193*</td>
<td>0.084</td>
<td>0.101*</td>
</tr>
<tr>
<td>OftenAcademic</td>
<td>-0.082</td>
<td>0.126</td>
<td>-0.033</td>
</tr>
<tr>
<td>OftenSocial</td>
<td>-0.047</td>
<td>0.122</td>
<td>-0.022</td>
</tr>
<tr>
<td>OftenPleasure</td>
<td>-0.212*</td>
<td>0.090</td>
<td>-0.115*</td>
</tr>
<tr>
<td><strong>Noncognitive Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CommService</td>
<td>-0.024</td>
<td>0.029</td>
<td>-0.047</td>
</tr>
<tr>
<td>HandleSystem</td>
<td>-0.014</td>
<td>0.021</td>
<td>-0.032</td>
</tr>
<tr>
<td>KnowledgeField</td>
<td>0.061*</td>
<td>0.024</td>
<td>0.134*</td>
</tr>
<tr>
<td>LeaderExp</td>
<td>0.036</td>
<td>0.033</td>
<td>0.065</td>
</tr>
<tr>
<td>LongRangeGoals</td>
<td>0.027</td>
<td>0.021</td>
<td>0.064</td>
</tr>
<tr>
<td>RealAppraisal</td>
<td>0.040</td>
<td>0.031</td>
<td>0.062</td>
</tr>
<tr>
<td>SelfConcept</td>
<td>-0.021</td>
<td>0.024</td>
<td>-0.043</td>
</tr>
<tr>
<td>SupportPerson</td>
<td>-0.003</td>
<td>0.038</td>
<td>-0.004</td>
</tr>
</tbody>
</table>

Note. $R^2 = .395$; adjusted $R^2 = .343$; $F(30, 354)=7.691, p<.001$

*p≤.1; *p≤.05; **p≤.01.
a standard deviation. This is considered a small effect. Along with age, high family income (p=.020) and being female (p=.010) are significant, positive factors in predicting first semester GPA.

Three variables about student’s college plans were significant predictors of first semester GPA. Number of credits attempted (p<.001) had a moderate positive effect and a primary goal that was degree-oriented (p=.020) had a small positive effect. Interestingly, goal certainty (p=.010) had a small negative effect on first semester GPA. One possible explanation for this may be that students with less clear plans may be more open and interested in exploring a greater variety of courses. This openness may encourage students to focus on a wider variety of courses instead of only those they perceive as most essential for their completion of a goal.

The prealgebra pretest reached marginal significance in the prior mathematics achievement block (p=.091). While common sense suggests there should be a positive correlation between knowledge of prerequisite content and the course grade, this finding points to a possible connection between mathematics knowledge and semester GPA that should be investigated further. It is likely that with a larger sample size this variable would reach statistical significance.

Two of the four anticipated interaction variables reached statistical significance, each having a small effect size. TimeperCredit was positively correlated with semester GPA (p=.023). Holding all other variables constant, for each one hour increase in anticipated studying per credit hour, semester GPA
increased by 0.193 points. Perhaps not surprising OftenPleasure, which measures student’s propensity to drink alcohol, party, and watch television was significantly and negatively correlated with semester GPA (p=.020).

Only one of the noncognitive variables, KnowledgeField, reached statistical significance in this model (p=.011). For each one-unit increase in knowledge acquired working in the field, semester GPA increased by 0.061 points, or .13 of a standard deviation.

In summary, first semester GPA was significantly and positively correlated to age, family income, being female, number of credits attempted, having a primary goal that was related to obtaining a degree, prealgebra pretest score, time spent studying, and knowledge acquired in the field. First semester GPA was negatively correlated with certainty of goal in college and frequency of engaging in partying, drinking alcohol, and watching television.

RQ2. Is there a significant relationship between scores on noncognitive constructs and the percent of credits attempted in the first semester that are completed after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

My second research question assesses the utility of noncognitive variables as predictors of the percent of credits completed during the first semester of college. I again used OLS regression with data from the full sample. The five blocks of independent variables significantly predicted percent of credits completed during the first semester, \( F(30,354)=7.643, p<.001 \), with five variables
reaching statistical significance and six additional variables noted for heuristic purposes. The adjusted R squared value is .342, indicating that 34.2% of the variation in the percent of credits completed is explained by the model. Table 9 presents unstandardized coefficients, standard errors, and standardized coefficients for each independent variable. Both statistically significant findings \((p \leq .05)\) and marginally significant findings \((p \leq .10)\) are noted in the table.

Four demographic variables reached marginal significance in the model predicting the percentage of credits completed in the first semester of college. Both age and family income have a positive effect while a self-identified disability and being nonwhite both have a negative effect. All four of these variables have a standardized coefficient with magnitude less than 0.1, suggesting a trivial effect size. Future research with a larger sample size will likely illustrate that these characteristics do make a statistically significant difference in completion rates.

Three variables measuring the degree of planning for college reached statistical significance. Certainty of goal has a small, negative effect on percent of credits completed \((p=.001)\). Number of credits attempted is positively and significantly related to percent of credits completed \((p<.001)\). For each additional credit attempted, the percent of credits completed increases by 4.9%. This is a large effect size. Additionally, having a primary educational goal that is related to obtaining a degree has a small, positive effect on percentage of credits completed \((p=.019)\).

None of the variables measuring prior mathematics achievement reached statistical significance in this study. This finding suggests that the percentage of
<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Age</td>
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<td>0.524**</td>
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<td>F09TotalLoan</td>
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<td>0.001</td>
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<td>PrimEdGoal_DegreeRelated</td>
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<td>0.105*</td>
</tr>
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<td>Prior Mathematics Achievement</td>
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<tr>
<td>HighMathBinary</td>
<td>1.613</td>
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<td>PreTestElemAlg</td>
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<td>PreTestPreAlg</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>TimeperCredit</td>
<td>4.921*</td>
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<td>0.084*</td>
</tr>
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<td>OftenAcademic</td>
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<td>-0.028</td>
</tr>
<tr>
<td>OftenSocial</td>
<td>-2.512</td>
<td>3.759</td>
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</tr>
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<td>OftenPleasure</td>
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<td>-0.092*</td>
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</tr>
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<td>HandleSystem</td>
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</tr>
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<td>KnowledgeField</td>
<td>1.827**</td>
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<td>0.131**</td>
</tr>
<tr>
<td>LeaderExp</td>
<td>0.924</td>
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<td>0.055</td>
</tr>
<tr>
<td>LongRangeGoals</td>
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<td>-0.001</td>
</tr>
<tr>
<td>RealAppraisal</td>
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<td>0.036</td>
</tr>
<tr>
<td>SelfConcept</td>
<td>-1.734*</td>
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<td>-0.118*</td>
</tr>
<tr>
<td>SupportPerson</td>
<td>0.716</td>
<td>1.163</td>
<td>0.029</td>
</tr>
</tbody>
</table>

Note. $R^2 = .393$; adjusted $R^2 = .342$; $F(30, 354)=7.643$, $p<.001$

* $p \leq .1$; * $p \leq .05$; ** $p \leq .01$. 

Table 9
Multiple Regression Analysis Summary for Predicting Percent of First Semester Credits Completed
credits completed in the first semester at a community college may be less influenced by prior academic experience and more by other non-academic factors.

Two variables measuring anticipated interactions and experiences were marginally significant predictors of the percent of credits completed in the first semester. TimeperCredit measures the amount of time a student anticipates studying per registered credit during the semester (p=.058). This variable is positively correlated with the percent of credits completed while OftenPleasure, which measures the anticipated frequency of drinking alcohol, partying, and watching television had a negative correlation (p=.064). Both of these variables should be analyzed with larger sample sizes to uncover their potential as predictor variables.

Finally, two noncognitive variables are statistically significant in this model. KnowledgeField (p=.013) has a small, positive effect on percentage of credits completed while SelfConcept (p=.019) has a small, negative effect. One possible rationale for this negative relationship could be the negative impact of overconfidence. Students who overestimate their abilities may be less likely to ask questions, seek assistance, or utilize the vast array of support structures available on campus. Either the delay or unwillingness to use of such services could conceivably result in successfully completing fewer courses in the semester.

In summary, the percent of credits completed during the first semester was significantly and positively correlated with age, high family income, number
of credits attempted, anticipated time spent studying per registered credit hour, degree-related primary educational goal, and knowledge acquired about the field of interest. Percent of credits completed was significantly and negatively correlated with having a disability, being nonwhite, certainty of educational goal, and frequency of seeking pleasure.

RQ3. Is there a significant relationship between scores on noncognitive constructs and passing Elementary Algebra after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

To investigate my third research question I conducted a logistic regression analysis to assess the extent to which noncognitive variables add incremental value in explaining success or failure in Elementary Algebra. When all five blocks of variables are considered together, they significantly predict whether or not a student passed Elementary Algebra, \( \chi^2 = 133.99, df = 30, N = 385, p < .001 \). The -2 Log likelihood is 389.37 for this model. The Nagelkerke pseudo \( R^2 \) is 0.395, suggesting the model accounted for 39.5% of the total variance. This suggests the set of predictor variables does discriminate between those passing and those not passing Elementary Algebra. The overall prediction success rate with this model is 74.8%. Table 10 presents the regression coefficients, B, the Wald statistics, and the odds ratios, Exp(B), for each independent variable. Both statistically significant findings \( (p \leq .05) \) and marginally significant findings \( (p \leq .10) \) are noted in the table.
A self-reported disability is the only demographic characteristic reaching statistical significance (p=.005). After controlling for all other variables in the model, for students reporting that they have a disability the odds of passing Elementary Algebra were only .35 times (or were 65% less than) the odds of passing for those who do not have a disability. High family income is marginally significant (p=.059); for each one thousand dollar increase in family income, the odds of passing Elementary Algebra are 1.77 times greater, all else equal.

College planning contributed two significant variables to the model. The odds of passing for students utilizing college advising services were twice as great as the odds of passing for those who did not make use of college advising sources after controlling for all other variables in the model (p=.026). This seems to be an important finding for improving community college student success and should be straightforward to implement.

For each additional credit hour a student attempted in the semester, the odds of passing Elementary algebra increased by a factor of 1.28 (p ≤ .001). One possible explanation for this finding is that higher levels of institutional and academic engagement lead to a higher likelihood of course completion. Alternatively, students enrolled in fewer credits are much more likely to have more non-educational distractions in their lives and therefore are less likely to complete the course.

For each single point increase on the elementary algebra pretest, the odds of passing Elementary Algebra increase by a multiple of 1.2 (p=.003). It is not
Table 10
Logistic Regression Analysis Summary for Predicting Pass or Fail Elementary Algebra Course

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
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<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.049</td>
<td>0.035</td>
<td>1.928</td>
<td>1.050</td>
</tr>
<tr>
<td>FamIncomeHigh</td>
<td>0.573*</td>
<td>0.303</td>
<td>3.567</td>
<td>1.774*</td>
</tr>
<tr>
<td>Female</td>
<td>0.381</td>
<td>0.285</td>
<td>1.784</td>
<td>1.463</td>
</tr>
<tr>
<td>HaveDisability</td>
<td>-1.058**</td>
<td>0.381</td>
<td>7.732</td>
<td>0.347**</td>
</tr>
<tr>
<td>Minority</td>
<td>-0.545</td>
<td>0.429</td>
<td>1.610</td>
<td>0.580</td>
</tr>
<tr>
<td>ParentEducBinary</td>
<td>-0.274</td>
<td>0.290</td>
<td>0.890</td>
<td>0.760</td>
</tr>
<tr>
<td><strong>College Plans</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AdvisorCnslrTchr</td>
<td>0.418</td>
<td>0.395</td>
<td>1.121</td>
<td>1.519</td>
</tr>
<tr>
<td>AdvisorCollege</td>
<td>0.715*</td>
<td>0.321</td>
<td>4.957</td>
<td>2.044*</td>
</tr>
<tr>
<td>AdvisorPersonal</td>
<td>0.208</td>
<td>0.285</td>
<td>0.532</td>
<td>1.231</td>
</tr>
<tr>
<td>CertainGoal</td>
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<td>0.184</td>
<td>1.659</td>
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</tr>
<tr>
<td>F09_Cr_Attempt</td>
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<td>0.041</td>
<td>35.778</td>
<td>1.281**</td>
</tr>
<tr>
<td>F09TotalGrantSchlrship</td>
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<td>0.114</td>
<td>1.483</td>
<td>0.870</td>
</tr>
<tr>
<td>F09TotalLoan</td>
<td>-0.084</td>
<td>0.103</td>
<td>0.658</td>
<td>0.920</td>
</tr>
<tr>
<td>PrimEdGoal_DegreeRelated</td>
<td>0.250</td>
<td>0.412</td>
<td>0.367</td>
<td>1.283</td>
</tr>
<tr>
<td>WorkOffCmpsBinary</td>
<td>-0.029</td>
<td>0.329</td>
<td>0.008</td>
<td>0.972</td>
</tr>
<tr>
<td><strong>Prior Mathematics Achievement</strong></td>
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<tr>
<td>HighMathBinary</td>
<td>-0.406</td>
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<td>0.666</td>
</tr>
<tr>
<td>PreTestElemAlg</td>
<td>0.192**</td>
<td>0.064</td>
<td>9.046</td>
<td>1.211**</td>
</tr>
<tr>
<td>PreTestPreAlg</td>
<td>0.077</td>
<td>0.050</td>
<td>2.326</td>
<td>1.080</td>
</tr>
<tr>
<td><strong>Anticipated Experiences/Interactions</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TimeperCredit</td>
<td>0.225</td>
<td>0.213</td>
<td>1.121</td>
<td>1.253</td>
</tr>
<tr>
<td>OftenAcademic</td>
<td>0.276</td>
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<td>0.826</td>
<td>1.318</td>
</tr>
<tr>
<td>OftenSocial</td>
<td>-0.440</td>
<td>0.295</td>
<td>2.227</td>
<td>0.644</td>
</tr>
<tr>
<td>OftenPleasure</td>
<td>0.009</td>
<td>0.220</td>
<td>0.002</td>
<td>1.009</td>
</tr>
<tr>
<td><strong>Noncognitive Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CommService</td>
<td>-0.010</td>
<td>0.073</td>
<td>0.020</td>
<td>0.990</td>
</tr>
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<td>HandleSystem</td>
<td>-0.114*</td>
<td>0.051</td>
<td>5.087</td>
<td>0.892*</td>
</tr>
<tr>
<td>KnowledgeField</td>
<td>0.126*</td>
<td>0.058</td>
<td>4.650</td>
<td>1.134*</td>
</tr>
<tr>
<td>LeaderExp</td>
<td>0.117</td>
<td>0.080</td>
<td>2.123</td>
<td>1.124</td>
</tr>
<tr>
<td>LongRangeGoals</td>
<td>0.096*</td>
<td>0.052</td>
<td>3.448</td>
<td>1.100*</td>
</tr>
<tr>
<td>RealAppraisal</td>
<td>0.081</td>
<td>0.076</td>
<td>1.144</td>
<td>1.084</td>
</tr>
<tr>
<td>SelfConcept</td>
<td>-0.145*</td>
<td>0.063</td>
<td>5.302</td>
<td>0.865*</td>
</tr>
<tr>
<td>SupportPerson</td>
<td>0.128</td>
<td>0.092</td>
<td>1.938</td>
<td>1.136</td>
</tr>
<tr>
<td>Constant</td>
<td>-5.712**</td>
<td>2.181</td>
<td>6.857</td>
<td>0.003**</td>
</tr>
</tbody>
</table>

Note. $\chi^2$=133.99; $df=30$, $N=385$; $p<.001$; -2 Log likelihood 389.37; Nagelkerke pseudo $R^2 = .395$;
*p≤.1; *p≤.05; **p≤.01.
surprising that students entering the course with more knowledge of course content are more likely to successfully complete the course.

