LOCUS OF CONTROL AND ACADEMIC ACHIEVEMENT: INTEGRATING SOCIAL LEARNING THEORY AND EXPECTANCY-VALUE THEORY

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ABSTRACT

The current study examines predictors of math achievement and college graduation by integrating social learning theory and expectancy-value theory. Data came from a nationally-representative longitudinal database tracking 12,144 students over twelve years from 8th grade forward. Models for math achievement and college graduation were tested through structural equation modeling. Consistent with earlier research, previous math achievement predicted both outcomes. Performance expectancies and task-specific self-concept respectively predicted math achievement and college graduation, although the contribution of task-specific self-concept was smaller than shown in previous research. The social learning theory concept of behavior potential was found to be a predictor of college graduation but not math achievement. Limitations and implications are discussed, with a focus on future research questions.

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CHAPTER 1
INTRODUCTION

Social Learning Theory

Social learning theory was designed to predict the potential for a behavior, or group of interrelated behaviors, to occur (Rotter, 1954; Rotter, Chance, & Phares, 1972). Four key constructs are defined by the theory. First, social learning theory refers to behavior potential as the likelihood of a particular behavior's occurrence and, therefore, represents the outcome variable for the theory. Social learning theory considers behavior potentials for both observable and unobservable behaviors, the latter of which could include a person's cognitions. These potentials also exist at the level of individual behavior units and groups of interrelated behaviors, with the term need potential often used to define several interrelated behaviors that are all targeted towards a common goal.

Another key construct of social learning theory is reinforcement value, which is the relative importance a particular reinforcement has to an individual. A particular reinforcement will have different value to different people, and any person will have a hierarchy of preferred reinforcers. As in traditional theories of behaviorism, stimuli gain reinforcement status by either serving a natural need or through pairings with an established reinforcer. Like behavior potentials, functional relationships can also develop between reinforcers. Known as need value, such functional relationships can stem from repeated pairings of reinforcers or from cognitive activities in which one imagines that specific outcomes follow the occurrence of a reinforcer. Social learning theory identifies reinforcement value as one of the predictors of behavior potential, as behaviors are more likely to occur when the available reinforcer is strongly valued by the individual.

Expectancy represents the second variable hypothesized to predict behavior potentials. The concept of expectations assumes an integral role in social learning theory, as it represents the perceived probability that a specific behavior will lead to a specific outcome. Although actual experience with particular behaviors can shape these expectations, one's perception of behavior-outcome relationships can also impact reinforcement expectancies. This latter factor deserves specific attention, as it distinguishes social learning theory from traditional behaviorist explanations focused solely on observable behavior-outcome relationships.

Social learning theory also states that reinforcement expectancies exist on a continuum from general to specific. At the general level, individuals can hold similar expectancies across a variety of specific situations. Such generalized expectancies can predict the occurrence of various behaviors and yield their greatest impact when a person engages in a novel task. As individuals gain experience with particular performance tasks, domain-specific expectancies for reinforcement emerge. While the former type of expectancy decreases in power as a function of the individual's experience with a task, the impact of domain-specific expectancies are assumed to grow stronger over time. In between the extremes of generalized and domain-specific expectancies, expectancies for specific domains can spread to other, similar performance situations. For example, if a seasoned baseball player began playing a new sport, social learning theory predicts that his expectations for reinforcement would be somewhat influenced by his baseball-specific expectations. However, if that same individual engaged in a non