None of the anticipatory variables reached statistical significance in predicting whether a student would pass or fail Elementary Algebra. Three noncognitive variables were statistically significant predictors and a fourth reached marginal significance. For each one point increase in knowledge acquired in the field (p=.031), the odds of passing Elementary Algebra increased by a factor of 1.13. The preference for long-term goals (p=.063) was also marginally significant, improving the odds of passing the class by a multiple of 1.1 for each one-point increase in scale. In a somewhat surprising finding, both positive self concept (p=.021) and effectively handling the system (p=.024) had a significant and negative impact on successful course completion. Overconfidence or naivety of postsecondary academic expectations are possible explanations for the negative correlation between passing Elementary Algebra and positive self concept. Several items which constitute handling the system seem to have undertones of political activism. Students with high scores on handling the system may be more likely to exert effort towards improving conditions and confronting discriminatory circumstances than those with lower handling the system scores, and therefore spend less energy preparing for their math course.

In summary, passing or failing Elementary Algebra is positively and significantly correlated with high family income, using a college advisor, the number of credits attempted in the semester, elementary algebra pretest score,
preference for long-term goals, and knowledge acquired about one’s prospective field of study. Significant and negative correlations exist with having a disability, effectively handling the system, and positive self concept.

RQ4. Is there a significant relationship between scores on noncognitive constructs and persistence to the spring semester at the institution after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

My fourth research question assesses the extent to which persistence from fall to spring at the host institution is correlated with noncognitive variables after controlling for demographics, college planning, prior mathematics achievement, and anticipated interactions and experiences during the semester. Because persistence is a binary outcome, I used logistic regression for this analysis on the full sample. When all five blocks of variables are considered together, they significantly predict whether or not a student passed Elementary Algebra, $\chi^2 = 93.47, df = 30, N = 385, p < .001$. The -2 Log likelihood is 246.40 for this model. The Nagelkerke pseudo $R^2$ is 0.368, suggesting the model accounted for 36.8% of the total variance. This suggests the set of predictor variables does discriminate between those students who did and did not persist at the institution from fall to spring. The overall prediction success rate with this model is 86.5%. Table 11 presents the regression coefficients, B, the Wald statistics, and the odds ratios, Exp(B), for each independent variable. Both
statistically significant findings \( (p \leq .05) \) and marginally significant findings \( (p \leq .10) \) are noted in the table.

Gender is the only significant demographic variable in this model. After controlling for all other variables in the model, the odds of females persisting in mathematics were 81% less than the odds of males persisting \( (p=.002) \). Number of credits attempted in the fall semester is once again a significant predictor variable \( (p<.001) \). For each one credit attempted in the fall semester, the odds of persisting to the spring semester increased by a factor of 1.33. The odds of a full-time student, defined as enrolled in 12 or more credits, persisting to the spring semester are more than ten times greater than a student only enrolled in one course (3 credits) even after controlling for all other variables in the model. Additionally the total amount of loans a student carries significantly impacts the odds of persistence. For each one thousand dollars in loans the odds of persistence to the spring semester increased by a multiple of 1.36.

There were no significant variables from the prior mathematics achievement block, however the elementary algebra pretest did reach marginal significance \( (p=.061) \). For each item correctly answered on the elementary algebra pretest, the odds of persistence to the spring semester decreased by a multiple of .85.

No variables measuring anticipated experiences or interactions reach statistical significance. One noncognitive variable is significant and a second is marginally significant in predicting persistence to the spring semester. For each single point increase in the long range goals score, the odds of persisting to the
Table 11
Logistic Regression Analysis Summary for Predicting Institutional Persistence from Fall 2009 to Spring 2010

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>Exp(B)</th>
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<td><strong>Demographics</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.014</td>
<td>0.043</td>
<td>0.104</td>
<td>1.014</td>
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<td>FamIncomeHigh</td>
<td>0.076</td>
<td>0.425</td>
<td>0.032</td>
<td>1.079</td>
</tr>
<tr>
<td>Female</td>
<td>-1.233**</td>
<td>0.404</td>
<td>9.296</td>
<td>0.291**</td>
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<tr>
<td>HaveDisability</td>
<td>-0.232</td>
<td>0.480</td>
<td>0.235</td>
<td>0.793</td>
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<tr>
<td>Minority</td>
<td>-0.225</td>
<td>0.560</td>
<td>0.161</td>
<td>0.798</td>
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<tr>
<td>ParentEducBinary</td>
<td>-0.019</td>
<td>0.383</td>
<td>0.003</td>
<td>0.981</td>
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<td><strong>College Plans</strong></td>
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</tr>
<tr>
<td>AdvisorCnslrTchr</td>
<td>0.567</td>
<td>0.597</td>
<td>0.903</td>
<td>1.763</td>
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<tr>
<td>AdvisorCollege</td>
<td>0.045</td>
<td>0.441</td>
<td>0.010</td>
<td>1.046</td>
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<td>AdvisorPersonal</td>
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<td>0.006</td>
<td>1.028</td>
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<td>CertainGoal</td>
<td>0.023</td>
<td>0.229</td>
<td>0.010</td>
<td>1.023</td>
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<tr>
<td>F09_Cr_Attempt</td>
<td>0.284**</td>
<td>0.042</td>
<td>45.368</td>
<td>1.328**</td>
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<td>F09TotalGrantSchlrship</td>
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<td>0.159</td>
<td>0.027</td>
<td>0.974</td>
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<td>F09TotalLoan</td>
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<td>0.152</td>
<td>3.120</td>
<td>1.362*</td>
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<td>PrimEdGoal_DegreeRelated</td>
<td>0.499</td>
<td>0.504</td>
<td>0.979</td>
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<tr>
<td>WorkOffCmpsBinary</td>
<td>0.506</td>
<td>0.435</td>
<td>1.532</td>
<td>1.658</td>
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<tr>
<td><strong>Prior Mathematics Achievement</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HighMathBinary</td>
<td>0.509</td>
<td>0.469</td>
<td>1.179</td>
<td>1.664</td>
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<tr>
<td>PreTestElemAlg</td>
<td>-0.158*</td>
<td>0.084</td>
<td>3.516</td>
<td>0.854*</td>
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<tr>
<td>PreTestPreAlg</td>
<td>0.094</td>
<td>0.066</td>
<td>2.018</td>
<td>1.099</td>
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<tr>
<td><strong>Anticipated Experiences/Interactions</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>TimeperCredit</td>
<td>0.114</td>
<td>0.223</td>
<td>0.263</td>
<td>1.121</td>
</tr>
<tr>
<td>OftenAcademic</td>
<td>-0.075</td>
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<td>0.034</td>
<td>0.928</td>
</tr>
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<td>OftenSocial</td>
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<td>0.408</td>
<td>0.352</td>
<td>0.785</td>
</tr>
<tr>
<td>OftenPleasure</td>
<td>-0.118</td>
<td>0.280</td>
<td>0.179</td>
<td>0.888</td>
</tr>
<tr>
<td><strong>Noncognitive Variables</strong></td>
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<td></td>
</tr>
<tr>
<td>CommService</td>
<td>-0.041</td>
<td>0.090</td>
<td>0.209</td>
<td>0.960</td>
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<tr>
<td>HandleSystem</td>
<td>0.070</td>
<td>0.067</td>
<td>1.063</td>
<td>1.072</td>
</tr>
<tr>
<td>KnowledgeField</td>
<td>0.127*</td>
<td>0.076</td>
<td>2.772</td>
<td>1.135*</td>
</tr>
<tr>
<td>LeaderExp</td>
<td>0.000</td>
<td>0.110</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>LongRangeGoals</td>
<td>0.194**</td>
<td>0.072</td>
<td>7.171</td>
<td>1.214**</td>
</tr>
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<td>RealAppraisal</td>
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<td>0.064</td>
<td>0.975</td>
</tr>
<tr>
<td>SelfConcept</td>
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<td>0.886</td>
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<td>SupportPerson</td>
<td>-0.011</td>
<td>0.124</td>
<td>0.007</td>
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</tr>
<tr>
<td>Constant</td>
<td>-5.846*</td>
<td>2.712</td>
<td>4.646</td>
<td>0.003*</td>
</tr>
</tbody>
</table>

Note. $\chi^2=93.47; df=30, N=385; p<.001; -2 \text{Log likelihood} 246.40$;
Nagelkerke pseudo $R^2 = .368$;
*p<.1; *p<.05; **p<.01.
spring semester at the institution are 1.21 times greater (p=.007). For each one point increase in the knowledge of field score, the odds of persistence increases by a factor of 1.14 (p=.096).

In summary, number of credits attempted, total amount of loans, knowledge acquired in the field, and preference for long-range goals were found to be significantly and positively related to persistence at the institution from fall to spring. Being female and the elementary algebra pretest score were significantly and negatively correlated with institutional persistence from fall to spring.

RQ5. Is there a significant relationship between scores on noncognitive constructs and the score on the Elementary Algebra final exam after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?

My fifth research question assesses the value of employing noncognitive variables as a predictor of student performance on the departmental Elementary Algebra final exam. Possible scores on the exam range from 0 to 32, so I used OLS regression. I used data from the posttest sample because only students who completed the final exam have a value for the dependent variable. The five blocks of independent variables significantly predicted percent of credits completed during the first semester, $F(30,254)=5.391$, $p<.001$, with five variables reaching statistical significance and one additional variable noted for heuristic purposes. The adjusted $R$ squared value is .342, indicating that 34.2% of the
variation in scores on the final exam is explained by the model. Table 12 presents unstandardized coefficients, standard errors, and standardized coefficients for each independent variable. Both statistically significant findings ($p \leq .05$) and marginally significant findings ($p \leq .10$) are noted in the table. My analysis shows that no demographic variables had a significant impact on student scores on the final exam after controlling for college plans, prior mathematics achievement, anticipated experiences, and noncognitive variables. The total amount of loans had a significant and negative impact on final exam scores ($p=.047$). For each one thousand dollars in loans a student’s final exam score decreased by nearly one-half of a point. While the effect size is small, the negative correlation suggests that even after controlling for all other variables in the model, students with higher levels of borrowing are underperforming on the final exam when compared to their less indebted classmates. In addition, a degree-related primary educational goal was positively correlated with scores on the final exam ($p=.025$).

Both the prealgebra and elementary algebra pretests are positively correlated with scores on the final exam ($p<.001$ for both). While this correlation is not surprising, it may have a very practical use as an advising tool very early in the semester. For each one-unit increase in a student’s prealgebra pretest score, the final exam score increased by .76 points. Similarly, for each one-unit increase on the elementary algebra pretest score, the final exam score increased by .57 points. It is worth noting that prerequisite knowledge, as measured by the
<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
</tr>
</thead>
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<tr>
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<td>0.069</td>
<td>0.058</td>
</tr>
<tr>
<td>FamIncomeHigh</td>
<td>0.886</td>
<td>0.732</td>
<td>0.075</td>
</tr>
<tr>
<td>Female</td>
<td>0.156</td>
<td>0.694</td>
<td>0.013</td>
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<tr>
<td>HaveDisability</td>
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<td>Minority</td>
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<td>1.070</td>
<td>-0.026</td>
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<td>ParentEducBinary</td>
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<td></td>
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<td>AdvisorCnsIrTchr</td>
<td>-0.675</td>
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<td>-0.040</td>
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<td>AdvisorCollege</td>
<td>0.055</td>
<td>0.780</td>
<td>0.004</td>
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<td>AdvisorPersonal</td>
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<td>CertainGoal</td>
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<td>F09_Cr_Attempt</td>
<td>0.183</td>
<td>0.136</td>
<td>0.081</td>
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<td>F09TotalGrantSchlrship</td>
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<td>0.290</td>
<td>0.000</td>
</tr>
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<td>F09TotalLoan</td>
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<td>0.246</td>
<td>-0.111*</td>
</tr>
<tr>
<td>PrimEdGoal_DegreeRelated</td>
<td>2.471*</td>
<td>1.098</td>
<td>0.123*</td>
</tr>
<tr>
<td>WorkOffCmpsBinary</td>
<td>-0.765</td>
<td>0.746</td>
<td>-0.055</td>
</tr>
<tr>
<td><strong>Prior Mathematics Achievement</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HighMathBinary</td>
<td>-1.622</td>
<td>1.016</td>
<td>-0.100</td>
</tr>
<tr>
<td>PreTestElemAlg</td>
<td>0.566**</td>
<td>0.148</td>
<td>0.246**</td>
</tr>
<tr>
<td>PreTestPreAlg</td>
<td>0.759**</td>
<td>0.122</td>
<td>0.378**</td>
</tr>
<tr>
<td><strong>Anticipated Experiences/Interactions</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>TimeperCredit</td>
<td>1.007</td>
<td>0.659</td>
<td>0.095</td>
</tr>
<tr>
<td>OftenAcademic</td>
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<td>0.745</td>
<td>-0.096</td>
</tr>
<tr>
<td>OftenSocial</td>
<td>-0.827</td>
<td>0.753</td>
<td>-0.079</td>
</tr>
<tr>
<td>OftenPleasure</td>
<td>0.097</td>
<td>0.586</td>
<td>0.010</td>
</tr>
<tr>
<td><strong>Noncognitive Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CommService</td>
<td>-0.029</td>
<td>0.188</td>
<td>-0.011</td>
</tr>
<tr>
<td>HandleSystem</td>
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<td>0.127</td>
<td>-0.034</td>
</tr>
<tr>
<td>KnowledgeField</td>
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<td>0.149</td>
<td>-0.014</td>
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<tr>
<td>LeaderExp</td>
<td>-0.184</td>
<td>0.206</td>
<td>-0.067</td>
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<tr>
<td>LongRangeGoals</td>
<td>0.314*</td>
<td>0.129</td>
<td>0.150*</td>
</tr>
<tr>
<td>RealAppraisal</td>
<td>0.348*</td>
<td>0.183</td>
<td>0.114*</td>
</tr>
<tr>
<td>SelfConcept</td>
<td>0.224</td>
<td>0.154</td>
<td>0.091</td>
</tr>
<tr>
<td>SupportPerson</td>
<td>-0.100</td>
<td>0.223</td>
<td>-0.026</td>
</tr>
</tbody>
</table>

Note. R² = .419; adjusted R² = .342; F(30, 254) = 5.391, p < .001. 
*p ≤ .1; *p ≤ .05; **p ≤ .01.
prealgebra pretest, appears to be more predictive of performance on the final exam than knowledge of material presented in the course, measured by the elementary algebra pretest, suggesting a good foundation or preparation for the course is more critical than exposure to the specific course content.

None of the anticipatory variables had a significant correlation with final exam scores. I identified one significant and one marginally significant noncognitive variable. Students more able to create and remain faithful to long-range goals enjoyed greater success on the final exam ($p=.016$). Realistic self-appraisal reached marginal significance ($p=.059$) with final exam score despite a relatively small sample size. Students who were able to more accurately assess their abilities, and were therefore more likely to confront their weaknesses, performed better on the final exam.

In summary, performance on the Elementary Algebra final exam was positively correlated with a primary educational goal related to obtaining a degree, prealgebra and elementary algebra pretest scores, a preference for long-term goals, and realistic self-appraisal. Final exam scores were negatively related to the total amount of loans a student held.

RQ6. Is there a significant relationship between scores on noncognitive constructs and persistence in mathematics after controlling for student demographics, college plans, prior math achievement, and expected engagement in social and academic activities?
My sixth and final research question explores the extent to which persistence in mathematics can be explained by noncognitive variables after controlling for demographics, college plans, prior mathematics achievement, and anticipated interactions and experiences during the first semester of college. I used logistic regression to examine this question; however I had to restrict the full sample to only those students who persisted at the institution to the spring semester. Previously I introduced this sample as the math persistence sample. When all five blocks of variables are considered together, they significantly predict whether or not a student will enroll in a mathematics class in the spring 2010 semester, \( \chi^2 = 44.12, df = 30, N = 323, p = .047 \). The -2 Log likelihood is 345.46 for this model. The Nagelkerke pseudo \( R^2 \) is 0.182, suggesting the model accounted for 18.2% of the total variance. This suggests the set of predictor variables does discriminate between those students who did and did not persist in mathematics from fall to spring. The overall prediction success rate with this model is 73.1%. Table 13 presents the regression coefficients, B, the Wald statistics, and the odds ratios, Exp(B), for each independent variable. Both statistically significant findings (\( p \leq .05 \)) and marginally significant findings (\( p \leq .10 \)) are noted in the table.

The only demographic variable significantly correlated with persistence in mathematics is ParentEducBinary (\( p=.016 \)). Recall the coding for this variable is 1 if at least one of the student’s parents had some postsecondary education experience and 0 if neither parent had attended any form of postsecondary education. My analysis shows that the odds of persisting in mathematics for a
student with at least one parent who attended some type of education after high school were 55% less than a student for which neither parent attended higher education.

Two college planning variables reached statistical significance and two others were marginally significant. The odds for mathematics persistence for students using a college advising source, defined as a staff member from the host institution, the host institution’s website, or an advisor from a different college, prior to or within the first few days of their college experience were 2.1 times greater than the odds of persistence in mathematics for students not using a college advising source (p=.029). Planning to work off campus one or more hours per week during the semester increased the odds of enrolling in a math course in the spring semester by a factor of 2.3 when compared to students not planning to work off campus (p=.011), controlling for all other variables in the model. For each additional one credit attempted in the fall semester, the odds of taking a math course in the spring semester increased by a multiple of 1.08 (p=.066). Additionally, for students who identified a primary educational goal related to obtaining a degree the odds of persisting in mathematics were 2.1 times greater than those with a goal not related to obtaining a degree (p=.093).

The highest math course completed in high school is positively correlated to persisting in mathematics (p=.091). The odds of persisting in mathematics in the spring semester for a student who reported completing a course in geometry, algebra II, statistics, trigonometry, pre-calculus, or calculus during high school were almost double the odds of a student whose highest math
Table 13
Logistic Regression Analysis Summary for Predicting Mathematics Persistence from Fall 2009 to Spring 2010

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.002</td>
<td>0.029</td>
<td>0.004</td>
<td>1.002</td>
</tr>
<tr>
<td>FamIncomeHigh</td>
<td>0.308</td>
<td>0.326</td>
<td>0.894</td>
<td>1.361</td>
</tr>
<tr>
<td>Female</td>
<td>0.104</td>
<td>0.304</td>
<td>0.117</td>
<td>1.109</td>
</tr>
<tr>
<td>HaveDisability</td>
<td>0.319</td>
<td>0.423</td>
<td>0.570</td>
<td>1.376</td>
</tr>
<tr>
<td>Minority</td>
<td>0.438</td>
<td>0.485</td>
<td>0.816</td>
<td>1.550</td>
</tr>
<tr>
<td>ParentEducBinary</td>
<td>-0.797*</td>
<td>0.331</td>
<td>5.796</td>
<td>0.451*</td>
</tr>
<tr>
<td>College Plans</td>
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<td></td>
</tr>
<tr>
<td>AdvisorCnslrTchr</td>
<td>0.574</td>
<td>0.424</td>
<td>1.831</td>
<td>1.775</td>
</tr>
<tr>
<td>AdvisorCollege</td>
<td>0.741*</td>
<td>0.339</td>
<td>4.771</td>
<td>2.097*</td>
</tr>
<tr>
<td>AdvisorPersonal</td>
<td>0.042</td>
<td>0.301</td>
<td>0.019</td>
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</tr>
<tr>
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<td>0.199</td>
<td>0.108</td>
<td>1.068</td>
</tr>
<tr>
<td>F09_Cr_Attempt</td>
<td>0.079*</td>
<td>0.043</td>
<td>3.391</td>
<td>1.082*</td>
</tr>
<tr>
<td>F09TotalGrantSchlrship</td>
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<td>0.125</td>
<td>0.351</td>
<td>0.929</td>
</tr>
<tr>
<td>F09TotalLoan</td>
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<td>0.599</td>
<td>0.918</td>
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<tr>
<td>PrimEdGoal_DegreeRelated</td>
<td>0.745*</td>
<td>0.443</td>
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<td>2.106*</td>
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<td>WorkOffCmpsBinary</td>
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<td>0.330</td>
<td>6.404</td>
<td>2.308**</td>
</tr>
<tr>
<td>Prior Mathematics Achievement</td>
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<td></td>
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<tr>
<td>HighMathBinary</td>
<td>0.664*</td>
<td>0.392</td>
<td>2.865</td>
<td>1.942*</td>
</tr>
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<td>PreTestElemAlg</td>
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<td>0.071</td>
<td>0.003</td>
<td>1.004</td>
</tr>
<tr>
<td>PreTestPreAlg</td>
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<td>0.727</td>
<td>1.049</td>
</tr>
<tr>
<td>Anticipated Experiences/Interactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TimeperCredit</td>
<td>0.204</td>
<td>0.265</td>
<td>0.596</td>
<td>1.227</td>
</tr>
<tr>
<td>OftenAcademic</td>
<td>0.507</td>
<td>0.339</td>
<td>2.243</td>
<td>1.660</td>
</tr>
<tr>
<td>OftenSocial</td>
<td>0.204</td>
<td>0.321</td>
<td>0.404</td>
<td>1.227</td>
</tr>
<tr>
<td>OftenPleasure</td>
<td>0.117</td>
<td>0.239</td>
<td>0.241</td>
<td>1.125</td>
</tr>
<tr>
<td>Noncognitive Variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CommService</td>
<td>0.108</td>
<td>0.080</td>
<td>1.834</td>
<td>1.114</td>
</tr>
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<td>0.053</td>
<td>1.255</td>
<td>1.061</td>
</tr>
<tr>
<td>KnowledgeField</td>
<td>-0.092</td>
<td>0.061</td>
<td>2.215</td>
<td>0.913</td>
</tr>
<tr>
<td>LeaderExp</td>
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<td>0.090</td>
<td>5.220</td>
<td>0.814*</td>
</tr>
<tr>
<td>LongRangeGoals</td>
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<td>0.055</td>
<td>0.346</td>
<td>1.033</td>
</tr>
<tr>
<td>RealAppraisal</td>
<td>0.018</td>
<td>0.082</td>
<td>0.050</td>
<td>1.018</td>
</tr>
<tr>
<td>SelfConcept</td>
<td>-0.037</td>
<td>0.063</td>
<td>0.343</td>
<td>0.964</td>
</tr>
<tr>
<td>SupportPerson</td>
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<td>0.101</td>
<td>0.303</td>
<td>0.946</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.141</td>
<td>2.232</td>
<td>0.920</td>
<td>0.118</td>
</tr>
</tbody>
</table>

Note. $\chi^2=44.12$; $df=30$, $N=323$; $p<.047$; -2 Log likelihood $345.46$; Nagelkerke pseudo $R^2 = .182$; *$p \leq .1$; **$p \leq .05$; ***$p \leq .01$. 

course completed in high school was pre-algebra, elementary algebra, or basic math.

No anticipated interaction variables reached statistical significance for predicting math persistence. Leadership experience is the only significant noncognitive variable. For each one point increase in the leadership experience score, the odds of persisting in mathematics decreased by 19%.

In summary, using a college advising source, the number of credits attempted, a degree-related primary educational goal, the expectation of working off campus during the semester, and the highest math course completed in high school were positively correlated with persisting in mathematics in the second semester. There was a significant, negative correlation between math persistence and having at least one parent with postsecondary education experience as well as leadership experience.

Summary

In this chapter I first described my full sample of first-time community college students who were enrolled in Elementary Algebra, completed both the prealgebra and elementary algebra pretests, and completed my survey, the EASSS. Next I described the rationale for and subsequent results of two subsets of the full sample, denoted posttest sample and math persistence sample. The two restricted samples allowed for analyses of the utility of noncognitive variables as predictors of posttest scores and mathematics persistence.

The last section of this chapter presented the results for the six research questions put forth in this study. I used a single model containing five blocks of
variables (demographic, college plans, prior mathematics achievement, anticipated interactions and experiences, and noncognitive variables) to analyze six different measures of success and persistence. Three measures of success; first semester GPA, percent of attempted credits which were completed, and Elementary Algebra posttest score, had continuous dependent variables and thus I used multiple linear regression. The remaining three measures of success; pass or fail Elementary Algebra, persist at the institution, and persist in mathematics, were binary outcomes and therefore required logistic regression.

In my first research question I wanted to examine which variables significantly impacted a student’s GPA in their first semester of college. I found that first semester GPA was positively correlated with three demographic variables: age, high family income, and being female. Three college planning variables significantly contributed to first semester GPA. The number of credits attempted and a primary educational goal related to earning a degree positively influenced GPA while certainty of goal had a negative impact. Only one measure of prior mathematics achievement reached marginal significance: the prealgebra pretest was positively correlated with first semester GPA. Two anticipatory variables reached significance: time spent studying per credit hour attempted was positive while the frequency of partying, drinking alcohol, and watching television had a negative impact. Only one noncognitive variable reached statistical significance; knowledge acquired about a field was positively correlated with first semester GPA.
In my second research question I wanted to determine the significant influences on the percentage of credits completed in the first semester of college. Four demographic variables were marginally significant: age and high family income had a positive impact while being a minority and having a disability had a negative correlation. Three college planning variables reached statistical significance. Number of credits attempted and a degree related educational goal were each positively correlated with the percentage of credits completed while certainty of goal had a negative effect. Two anticipated experiences had a marginally significant impact on percent of credits completed: time spent studying per credit was positive while anticipated partying, drinking alcohol, and watching television was negative. Two noncognitive variables were significantly correlated with percent of credits completed: knowledge acquired about a field was positive while self concept was negative.

In my third research question I wanted to ascertain which variables significantly impacted the odds of passing Elementary Algebra. I found that the odds of passing Elementary Algebra improved for students from families with higher incomes while the odds for students with a disability to pass were significantly lower than the odds for students without a disability. Two college planning variables had a significant, positive impact on passing the course: number of credits attempted and using a college advising source. Scores on the elementary algebra pretest were positively correlated with passing the course. Four of the noncognitive variables reached statistical significance. Knowledge acquired about a field had a positive impact and the tendency towards long range
goals had a marginally significant positive impact. Both self concept and the ability to handle the system were negatively correlated with passing Elementary Algebra.

In my fourth research question I wanted to determine which variables significantly impacted persistence at the institution to the second, or spring semester. I found that the odds of females persisting at the institution were lower than the odds of males persisting while both the number of credits attempted and total amount of loans improved the odds of persistence. For each question answered correctly on the elementary algebra pretest, the odds of persistence at the institution decreased by nearly 15%. Two noncognitive variables were positively correlated with institutional persistence: knowledge acquired in a field was marginally significant while a tendency towards long term goals was significant.

In my fifth research question I sought to identify traits which significantly affected a student's score on the common course posttest. Two college planning variables were significant contributors to posttest scores: total amount of loans had a negative correlation while a degree-oriented educational goal had a positive impact. Both pretest measures of prior mathematics achievement had a significant and positive correlation with posttest scores. The preference for long range goals and realistic self appraisal each positively impacted posttest scores.

In my final research question I wanted to examine the student characteristics which were significantly correlated with persistence in mathematics. My results indicated that the odds of persisting in mathematics
were lower for a student with at least one parent who attended some form of postsecondary education than a student for which neither parent attended postsecondary education. Four measures of college planning had a positive correlation with mathematics persistence. Using a college advising source and plans to work off campus during the semester significantly increased the likelihood of persisting in mathematics while a primary educational goal and the number of credits attempted had a marginally significant influence. The odds of a student who completed high school algebra II, geometry, statistics, trigonometry, precalculus, or calculus course persisting in mathematics were higher than the odds of math persistence for those whose highest completed math course was basic math, prealgebra, or algebra I. Only one noncognitive variable reached statistical significance: leadership experience was negatively correlated with mathematics persistence.

In the final chapter I begin by summarizing and discussing my research findings by independent variable. I examine some broader conclusions based upon my findings and connect them to the literature guiding this research. Next I discuss both practical and theoretical implications of this research. My findings offer insight for community college faculty and administration to implement student success oriented strategies right away. With a focus squarely on community college students, my study also fills a void in the student success literature. Finally I examine a number of limitations of this study and areas for further inquiry, each of which should guide scholarly discovery in the arena of community college student success.
CHAPTER 5: DISCUSSION

Introduction

Community colleges are the fastest growing institutional type in America and enroll the most diverse student body. Unfortunately they are also the least researched educational entity and therefore both community college staff and students lack the benefits of theoretically-driven practices and policies. One area of particular concern is student success and persistence. Prior research with students attending four-year institutions suggests academically underprepared students, first-generation college students, members of a racial or ethnic minority, students from low-SES families, and part-time students are all traits correlated with lower likelihood of success and persistence in college. A disproportionate number of community college students possess one or more of these characteristics, and are therefore more likely to leave college before achieving their educational goals. Pascarella and Terenzini (2005) concluded that community college students are significantly different than their four-year counterparts on a variety of demographic, academic achievement, and educational aspiration characteristics.

Astin (1970a, 1970b, 1993), Pascarella (1985), and Tinto (1975, 1993) each provide models for student success that have been widely employed in higher education research and practice for decades. Each of these models was developed for use with full-time, residential students attending four-year institutions. Tinto’s model of student departure is arguably the most widely cited model in student persistence research, yet this model is poorly equipped for
application to community college student populations (Braxton et al., 1997). Tinto’s model falls short in two critical venues: lack of theoretical support for application to community college students and a lack of psychological or affective perspective in explaining student persistence. Both Bean and Metzner (1985) and Pascarella and Terenzini (2005) suggest that in-college social and environmental integration are less influential for community college students than students attending four-year institutions. Bean and Eaton (2000) encouraged student success researchers to measure a variety of psychological characteristics upon matriculation in college. Tracey and Sedlacek (1984, 1985, 1987) and Sedlacek (2004) provide one likely candidate for measuring motivational and experiential constructs. Research has shown that scores on the NCQ are significantly correlated with college success and persistence in a variety of nontraditional populations.

Developmental mathematics provides a logical starting point for the development of a model of community college student success. Nearly every student in postsecondary education must satisfy a mathematics requirement. Adelman (2006) reported that measures of mathematics aptitude were among the best predictors of college student success. Furthermore, students are most likely to need remediation in mathematics (Bahr, 2007, 2008, 2010; McCabe, 2000; Oudenhoven, 2002; Parsad & Lewis, 2003) and those who successfully complete mathematics remediation graduate and transfer at nearly the same rate as students who are prepared for college-level mathematics when they enter college (Adelman, 1996; Bahr, 2008, 2010).
To identify precollege attributes which impact early community college success I created and administered the EASSS, a survey instrument measuring a host of cognitive and noncognitive constructs, to a sample of first semester community college students. In addition subjects completed institutional pretests encompassing both prealgebra and elementary algebra content and an institutional final exam. I used factor analysis as a data reduction strategy with the items from the EASSS which required students to anticipate the frequency and likelihood of engaging in a variety of academic and social interactions during their first semester of college. To investigate my six research questions I used both linear and logistic regression with a single, theoretically driven model containing five blocks of variables: demographic characteristics, indicators of college planning, prior mathematics achievement, anticipated interactions and experiences, and noncognitive variables.

My model proved to be significant in its explanation of various measures of student success early in the first semester for each of the six research questions. In each application of the model between six and eleven independent variables reached statistical significance ($p \leq .05$) or marginal significance ($p \leq .10$). Overall 23 of the 30 variables used in the model reached at least a marginally significant level in at least one of the six applications. Each research question defined student success in a slightly different fashion. Research Questions 1 and 2 measured general success and persistence by examining semester GPA and percent of credits completed. Research Question 3 focused strictly on mathematics success and persistence as measured by the binary
pass/fail outcome of Elementary Algebra. Research Question 5 analyzed mathematics success as measured by the institutional final exam. The remaining two questions exclusively measured persistence: Research Question 4 measured institutional persistence to the spring semester whereas Research Question 6 measured persistence in mathematics.

In the remainder of this chapter I discuss the results of this study and compare my results to previous research and theory described in the literature review. Next I describe the implications of my research for policy and practice as well as for the advancement of theory. I conclude with an examination of the limitations of this study and recommendations for future research.

**Discussion of Results**

Recall that in Chapter 4 I presented results of the final regression model which included all five blocks of variables. To minimize redundancy, and more importantly, to emphasize the global utility of the variables for explaining early community college student success and persistence, I present my discussion of the results by variable block. As I discuss my findings and their implications it is important to remember that these results assume all other variables in the model are held constant.

The first block in each model was comprised of demographic variables. Several demographic characteristics were significant predictors of student success though their influence was more prominent in measures of general first semester success. Older students did significantly better in terms of first semester GPA and percent of credits completed. Consistent with reports from
Bean and Metzner (1985), age was not a significant predictor of persistence at the institution or in mathematics. Also consistent with Tinto's (1993) research, students from high SES families had higher first semester GPAs, completed a higher percentage of credits in the first semester, and were more likely to pass Elementary Algebra than their counterparts from low SES families.

Gender was a significant predictor for two of the six outcomes. Females earned higher GPAs in the first semester of college than males, however they were less likely to persist to the spring semester at the institution. Tinto (1993) described several reasons for college departure which impacted men and women differently. According to Tinto, family responsibilities are more likely to hinder persistence in women than men. Furthermore marriage has been identified as a positive predictor of persistence for men but a negative predictor of persistence for women. Finally it is worth noting the poor economic conditions in 2009-2010, both locally and nationally, as a potentially negative influence on persistence. Based on prior research it seems feasible that women may be more likely to put their education “on hold” due to job loss or other financial constraints which undoubtedly occurred during the time of this study. Mathematics performance and persistence did not significantly differ based upon gender.

Students identifying themselves as having a disability were less likely to pass Elementary Algebra and on average completed a slightly lower percentage of attempted credits than students not having a disability. Having a disability did not significantly impact either measure of persistence. Race was only significant in one outcome. All else equal, minority students completed a modestly lower
percentage of attempted credits than white students. Perhaps the most unexpected finding from the demographic variables is that students who have at least one parent with postsecondary education experience are less likely to enroll in a mathematics course in their second semester than students whose parents never attended higher education.

Both Pascarella and Terenzini (2005) and Tinto (1993) identified entry characteristics as significant predictors of success and persistence in college. My findings seem consistent with this notion, though the impact of demographic characteristics appears to be more evident with broader measures of success and persistence, first semester GPA and percent of credits completed, than specific mathematics success or persistence. Nevertheless this study validates the need to include individual demographic characteristics in a model of community college student success.

My second block of variables measures college planning, with a particular emphasis on academic preparation for college. A cornerstone of traditional persistence models is the initial commitment to college; both to the institution and one’s personal goals. Bean and Metzner (1985) stressed that for nontraditional student populations, the level of academic initial commitment was much more important than social commitment. One clear example of academic planning is the use of advising services. The host institution does not mandate advising sessions for all students, therefore I expected a high degree of variation in the types and use of advising. I measured three types of advising: advising from a high school teacher or counselor or vocational counselor, advising from a college
advisor or website, and advising from personal sources such as family and friends. The use of high school or vocational advisors and family advisors was not significant, however I maintained those variables as controls. Meeting with an advisor from the host institution or a different college or using advising services on a college website increased the likelihood of both passing Elementary Algebra in the fall semester and persisting in mathematics in the spring semester. In both instances the odds of success more than doubled for students using college advising sources when compared to those not receiving advising from a college source. In terms of success and persistence in mathematics, it is clear students benefit from the advice of an individual familiar with higher education. The increased likelihood of passing Elementary Algebra may suggest advisors were able to help students prepare a realistic course schedule, taking into account work, family responsibilities, and other obligations. Advisors may also have had the opportunity to inform students of the numerous support services available on campus including tutoring and career advising. The marked increase in mathematics persistence suggests advisors were effective in helping students map a multiple-semester course plan. As I previously stated, the vast majority of students complete Elementary Algebra as a prerequisite for a second math course. This finding supports my conclusion that college advising sources are helpful and necessary to ensure students are aware of program requirements and efficiently schedule their courses.

Perhaps the most consistent finding in my study is the positive impact number of credits attempted has on virtually every outcome variable. Both first-
semester GPA and percent of credits completed increased significantly with each additional credit attempted. The odds of passing Elementary Algebra increased by a factor of 1.28 for each additional credit attempted and the odds of persisting at the institution increased by a factor of 1.33 per credit attempted. Attempting more credits also positively impacted mathematics persistence, though the odds ratio was not as impressive. This finding should not come as a surprise. Prior research has shown that full-time students are more successful and persistent than part-time students. This finding also makes common sense. Students enrolled in more credits probably have fewer nonacademic distractions and certainly have a greater opportunity for improved integration within the institution.

Another strong predictor of early success is a student’s primary educational goal. An educational goal related to obtaining a degree positively impacted first semester GPA, percent of credits completed, score on the posttest and mathematics persistence. Initial possession of such a goal likely suggests an underlying desire or motivation to complete an educational plan, which therefore further motivates higher levels of effort and use of existing support services on campus. A related, but unexpected finding is that goal certainty did not impact persistence but negatively impacted both first semester GPA and percent of credits completed. Prior research suggests persistence, not academic success, is more likely to be significantly influenced by goal certainty. Bean and Metzner (1985) suggest that goal certainty may increase the intent to transfer which would negatively impact measures of persistence. Tinto (1993) cited strong support for a positive correlation between the strength of an individual’s
intentions and persistence in college. One plausible explanation for this finding is that a high degree of goal certainty restricts effort and motivation to only those areas which, from the student’s perspective, are directly related to their goal. In other words, students with less certainty about their educational goals may be more open to learning a broad set of skills and concepts.

It is important to remember that both educational goals and certainty of goals were measured within the first few days of arriving on campus. In essence then, students created their goals prior to any college influence. Of course students who arrived on campus with very specific and certain goals are more likely to suffer negative consequences if they misjudged their own abilities, did not anticipate the level of academic rigor necessary in college, or were uninformed as to the breadth and depth of degree requirements. In each case, a student who is initially quite certain of an educational goal could reasonably be expected to falter more than a less certain student when his/her goals are challenged.

Securing financial assistance to attend college is another example of college planning. My results indicate that the amount of grants and scholarships do not impact success or persistence early in college. The amount of loans a student has does positively impact institutional persistence and negatively impact scores on the final exam. Loans are typically considered a less desirable form of financial aid, and are more likely to suggest lower family income or less knowledge about alternative sources of financial aid. The relationship between debt and institutional persistence may suggest a greater commitment to
education, after all the loans will have to be paid back. Alternatively the relationship may imply less opportunity to transfer due to the increased financial liability. Pascarella and Terenzini (2005) reported the impact of loans on persistence to be mixed. Several studies reported loans generally have either a positive impact on persistence or no impact while other researchers reported greater amounts of debt decreased persistence.

Prior research regarding the impact working off campus has on persistence is mixed. The general consensus is some work (less than 20 hours per week) improves persistence while working in excess of 20 hours per week is detrimental to college persistence. Unfortunately my sample size was not sufficient to examine the impact of different amounts of work on persistence. Instead I created a dichotomous variable which differentiated students by their intent to work off campus (yes or no). After controlling for all other attributes in the study, intent to work off campus was positively correlated only with math persistence. Reasons for working off campus run the gamut from absolutely necessary to provide for one’s family to completely voluntary. Work may well provide structure and encourage improved time management for some, while causing additional stress and burden for others. Further investigation is necessary before any causal link can be established.

As a group, the college planning variables offer insight to all six dependent variables. The number of credits attempted has the strongest influence on all measures of success and persistence. There is unequivocal support, both from this study and prior research, that students enrolled in more courses are more
likely to be successful and persist in college. Students who make use of advising sources, both human and technological, reap significant benefits at least in terms of mathematics success and persistence. Community college administrators should consider implementing more active advising strategies, particularly for students who begin college in need of mathematics remediation.

The third block of variables entered in each model were measures of prior mathematics achievement and ability. Academic achievement is another common control variable utilized in traditional models of student success. Unfortunately traditional measures of student academic achievement and ability are often not available for community college researchers. In my case the institution does not collect high school transcripts or high school GPAs. Furthermore two-thirds of my sample did not take the ACT test and the institution does not require students to complete all portions of the Compass placement exam. I attempted to collect self-reported high school GPAs however 12% of my sample could not remember it, did not have one, or elected not to provide one. Given the potential bias inherent in high school GPA and the significant reduction in sample size to include this measure, I elected to instead restrict my measure of prior academic achievement to exclusively achievement in mathematics. I used three measures of precollege mathematics achievement: an institutional prealgebra pretest, institutional elementary algebra pretest, and the highest math course completed in high school. Not surprisingly, prior mathematics knowledge was positively correlated with first semester GPA, posttest score, and passing Elementary Algebra. Given the sequential nature of mathematics, I expected a
positive correlation between students with more complete knowledge of
prerequisite skills and exposure to the objectives of the course and mathematics
success and persistence. This block of controls provided one negative
correlation: a marginally significant relationship between elementary algebra
pretest score and institutional persistence. One possible explanation is that
students with higher levels mathematics knowledge upon matriculation are more
likely to transfer, though it is not clear whether these individuals transferred or left
higher education all together.

The fourth block of variables entered into each model measured student’s
expected level of engagement. According to Astin (1993), Pascarella (1985),
and Tinto (1975, 1993) institutional integration, including both academic and
social integration, is a key predictor of college success and persistence. Bean
and Metzner (1985) contend that community college success and persistence
are less a function of social integration because community college students are
more likely to be older, commuters, and part-time, therefore less likely to spend
time on campus and more likely to already have established venues for
socialization. Based upon Astin’s (1993) multitude of environmental integration
items and his recommendation to ask students to anticipate their involvement in
circumstances where actual direct measurement is not possible, I created three
factors asking students to anticipate their frequency of involvement in academic
and social situations. Based upon factor analysis, the social integration items
were further subdivided into “positive” and “negative” social interactions.
OftenPleasure captured the anticipated frequency of partaking in the isolating
and educationally detrimental behaviors of partying, drinking alcohol, and watching television. As I suspected, there was a negative correlation between OftenPleasure and both first semester GPA and percent of credits completed. Neither the anticipated social nor academic integration factors were significant predictors of any outcome variables. The lack of significance can be interpreted in several ways. Perhaps in a community college population environmental integration is less crucial than with four-year institutions, suggesting the impact is accounted for in the other blocks of variables. It is possible that differences in anticipated social and academic integration do not impact success and persistence during the first semester; however the influence becomes more prominent later in the second semester or year. It is also possible that some students were unable to accurately respond to the anticipatory items or the items did not fully capture the types of activities which impact success in community college students.

The first four blocks of variables entered into each model have described the categories of variables commonly included in traditional student success models. I have identified several instances in which my results seem to agree with the majority of research findings in higher education. I have also highlighted some findings which appear contradictory to prior research, though it is unclear if the discrepancies are due to differences in community college and four-year student populations, the math-specific nature of my sample, or some other variable. At any rate, my findings substantiate the concerns voiced by Braxton et
al. (1997) and Bean and Eaton (2000) that traditional models of student success are somewhat less appropriate for use with community college populations.

The fifth and final block of variables entered into each of my models demonstrates the integrated nature of this study. The crux of my study is the addition of noncognitive variables to a student success model; anticipating this addition will improve the overall model fit when applied to a sample of community college students. After controlling for demographic characteristics, measures of college planning, prior mathematics achievement, and anticipated engagement and quality of effort, six of the eight noncognitive variables measured with the NCQ reached statistically significant levels for at least one dependent variable. The noncognitive variables also exhibited breadth of significance, with at least one significant finding in each of the six outcome measures. This result suggests that the NCQ can be useful in explaining success and persistence of a community college population using an array of success definitions. The direction of correlation is also interesting; three noncognitive variables are positively correlated with success measures while three others were negatively associated the success outcomes. Finally noncognitive variables that were significant predictors of more than one outcome were consistent in the direction of correlation.

In my study knowledge acquired in a field was the most frequently significant noncognitive variable; it was a significant and positive indicator of first semester GPA, percent of credits completed, passing Elementary Algebra, and institutional persistence (marginally significant). This finding is consistent with
prior research of various nontraditional groups (Ancis & Sedlacek, 1997; Boyer & Sedlacek, 1988; Fuertes & Sedlacek, 1994; Noonan et al., 2005; Ting, 1997, 1998; Ting & Robinson, 1998; Tracey & Sedlacek, 1985) however this variable was not typically the most important measure in the NCQ. Knowledge acquired in a field measures the extent to which individuals have learned from personal experiences related to an educational concept. The learning may be a specific skill, such as computations involving fractions, or a more general strategy such as time management or confidence in seeking assistance with a new experience. Positive personal experiences may also fuel a general curiosity about the unknown, which translates well to success in college. The beauty of this measure, like all the noncognitive variables, is the relative impartialness of the measurement based upon cultural or gender differences in how the experience occurred.

The preference for long-term goals is significantly and positively correlated with three measures of student success: score on the posttest, passing Elementary Algebra (marginally significant), and institutional persistence. This finding suggests that long-term goals may help students stay focused and prioritize daily activities to maximize the likelihood of meeting their goals. As expected, the possession of long-term goals increased the chances for institutional persistence, suggesting student planning often extends beyond one semester. Prior research identified a similar relationship between the preference for long-term goals and increased persistence, particularly early in one’s college

Realistic appraisal, the ability to identify one’s strengths and weaknesses, turned out to be a marginally significant predictor of the posttest score. Based upon my review of the literature, I expected this variable to be significant in more analyses. It seems reasonable for a group of developmental mathematics students to respond more similarly to “I expect to have a harder time than most students here” and “I am as skilled academically as the average applicant here” than most of the other items included in the NCQ. Truncated variation may explain the lack of significant findings for this variable.

Perhaps the biggest surprise from the inclusion of noncognitive variables is my finding that self concept is negatively correlated with percent of credits completed and passing Elementary Algebra. Each instance of a significant relationship between self concept and measures of college student success and persistence I reviewed illustrated a positive correlation (Boyer & Sedlacek, 1988; Fuertes & Sedlacek, 1994; House, 1995a; Noonan et al., 2005; Sedlacek & Adams-Gaston, 1992; Tracey & Sedlacek, 1984, 1985, 1987; White & Sedlacek, 1986). Perhaps this finding implies that some degree of overconfidence exists in students as they enter the community college, and has negative academic consequences at least early in college. Responses to one item in particular may need closer examination: the more strongly students disagree with the statement “People can pretty easily change me even though I thought my mind was already made up on the subject” the higher the self concept score. Perhaps
disagreement with this statement implies a higher degree of stubbornness or unwillingness to change, which conceivably could be negative in terms of study skills. It is not uncommon for new college students to perceive their high school study skills as sufficient for college. Students more apt to heed warnings from instructors and advisors may score lower on this item, but succeed at a higher level in the first semester.

The only statistically significant result involving leadership experience was a negative correlation with mathematics persistence. This result contradicts the prior research I reviewed. We know that as a group community college students are more likely to be first-generation college students, come from lower-income families, and are more likely to be academically underprepared when they begin college. Collectively these attributes likely reduce the magnitude and scope of experiences available during high school when compared to university students and may lead to less variation in scores on this variable, and therefore limited significant findings.

I found effectively navigating the system to be negatively correlated with passing Elementary Algebra. Again, this result is contradictory to the prior research discussed earlier in my literature review. If any construct included in the NCQ may need to be updated it would be Handling the System. Sedlacek defines racism to include “all types of –isms (sexism, ageism, even ‘athleteism’)” (2004, p. 5) that may adversely affect people. Unfortunately the items included on the NCQ specifically use the word “racism” and do not expound on the definition as Sedlacek did. It is quite possible that students in my sample
responded to these items with a narrower and overly simple interpretation like those in some basic dictionary definitions of “racism” such as “a belief that race is the primary determinant of human traits and capacities and that racial differences produce an inherent superiority of a particular race” (The Random House Dictionary, 2010). If the items were updated to include Sedlacek’s broader interpretation the results may be more meaningful.

Neither Community Service nor the Availability of a Strong Support Person reached statistical significance with any of the dependent variables. The mean score for Strong Support Person is 12.4 (possible scores from 4 to 15) suggesting most students perceive they have a positive support structure available. The minimal variation in scores may be to blame for the lack of statistically significant findings. Several of the items included in the Community Service construct could be interpreted as having a significant social component, and therefore may be less predictive of academic success and persistence in a community college sample than a sample of four-year college students.

One intriguing rationale for the unexpected findings with some of the noncognitive variables lies in the scoring rubric for the three open-ended questions in the NCQ (See Appendix B). The construct Self Concept includes the item “Please list three things that you are proud of having done.” and one item in Leadership Experience asks students to “Please list groups belonged to (formal or informal) and offices held (if any) in your high school or community.” Neither scoring rubric differentiates between academically and socially oriented activities. Both Bean and Metzner (1985) and Pascarella and Terenzini (2005)
postulated that community college students were less influenced by social integration than by academic integration. Perhaps the relationship between socially oriented “things” and “groups” is less transferable to college success and persistence in community college students than university students. My proposed interpretation gains further support by looking at the items included in the constructs Preference for Long Range Goals and Knowledge Acquired in a Field, the constructs with the most significant and positive relationships. Both constructs include open-ended items with a scoring rubric squarely focused on the academic nature of the responses.

In summary, after controlling for variables commonly found in traditional models of student success, noncognitive variables do capture significant differences in all six of my measures of student success and persistence. Unlike the majority of prior research, I found Knowledge Acquired in a Field and Preference for Long-Term Goals to be the most powerful noncognitive variables, both in terms of the number of significant results and positive direction of correlation. One potential explanation for this finding may be the academic orientation to many of the items used in computing these scores, whereas some of the other noncognitive variables include more socially oriented items. Perhaps academically oriented measures are better at discriminating between community college students with high and low probability for success and persistence than those measures with a strong social component. Self Concept, Effectively Handling the System, and Leadership Experience all had significant negative correlations with at least one success or persistence measure. While
inconsistent with prior research, this finding may suggest overconfident students and students less willing to change their behaviors are more prone to suffer academically early in their college experience.

**Implications for Advancement of Theory**

Community colleges continue to respond to local and national needs for preparing a work force for a rapidly changing economy. One clear indicator of their success is the tremendous growth in the number of students served. A second is the tremendous diversity apparent at every community college in America: age, race, educational goals, academic preparation, and motivation just to name a few. Unfortunately studies examining likely indicators of success and persistence in community college student populations are few in number. The majority of existing research on community college student success employs a model derived from research on traditional-aged, middle class, white students attending four-year residential colleges. We need additional studies to be conducted with populations of community college students for at least two reasons: first to build a body of evidence which unequivocally demonstrates significant differences between community college and four-year residential college students, and second to propose, examine, and modify improvements to existing student success models, including the model proposed in this study, to ultimately devise a comprehensive model of community college student success.

In my study I have proposed and tested a model of community college student success which includes a set of psychological variables previously shown to reliably predict success in among a variety of nontraditional student
populations. I have provided an empirical foundation using a sample of
developmental mathematics students attending a community college, noting the
key differences between my findings and those typical of traditional student
success models as well as models including noncognitive variables conducted
with nontraditional groups of university students.

My study may not provide solutions to all questions about community
college student success, however it does suggest the presence of significant
differences between populations of students attending two- and four-year
institutions. Furthermore my study does offer compelling evidence that
noncognitive variables can effectively explain additional variation in student
success after controlling for all entry characteristics examined by traditional
models of student success. Future theories of, and research on, community
college student success should strongly consider the inclusion of noncognitive
variables. Additionally community college institutional research departments
should keep these variables in mind as they examine student trends in their own
institutions.

Replication of this study at other community colleges is crucial for theory
advancement. Replication is necessary with similarly defined samples, samples
of students with developmental needs in other academic disciplines, samples
with general populations of first-time community college students, and samples of
returning community college students to fully examine the robustness of this
model. Only through repeated examination of similar samples can we determine
the extent to which this model is valuable in predicting success and persistence in a community college.

The advancement of theory would also benefit from the consideration of alternative measures of noncognitive variables. This may include identifying and testing other instruments in existence or developing new measures. Identifying probable causal links between existing attitudes and behaviors and community college success may inspire further theory refinement, future research in this arena, and also spur conversations among community college stakeholders which lead to research-based policy changes and subsequent improvements in student success.

**Recommended Revisions to NCQ**

I found several of the variables included in the NCQ to be significant indicators of student success and persistence, however the NCQ could be even more useful after some revisions to both the instrument and the scoring rubric to better fit community college populations. According to Sedlacek, no response to “How much education do you expect to get during your lifetime?” is equated to “Bachelors degree or equivalent.” I determined this was an inappropriate conclusion with a community college sample, and instead equated nonresponse with “Associate’s degree.”

Sedlacek’s construct measuring a student’s ability to effectively handle the system is dominated by items assessing one’s ability to effectively deal with racism. According to Sedlacek (2004), the word racism “covers all types of – isms (sexism, ageism, even ‘athleteism’) …” that interfere with the development of
Based upon verbal and written comments from students both during my pilot testing as well as in my sample, students did not interpret racism with this broad definition. Therefore I encourage future researchers to add additional items to specifically address issues related to gender, age, race, and other statuses in which differential treatment (or the perception of) may exist. In addition, effectively handling the system should also include measures of stress management and the extent to which students possess coping strategies.

Researchers should also consider adding measures of assertiveness in the NCQ. The extent to which a student is proactive in all types of interaction with the institution may be predictive of success and persistence in college. It would also be desirable to include items to more fully measure goal commitment and motivation to achieve goals.

The three open-ended items of the NCQ should also be considered for revision. Missing data and truncation of variance were both significant issues associated with these items. The majority of students provided only one or two responses when asked for “three goals you have for yourself right now” or “three things you are proud of having done.” Future research should focus on asking more specific questions, each with fewer required responses. Additionally, the scoring rubric should be expanded to assess each response of terms of both social and academic properties. For example, being captain of the football team and making the honor roll six semesters both receive a score of 3, yet may impact student success differently.
In the next section I discuss important implications for policy and practice concerning community college student success.

**Implications for Policy and Practice**

Community college leaders must realize that traditional models of student success and persistence are a poor fit for their students. Student success should always be central to the mission of a community college and now as accountability requirements increase at institutions of higher education, student success and persistence become even more prominent concerns. My study offers several implications for improving student success which community college leaders should consider adopting and adapting at their respective institutions. The most fundamental of recommendations is to begin collecting and requiring data from students beyond the most basic demographic characteristics. Measures of academic achievement should include both high school experiences and current academic abilities. Scores from standardized placement exams are very useful or colleges may need to invest in the development of in-house measures. Whatever measures are collected, there must be a concerted effort to ensure data are collected from all possible students. Data collection must also be extended to measure many of the noncognitive constructs which my study and other research suggest are correlated with student success. The increased functionality of online survey tools may make this data collection easier to implement, both in terms of coverage and cost. Adding measures of key constructs to the college application should receive serious consideration. It is important to collect data very early in
the college experience, ideally before the student ever enters a college classroom. As such, a large portion of the data should measure student’s expected engagement in college. In addition, institutions should carefully analyze the extent to which engagement with the college environment is possible.

Frequently community college intervention processes take too long before initial contact with a student. Bradburn (2002) reported that nearly one in four students at a public two-year college left in the first year while only about one in fourteen students at four-year colleges left during the first year. Unlike four-year institutions, community college students are often less committed to the institution, and therefore are more at risk to leave before traditional strategies such as midterm grades or academic probation have an opportunity to intervene. Instead community colleges must develop strategies to identify at-risk students and intervene very early in the college experience, ideally prior to registering for first semester classes.

Community colleges should consider adopting policies which mandate placement and advising. If student-to-advisor ratios are too large to require all students to meet with advisors, then at a minimum colleges should require advising sessions for new students and for students with remedial needs. My findings clearly indicate students who used a college advising source were more likely to succeed and persist in mathematics. Additionally remedial needs, particularly in mathematics, should be addressed early in college. Successful remediation of mathematics deficiencies should be a focal point of community
college policy. Mathematical competency and quantitative reasoning skills are necessary to complete coursework in many other disciplines. Colleges should carefully examine Bahr’s (2007, 2008, 2010) findings regarding credential attainment as a function of successful mathematics remediation and consider beginning a similar study at their institution.

Over the last decade, semester or year-long “College 101” courses have become quite common at all types of higher education institutions. These courses are intended for first-time college students and typically integrate study and time management skills with career exploration and orientation to the institution. These courses offer the perfect environment to collect cognitive and noncognitive data from first-time students especially if prematriculation data collection proves impossible. In addition, community colleges should develop follow-up data collections to examine how educational goals, aspirations, and intent to transfer change over the first semester and if there is change in the certainty of these goals. Follow-up surveys should also aim to determine how often students actually engaged in a variety of academic, social, and work related activities during the semester and compare those results to the anticipated engagement.

Finally my research indicates knowledge acquired in the field was the most powerful noncognitive variable in terms of promoting success and persistence both in mathematics and at the community college. Community college practitioners should consider ways to promote service learning and job shadowing opportunities as well as internship experiences. Perhaps the
connection between academic skills and the application of skills to an occupation is more important for community college students than for students attending four-year institutions. Recognizing the connection between college and a future career may increase commitment to one’s educational goals.

Overall my findings have several significant implications for community college policy and practice to increase student success and persistence. I have identified a number of indicators of student success which are appropriate for community college students. Community colleges should carefully examine which variables are feasible to collect and which may hold the greatest potential to identify at-risk students. Once data collection and analyses procedures are in place, college leaders must determine how to effectively and efficiently use the data to improve student success and persistence. In the next section I discuss some important implications for future research.

**Implications for Future Research**

I intended this study to be an initial step in the creation of an integrated model of community college student success. In this section I discuss next steps for this study in particular and for future studies of a similar nature. The few studies of community college student success that do exist suggest that two-year and four-year college students differ on several key characteristics and therefore the ongoing research-based pursuit of a model of community college student success is necessary.

This study needs to be replicated at other community colleges to determine the extent to which the included variables accurately model different
samples of community college students. Iowa is not as racially diverse as many other areas of the country, therefore it is particularly important for this study to be replicated in more racially diverse community college populations. In addition, many community colleges have a significantly higher proportion of part-time students than the host institution for this study. This study should also be extended to other types of disciplines with large populations of remedial students to determine if the results are similar to those found with a sample of developmental mathematics students.

Similar studies should be conducted with more general populations of first-time community college students to determine the extent to which the model applies to students who are college-ready upon matriculation. Researchers should also examine samples of returning community college students who need remediation in mathematics or English as well as those who are prepared for college-level academics. Only by replicating this study in multiple institutions with a variety of samples can we begin to understand the full potential for noncognitive variables as predictors of community college student success and persistence.

Future studies should consider strategies to include a follow-up questionnaire to determine how accurately students anticipated their social and academic engagement. The crux of this study was to determine how pre-college attributes influenced success and persistence; however it would be beneficial to know if certain pre-college characteristics result in significantly different expectations of in-college behaviors. Future research should also be more
longitudinal in nature. This study focused on persistence to the second semester and to the next mathematics course, however neither are representative of the ultimate goal in community college; successful completion of a college-level mathematics course and attainment of a credential or transfer to a four-year institution. It remains to be seen how measures of early student success translate to success later in college. Researchers should also consider how dependent variables such as first semester GPA can be used as independent variables for longer term student success research. For example, does persistence in mathematics depend on first semester GPA?

Other areas for future research include international students and students with disabilities; two groups of students likely to attend community colleges that have unique needs. I found that students with a self-reported disability did differ significantly from students not reporting a disability on two of my six dependent measures. In my study, students did not identify the type or severity of a disability, only that they did or did not have a disability. Researchers may want to examine the type and extent of disability to determine the impact of the NCQ with varying types and levels of disability. Further, future research should examine the resources and support available to students with disabilities, the extent to which students make use of the available services, and their motivation for the use (or lack of use) of such services. Researchers should consider the potential impact of the community college environment on student success and persistence. The traditional models of Tinto, Astin, and Pascarella are centered on the relationship between student and college environment whereas Bean and
Metzner suggest the college environment has minimal impact on nontraditional students. Future studies should examine whether the community college has an impact on certain types of students under certain conditions. Large numbers of traditional-aged students attend community colleges and many students do attend full-time. Perhaps the community college environment does have a significant effect on success and persistence for traditional-aged full-time students, but as student age increases and/or students are on campus fewer hours, the environmental influence diminishes. In addition future research should consider the potential impact of living in close proximity to the community college. Some community colleges have significant numbers of students who live very near campus while others are located in the midst of a business district.

Replication of the NCQ is necessary to determine which variables are the most significant predictors of success. Prior research found the most influential variables to be positive self concept and realistic self-appraisal. In my study knowledge acquired in a field and preference for long-term goals were variables most likely to reach statistical significance. Additional studies are necessary to determine if the difference can be attributed to differences in two-year versus four-year student populations, because my sample included only developmental mathematics students, or some other rationale. In addition, future research should explore the relationship between positive self concept and success and persistence in the community college. Contrary to prior research, I found positive self concept to be negatively correlated with both percent of credits completed and passing Elementary Algebra. I hypothesized that perhaps some students fall
victim to overconfidence but additional studies are necessary to determine if this is true.

**Summary and Conclusion**

Building a model of community college student success is long overdue. As a first step toward the construction of a comprehensive model of community college success, I adapted and extended traditional models of student success to include measures of expected academic and social engagement as well as multiple measures of noncognitive variables shown to be predictive of success with nontraditional populations. At the core of this study is an examination of the unique contributions noncognitive variables made to a model of community college student success. Overall the eight noncognitive variables measured by Sedlacek and Tracey’s NCQ were significantly related to measures of student success and persistence after controlling for student demographics, college plans, prior math achievement, and expected engagement in social, academic, and work activities. Either knowledge acquired in a field or preference for long-range goals or both was significantly and positively correlated with five of the six dependent variables. Effectively handling the system only reached statistical significance for one dependent variable, passing Elementary Algebra, and the correlation was negative. Similarly, leadership experience was negatively correlated with mathematics persistence, and self concept was negatively correlated with both percent of credits completed and passing Elementary Algebra. These negative relationships were unexpected and contrary to prior research, yet the implications cannot be overlooked. Neither demonstrated
community service for the presence of a strong support person reached statistical significance in this study.

Hopefully my study provides an entry point for additional research with this large yet understudied population. Additional research with different samples of community college students and alternative measures of noncognitive constructs is necessary to ensure a quality instrument that can assist in maximizing the likelihood of success in college. Providing access to all students is not enough; we must also do our best to ensure institutional policies and procedures are aligned with student success.
APPENDIX A: NONCOGNITIVE QUESTIONNAIRE FORM B (NCQ-B)

1. Student ID #
2. Gender
   - Male
   - Female

3. Race/Ethnicity
   - African American
   - White
   - Asian American or Pacific Islander
   - Hispanic
   - American Indian or Alaskan Native
   - Other

4. How much education do you expect to get during your lifetime?
   - Associate’s degree
   - College, but less than a bachelor’s degree
   - Bachelor of Arts or equivalent
   - One of two years of graduate or professional study (Master’s degree)
   - Doctoral degree such as M.D. or Ph.D.

5. About 50% of college students typically leave before finishing a program. If this should happen to you, what will be the most likely cause?
   - Absolutely certain that I will finish
   - To accept a good job
   - To enter military service
   - It would cost more than my family or I could afford
   - Marriage
   - Disinterest in study
   - Lack of academic ability
   - Insufficient reading or study skills
   - Other

6. Please list three goals that you have for yourself right now:

7. Please list three things that you are proud of having done:

8. Please list groups belonged to (formal or informal) and offices held (if any) in your high school or community.
Please indicate the extent to which you agree with each of the following items. Respond to the statements below with your feelings at present or your expectation of how things will be by filling in the appropriate oval.

1 = strongly agree
2 = agree
3 = neutral
4 = disagree
5 = strongly disagree

9. I am sometimes looked up to by others.
10. There is no use in doing things for people; you only find that you get it in the neck in the long run.
11. I expect to have a harder time than most students here.
12. Once I start something, I finish it.
13. I am as skilled academically as the average applicant here.
14. I expect I will encounter racism at this school.
15. People can pretty easily change me even though I thought my mind was already made up on the subject.
16. My friends and relatives don’t feel I should go to college.
17. I want a chance to prove myself academically.
18. I enjoy working with others.
19. My background should help me fit in well here.
20. My friends look at me to make decisions.
21. I expect the faculty to treat me differently from the average student here.
22. I am uncomfortable interacting with people from other races or cultures.
23. I try to find opportunities to learn new things.
24. I think many people see racism where it doesn’t exist.
25. I expect to get picked on by other students and faculty because of my background.
26. Everyone must work toward improving social conditions.
27. I often make lists of things to do.
28. I keep pretty much to myself.
29. I sometimes need help from others.
30. I prefer to be spontaneous rather than to make plans.
31. I have done work in many community projects.
32. I have already learned something in my proposed major field outside of high school.
33. I am not good at getting others to go along with me.
34. It is more important to study than to get involved in campus activities.
35. I usually note important dates on my calendar.
36. The best way to avoid problems is to take things one day at a time.
37. I have studied things about my major field on my own.
38. I expect to have little contact with students from other races.
39. I enjoy being a student.
APPENDIX B: CODING FOR SELECT NCQ-B ITEMS

Question 4: How much education do you expect to get during your lifetime?
1* = Associate’s degree
1 = College, but less than a bachelor’s degree
2 = Bachelor of Arts or equivalent
3 = One of two years of graduate or professional study (Master’s degree)
4 = Doctoral degree such as M.D. or Ph.D.
2 = No response

* Sedlacek’s original NCQ and respective scoring guide did not include Associate’s degree as an option. I chose to equate it with “College, but less than a bachelor’s degree.”

Question 5: About 50% of college students typically leave before finishing a program. If this should happen to you, what will be the most likely cause?
4 = Absolutely certain that I will finish
2 = To accept a good job
2 = To enter military service
2 = It would cost more than my family or I could afford
2 = Marriage
2 = Disinterest in study
2 = Lack of academic ability
2 = Insufficient reading or study skills
2 = Other
2 = No response

Question 6: Please list three goals that you have for yourself right now:

6A: Coding for Long Range Goals

1 = a vague and/or immediate, short-term goal (for example, “to meet people,” “to get a good schedule,” “to gain self confidence”)

2 = a specific goal with a stated future orientation that could be accomplished during undergraduate study (for example, “to join a sorority so I can meet more people,” “to get a good schedule so I can get good grades in the fall,” “to run for a student government office”)

3 = a specific goal with a stated future orientation that would occur after undergraduate study (for example, “to get a good schedule so I can get the classes I need for graduate school,” “to become president of a Fortune 500 company”)
After each response is coded, the score for this item is determined by computing the mean of scores for each response and rounding to the nearest integer.

6B: Coding for Knowledge Acquired in a Field

1 = not at all academic or school-related; vague or unclear (for example, “to get married,” “to do better,” “to become a better person”)

2 = school related, but not necessarily or primarily education-oriented (for example, “to join a fraternity,” “to become student body president”)

3 = directly related to education (for example, “to get a 3.5 GPA,” “to get to know my teachers”)

After each response is coded, the score for this item is determined by computing the mean of scores for each response and rounding to the nearest integer.

**Question 7:** Please list three things that you are proud of having done:

1 = at least 75% of applicants to your school could have accomplished it (for example, “graduated from high school,” “held a part-time summer job”)

2 = at least 50% of applicants to your school could have accomplished it (for example, “played on an intramural sports team,” “was a member of a school club”)

3 = only the top 25% of applicants to your school could have accomplished it (for example, “won an academic award,” “was captain of football team”)

After each response is coded, the score for this item is determined by computing the mean of scores for each response and rounding to the nearest integer.

**Question 8:** Please list groups belonged to (formal or informal) and offices held (if any) in your high school or community.

8A: Coding for Leadership Experience

1 = ambiguous group or no clear reference to activity performed (for example, “helped in school”)
2 = membership but no formal or implied leadership role; it has to be clear that it’s a functioning group and, unless the criteria are met for a score of 3 as described below, all groups should be coded as 2 even if you, as the rater, are not familiar with the group (for example, “Fashionettes,” “was part of a group that worked on community service projects through my church”)

3 = leadership was required to fulfill role in group (for example, officer or implied initiator, organizer, or founder) or entrance into the group was dependent upon prior leadership (for example, “organized a tutoring group for underprivileged children in my community,” “student council”)

After each response is coded, the score for this item is determined by computing the mean of scores for each response and rounding to the nearest integer.

8B: Coding for Demonstrated Community Service

1 = no community service performed by group, or vague or unclear in relation to community service (for example, “basketball team”)

2 = some community service involved, but it is not the primary purpose of the group (for example, “Scouts”)

3 = group’s main purpose is community service (for example, “Big Brothers/Big Sisters”)

After each response is coded, the score for this item is determined by computing the mean of scores for each response and rounding to the nearest integer.

8C: Coding for Knowledge Acquired in a Field

1 = not at all academic or school-related; vague or unclear

2 = school related, but not necessarily or primarily education-oriented

3 = directly related to education

After each response is coded, the score for this item is determined by computing the mean of scores for each response and rounding to the nearest integer.
APPENDIX C: SUBSCORE COMPUTATIONS FOR NCQ-B

1. Positive self-concept
   item 4 + item 5 + item 7 + item 10 + item 15 + (6 – item 39)

2. Realistic self-appraisal
   item 4 + item 11 + (6 – item 13)

3. Understands and deals with racism
   (6 – item 14) + (6 – item 17) + item 22 + item 24 + item 25 + (6 – item 26)
   + item 34 + item 38

4. Preference for long-range goals
   item 6A + (6 – item 12) + (6 – item 27) + item 30 + (6 – item 35) + item 36

5. Availability of a strong support person
   item 16 + item 21 + (6 – item 29)

6. Successful leadership experience
   item 8A + (6 – item 9) + (6 – item 20) + item 33

7. Demonstrated community service
   item 8B + (6 – item 18) + item 28 + (6 – item 31)

8. Knowledge acquired in a field
   item 6B + item 8C + (6 – item 23) + (6 – item 32) + (6 – item 37)
APPENDIX D: PREALGEBRA PRETEST

Choose the one answer that best completes each statement or answers the question and fill in the corresponding bubble on the answer sheet. No calculators.

1. Find the reciprocal of $\frac{-4}{7}$.
   A) $\frac{4}{7}$    B) $\frac{7}{4}$    C) $-\frac{7}{4}$    D) 1

2. Simplify $\frac{96}{12}$.
   A) 4    B) 2    C) 12    D) 8

**Perform the indicated operation and simplify, if possible.**

3. $-10 + (-94)$
   A) $-104$    B) 104    C) $-84$    D) 84

4. $-4 - 6$
   A) $-10$    B) $-2$    C) 2    D) 10

5. $13 - (-6)$
   A) $-19$    B) $-7$    C) 7    D) 19

6. $-4 \cdot (-8)$
   A) 40    B) 36    C) 32    D) $-36$

7. $\frac{2}{3} \cdot \frac{1}{3}$
   A) $\frac{2}{9}$    B) $\frac{5}{18}$    C) $\frac{1}{2}$    D) $\frac{5}{9}$
8. \( \frac{1}{9} + \frac{5}{9} \)

A) \( \frac{1}{3} \)  
B) \( \frac{2}{3} \)  
C) \( \frac{4}{9} \)  
D) \( \frac{5}{9} \)

9. \( \frac{3}{7} \div \frac{1}{2} \)

A) \( \frac{3}{7} \)  
B) \( \frac{3}{14} \)  
C) \( \frac{4}{9} \)  
D) \( \frac{6}{7} \)

10. \( \frac{7}{9} - \frac{3}{4} \)

A) \( \frac{1}{36} \)  
B) 36  
C) \( \frac{2}{9} \)  
D) \( \frac{1}{72} \)

11. \( \frac{-2}{5} + \frac{4}{15} \)

A) \( \frac{2}{15} \)  
B) \( \frac{2}{3} \)  
C) \( -\frac{2}{3} \)  
D) \( -\frac{2}{15} \)

12. \( \frac{-25}{6} \cdot \left( \frac{-9}{7} \right) \)

A) \( \frac{17}{21} \)  
B) \( \frac{75}{14} \)  
C) \( -\frac{225}{13} \)  
D) \( -\frac{34}{13} \)

13. \( \frac{-44}{0} \)

A) Undefined  
B) 1  
C) 0  
D) 44
14. \((-4)^2\)
A) \(-16\)  B) \(-8\)  C) 8  D) 16

15. \(11 + 5^2 - (-3) \cdot 10\)
A) 330  B) 6  C) 66  D) 240
APPENDIX E: ELEMENTARY ALGEBRA PRETEST

Choose the one answer that best completes each statement or answers the question and fill in the corresponding bubble on the answer sheet. Our objective is to determine what algebra skills you possess as you enter this course. We expect you will not answer very many of these questions correctly. High performance on this part of the exam may indicate you should be in a more advanced course. If you do not know what a question is asking you to do, we suggest you choose “E) I have no idea” rather than guessing. No calculators.

16. Evaluate $3x^2 + 9x$ for $x = 4$.
   A) 48       B) 60       C) 84       D) 12
   E) I have no idea

17. Use the distributive law to multiply $8(a + b)$.
   A) $8ab$       B) $8a + 8b$     C) $8a + b$     D) $16ab$
   E) I have no idea

18. Write an equation for the following statement: Five times the sum of 3 and some number is 70.
   A) $5(3) + x = 70$     B) $5(3 + x) = 70$     C) $5 + 3x = 70$     D) $5x + 3 = 70$
   E) I have no idea

19. Solve the equation: $12y - 20 = 7y$.
   A) $y = -\frac{20}{19}$     B) $y = 4$     C) $y = 7$     D) $y = -\frac{8}{7}$
   E) I have no idea

20. Solve the equation: $3x + 5(2x - 7) = -20 - 2x$.
   A) $x = 1$     B) $x = -5$     C) $x = -1$     D) $x = -\frac{11}{3}$
   E) I have no idea

21. Factor the polynomial completely: $x^2 - 16x + 28$.
   A) $(x - 7)(x - 4)$     B) $(x + 7)(x + 4)$     C) $(x - 14)(x - 2)$     D) $(x + 14)(x + 2)$
22. Solve the following equation: $x^2 + 7x - 18 = 0$.

A) $x = 9, 2$  
B) $x = 9, -2$  
C) $x = -9, 2$  
D) $x = -9, 1$

E) I have no idea

23. Multiply $(4m + 3)^2$.

A) $4m^2 + 24m + 9$  
B) $16m^2 + 9$  
C) $16m^2 + 24m + 9$  
D) $4m^2 + 9$

E) I have no idea

24. Subtract $(3x^2 - 4x + 1) - (x^2 + 3x - 5)$.

A) $4x^2 + x + 6$  
B) $2x^2 - 7x + 6$  
C) $4x^2 - x - 6$  
D) $2x^2 - x - 4$

E) I have no idea

25. Write the slope-intercept equation of the line with slope $\frac{1}{2}$ and y-intercept (0, 3).

A) $y = \frac{1}{2}x - 3$  
B) $y = \frac{1}{2}x + 3$  
C) $y = -\frac{1}{2}x + 3$  
D) $y = -\frac{1}{2}x - 3$

E) I have no idea

26. Find the slope of the line $7x + 5y = 29$.

A) $\frac{5}{7}$  
B) $-\frac{7}{5}$  
C) $\frac{7}{5}$  
D) $-\frac{5}{7}$

E) I have no idea

27. A DVD player is on sale for $200. The sales tax is 6%. How much will the DVD player cost including the tax?

A) $206$  
B) $212$  
C) $320$  
D) $1200$

E) I have no idea

28. Simplify $(4r^5)^3$.

A) $64r^{15}$  
B) $64r^5$  
C) $64r^8$  
D) $4r^{15}$

E) I have no idea
29. Simplify \(9x - y - 3(8x - 8y + 2z)\).

A) \(-15x - 25y + 6z\) \hspace{1em} B) \(-15x + 7y - 2z\) \hspace{1em} C) \(-15x + 23y - 6z\) \hspace{1em} D) \(-15x - 9y + 2z\) \\
E) I have no idea

30. Solve the inequality \(7x + 4 \geq 6x - 8\) and graph your answer.

A)

B)

C)

D)

E) None of these
APPENDIX F: ELEMENTARY ALGEBRA POSTTEST

Complete each multiple choice question by choosing the one alternative that best completes the statement or answers the question. Mark the corresponding letter on the answer sheet.

1. Simplify the expression $5x - y - 2(6x - 8y + 7z)$.
   
   A) $17x - 17y + 14z$
   B) $9x - 11y - 9z$
   C) $-7x + 15y - 14z$
   D) $-7x - 9y + 7z$
   E) $-7x - 17y + 14z$

2. Evaluate $5x^2 - 3(x - y) + 7y$ for $x = -2$ and $y = 3$.
   
   A) $-64$
   B) $16$
   C) $26$
   D) $56$
   E) $136$

3. Translate “2 less than 4 times a number” to an algebraic expression.
   
   A) $4x - 2$
   B) $2 - 4x$
   C) $2x - 4$
   D) $4 - 2x$
   E) $\frac{x}{4} - 2$

4. Solve the equation $-6x + 5(2x - 2) = 2 - 8x$ for $x$.
   
   A) $x = -1$
   B) $x = -\frac{2}{3}$
   C) $x = 0$
   D) $x = 1$
   E) $x = 2$
5. In a local election, 24,300 people voted. This was a decrease of 8% from the last election. How many people voted in the last election? Round to the nearest whole person if necessary.

A) 1,944 people  
B) 22,356 people  
C) 22,500 people  
D) 26,244 people  
E) 26,413 people

6. Solve the formula $A = P + 2Pr$ for $r$.

A) $r = \frac{P - A}{2P}$  
B) $r = \frac{A - P}{2P}$  
C) $r = \frac{A}{2}$  
D) $r = A - 3p$  
E) $r = \frac{2P}{A - P}$

7. To rent a moving truck for one day, the rental company charges $20 plus 35 cents per mile. If Suzanne has a budget of $90, what is the maximum number of miles can she drive and stay within her budget? The first step to solve this application is to define a variable. Which definition below is the most appropriate?

A) Let $x$ represent the cost of renting the truck for one day  
B) Let $x$ represent the number of days to rent the truck  
C) Let $x$ represent the number of miles driven  
D) Let $x$ represent the cost of driving one mile  
E) Let $x$ represent Suzanne’s budget

8. To rent a moving truck for one day, the rental company charges $20 plus 35 cents per mile. If Suzanne has a budget of $90, what is the maximum number of miles can she drive and stay within her budget? Round your answer to the nearest mile.

A) 2 miles  
B) 20 miles  
C) 57 miles  
D) 200 miles  
E) 314 miles
9. Solve the equation $\frac{2}{3}x - 1 = 10$ for $x$.

A) $x = 6$
B) $x = \frac{13}{2}$
C) $x = \frac{22}{3}$
D) $x = \frac{27}{2}$
E) $x = \frac{33}{2}$

10. Solve $4 - 2x < 10$.

A) $\{x | x < -7\}$
B) $\{x | x < -4\}$
C) $\{x | x < -3\}$
D) $\{x | x > -7\}$
E) $\{x | x > -3\}$

11. Find the intercepts of the equation $-2x + 4y = 8$.

A) $(4, 0), (0, 2)$
B) $(-4, 0), (0, -2)$
C) $(-4, 0), (0, 2)$
D) $(-2, 0), (0, 4)$
E) $(2, 0), (0, -4)$

12. Jodi rented a mountain bike from The Bike Rack for $12. During the 3 hour rental, she rode 24 miles. Find Jodi’s average rate of change in miles per dollar.

A) 0.25
B) 0.5
C) 2.0
D) 4.0
E) 8.0
13. Find the slope of the line containing the points \((4,3)\) and \((7,-4)\).

A) \(\frac{7}{3}\)
B) \(\frac{7}{3}\) 
C) \(\frac{4}{7}\)
D) \(-\frac{4}{7}\)
E) Undefined

14. Write the equation for the line with slope \(m=5\) and passing through the point \((4,6)\).

A) \(y = 4x + 5\)
B) \(y = 4x + 6\)
C) \(y = 5x + 6\)
D) \(y = 5x - 14\)
E) \(y = 5x + 26\)

15. Write a linear equation to represent the data in the table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>-4</td>
</tr>
</tbody>
</table>

A) \(y = -\frac{4}{5}x + 4\)
B) \(y = -\frac{4}{5}x + 5\)
C) \(y = -4x + 4\)
D) \(y = -4x + 5\)
E) \(y = -\frac{4}{5}x + 4\)

16. Find the equation of the line shown in the graph.

A) \(x = 3\)
B) \(y = 3\)
C) \(y = x - 3\)
D) \(y = -x + 3\)
E) \(y = x + 3\)
17. Choose the graph that illustrates the line \( y = 2x - 7 \). (Each tick mark is one unit.)

A) 

B) 

C) 

D) 

E)
18. Simplify \((5x^3 - 2x^2 + 1) - (7x^3 - 4x + 1)\).

A) \(-2x^3 + 2x\)
B) \(-2x^3 + 2x^2 - 4x\)
C) \(-2x^3 - 2x^2 + 4x\)
D) \(-2x^3 + 2x^2 + 4x + 2\)
E) \(-2x^3 - 2x^2 - 4x + 2\)

19. Multiply \((x-5)(8x^2 + x + 9)\).

A) \(8x^3 - 39x^2 + 14x - 45\)
B) \(8x^3 + 39x^2 + 4x - 45\)
C) \(8x^3 - 41x^2 + 4x - 45\)
D) \(8x^3 - 39x^2 + 4x - 45\)
E) \(8x^2 + x + 4\)

20. Simplify \((4a - 5)^2\).

A) \(4a^2 - 25\)
B) \(4a^2 + 25\)
C) \(4a^2 - 40a + 25\)
D) \(16a^2 + 25\)
E) \(16a^2 - 40a + 25\)

21. Perform the indicated operation \((x^2 + 8x + 7) ÷ (x + 6)\).

A) \(x + 3\)
B) \(x + 2 - \frac{5}{x + 6}\)
C) \(\frac{x + 2}{x + 6}\)
D) \(x + 2 + \frac{5}{x + 6}\)
E) \(\frac{x^2 + 15}{6}\)
22. Simplify \( \left( \frac{x^5}{3} \right)^{-3} \).

A) \( \frac{x^2}{27} \)
B) \( \frac{27}{x^8} \)
C) \( \frac{27}{x^{15}} \)
D) \( \frac{x^{15}}{27} \)
E) \( -\frac{x^{15}}{27} \)

23. Multiply and write your answer in scientific notation. \((4.7 \times 10^{-3})(7.5 \times 10^7)\)

A) \( 3.525 \times 10^{11} \)
B) \( 3.525 \times 10^5 \)
C) \( 3.525 \times 10^4 \)
D) \( 1.22 \times 10^{11} \)
E) \( 1.22 \times 10^5 \)

24. Find the greatest common factor of the expression. \(36x^9y^9 + 30x^3y^5 - 12x^5y^3\)

A) 6
B) \( 6xy \)
C) \( 6x^3y^3 \)
D) \( 6x^9y^9 \)
E) \( 6x^{17}y^{17} \)

25. Find \( b \) so \( x^2 + bx + 21 \) can be factored.

A) \( b = -10 \)
B) \( b = -4 \)
C) \( b = 0 \)
D) \( b = 3 \)
E) \( b = 7 \)
26. Factor $6x^2 - 30x + 36$ completely. If the polynomial is prime, so state.

A) $6(x-6)(x-1)$
B) $6(x-6)(x+1)$
C) $6(x-3)(x-2)$
D) $6(x+3)(x+2)$
E) Prime

27. Solve the equation $4x^2 - 11x = 20$.

A) $\frac{-5}{2}, 2$
B) $\frac{5}{2}, -2$
C) $\frac{-5}{4}, -4$
D) $\frac{-5}{4}, 1$
E) $\frac{-5}{4}, 4$

28. Choose the appropriate equation to solve the application. The length of a rectangular garden is 5 more than twice the width. If the area is 300 square feet, find the length and the width.

A) $w(2w+5) = 300$
B) $2w(w+5) = 300$
C) $w(5w+2) = 300$
D) $2w+2(2w+5) = 300$
E) $2w+2(5w+2) = 300$

29. Perform the indicated operation. $\frac{3}{10x} + \frac{9}{14x^2}$

A) $\frac{12}{10x + 14x^2}$
B) $\frac{21x + 45}{70x^2}$
C) $\frac{12}{24x^3}$
D) $\frac{12}{140x^2}$
30. Simplify \( \frac{y^2 - 6y - 16}{y^2 - 5y - 24} \) if possible.

A) \( \frac{y + 2}{y + 3} \)

B) \( \frac{y - 2}{y - 3} \)

C) \( \frac{y - 4}{y - 6} \)

D) \( \frac{-6y - 16}{-5y - 24} \)

E) \( \frac{-6y - 2}{-5y - 3} \)

31. Multiply and simplify \( \frac{6p - 6}{p} \cdot \frac{4p^2}{7p - 7} \)

A) \( \frac{42p^2 - 84p + 42}{4p^3} \)

B) \( \frac{4p^2 + 6p - 6}{8p - 7} \)

C) \( \frac{6p}{7} \)

D) \( \frac{24p}{7} \)

E) 0

32. Perform the indicated operation and simplify \( \frac{m^2 - 9m}{m - 3} + \frac{18}{m - 3} \)

A) \( m - 6 \)

B) \( m - 3 \)

C) \( m + 6 \)

D) \( m^2 - 6 \)

E) \( m^2 - 3 \)
APPENDIX G: EASSS

Elementary Algebra
Student Success Survey

Helping you successfully accomplish your educational goals is very important to us. We need your help to better understand community college student expectations of what will likely happen this semester both inside and outside the classroom. This survey will only take about 20 minutes to complete. Your responses will help us improve student success throughout Kirkwood. Because of the importance of this survey, your instructor has graciously agreed to provide time for you to complete the survey now. Thank you!

<table>
<thead>
<tr>
<th>MARKING INSTRUCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use a No. 2 pencil only.</td>
</tr>
<tr>
<td>• Do not use ink, ballpoint, or felt tip pens.</td>
</tr>
<tr>
<td>• Make solid marks that fill the response completely.</td>
</tr>
<tr>
<td>• Erase cleanly any marks you wish to change.</td>
</tr>
</tbody>
</table>

CORRECT: ●  INCORRECT: X ☒ ☐

Please indicate your K number here. If you are unsure of your K number, please print your name below and we will fill it in for you.

Name (optional)
1. What is your primary educational goal at Kirkwood?
   - Certification/Licensure
   - Change careers
   - Explore for career
   - Improve skills for present job
   - Personal Interest
   - Prepare to enter job market
   - Self improvement/Improve basic skills
   - Transfer to another college
   - Undecided/Unknown

2. How certain are you of your educational goal at Kirkwood?
   - Not at all certain
   - Somewhat certain
   - Pretty certain
   - Very certain

3. About 50% of college students typically leave before finishing a program. If this should happen to you, what will be the most likely cause?
   - Absolutely certain that I will finish a program
   - To accept a good job
   - To enter military service
   - It would cost more than my family or I could afford
   - Marriage
   - Children or child care issues
   - Disinterest in study
   - Lack of academic ability
   - Insufficient reading or study skills
   - Other

4. How much education do you expect to get during your lifetime?
   - Less than an associate's degree
   - Associate's degree
   - Bachelor's degree or equivalent
   - 1 or 2 years of graduate study (master's degree)
   - Doctoral degree such as M.D. or Ph.D.

5. Have you ever taken college classes at Kirkwood or any other college before this semester?
   - Yes
   - No

6. Are you currently taking classes at any other college besides Kirkwood?
   - Yes, where? _________________
   - No

7. Which of the following advising sources did you use to select your classes this semester? Choose all that apply.
   - Family member
   - Friend
   - High school teacher/counselor
   - Special Education teacher/counselor
   - Vocational/Rehabilitation counselor
   - Veterans Vocational/Rehabilitation counselor
   - Kirkwood website
   - Kirkwood staff member
   - Advisor from different college/university
   - None

8. During this semester, how much time do you expect to spend during a typical week studying or doing homework?
   - None
   - 1 - 2 hours
   - 3 - 6 hours
   - 6 - 10 hours
   - 11 - 15 hours
   - 16 - 20 hours
   - 21 - 25 hours
   - 26 or more hours

9. During this semester, how much time do you expect to spend during a typical week doing each of the following activities?

   Working for pay on campus
   Working for pay off campus

10. Which format is your Elementary Algebra course?
    - Face-to-Face (all students at one site for lecture)
    - KTS (lecture broadcast to multiple sites via TV)
    - Hybrid (both lecture and online lab component)
11. During the current semester, how likely is it you will do each of the following?

- Participate in student clubs or organizations
- Participate in intramural activities
- Act as a leader in a student group
- Volunteer your time
- Attend a cultural diversity event
- Talk with instructors outside of class about coursework
- Talk with instructors outside of class about topics other than coursework
- Attend religious services
- Discuss course content with students outside of class
- Receive tutoring in courses
- Receive vocational or career counseling
- Tutor another student
- Ask a question about an instructor's feedback on a graded assignment
- Seek help with my study skills
- Seek help with my writing skills
- Seek help with my reading skills
- Hold a full-time job
- Hold a part-time job off campus
- Hold a part-time job on campus

12. Please list three goals that you have for yourself right now.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

13. Please list three things that you are proud of having done.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

14. Please list groups belonged to (formal or informal) and offices held (if any) in your high school or community.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
15. During the current semester, how often do you expect to do each of the following?

- Study or do homework by yourself
- Study or do homework with friends
- Talk with instructors outside of class about coursework
- Talk with instructors outside of class about topics other than coursework
- Attend class or lab unprepared
- Receive tutoring in courses
- Tutor another student
- Use a computer for coursework
- Use a computer for recreational purposes
- Participate in volunteer activities
- Exercise or workout
- Play sports
- Watch television
- Party
- Socialize with friends
- Socialize with someone from another racial or ethnic group
- Drink alcoholic beverages
- Participate in religious activities

16. Please indicate your high school GPA, rounded to one decimal place.

- Somewhat of my high school was in a different country, so I do not have a high school GPA

17. Did you take the ACT test?

- Yes, please indicate your composite score
- No

18. Do you currently live with one or both of your parents or guardians?

- Yes
- No

19. Please indicate your mother's and father's education level.

- Not a high school graduate
- High school diploma or GED
- Less than an associate's degree
- Associate's degree
- College, but less than a bachelor's degree
- Bachelor's degree or equivalent
- 1 or 2 years of graduate study (master's)
- Doctoral degree such as M.D. or Ph.D
- Unknown
20. Please indicate the extent to which you agree with each of the following items. Respond to the statements below with your feelings at present or your expectation of how things will be.

I am sometimes looked up to by others.
There is no use in doing things for people; you only find that you get in the neck in the long run.
I expect to have a harder time than most students here.
Once I start something, I finish it.
I am as skilled academically as the average applicant here.
I expect I will encounter racism at this school.
People can pretty easily change me even though I thought my mind was already made up on the subject.
My friends and relatives don't feel I should go to college.
I want a chance to prove myself academically.
I enjoy working with others.
My background should help me fit in well here.
My friends look at me to make decisions.
I expect the faculty to treat me differently from the average student here.
I am uncomfortable interacting with people from other races or cultures.
I try to find opportunities to learn new things.
I think many people see racism where it doesn't exist.
I expect to be picked on by other students and faculty because of my background.
Everyone must work toward improving social conditions.
I often make lists of things to do.
I keep pretty much to myself.
I sometimes need help from others.
I prefer to be spontaneous rather than to make plans.
I have done work in many community projects.
I have already learned something in my proposed major field outside of high school.
I am not good at getting others to go along with me.
It is more important to study than to get involved in campus activities.
I usually note important dates on my calendar.
The best way to avoid problems is to take things one day at a time.
I have studied things about my major field on my own.
I expect to have little contact with students from other races.
I enjoy being a student.

21. What is the highest math class you completed in high school?

- Algebra I
- Geometry
- Algebra II
- Statistics
- Trigonometry
- Pre-Calculus
- Calculus
- Other, please specify ____________________________

22. Which of the following types of financial aid are you receiving this semester?

- Only student loans
- Only grants/scholarships
- Both loans and grants/scholarships
- None
23. Please indicate your gender.
   - Male
   - Female

24. Please indicate your racial or ethnic identification.
   - African American
   - Asian American
   - Hispanic
   - White
   - Other, please specify ____________

25. Do you have a disability? (e.g. ADHD, learning, visual, etc.)
   - Yes
   - No

26. Please indicate which range includes your total family income in 2008.
   - less than $24,999
   - $25,000 to $49,999
   - $50,000 to $74,999
   - $75,000 to $99,999
   - $100,000 to $124,999
   - $125,000 or more

27. Please indicate your age.

If you would like additional information about this research, email david.keller@kirkwood.edu.

Thank you very much for participating in this survey!

Please use this space to provide any additional information or clarify any of your responses.
## APPENDIX H: BIVARIATE CORRELATIONS FOR INDEPENDENT VARIABLES

Bivariate Correlations for all Independent Variables

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*p ≤ 0.05; **p ≤ 0.01
## Bivariate Correlations for all Independent Variables (continued)

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*p ≤ .05; **p ≤ .01
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### Bivariate Correlations for all Independent Variables (continued)

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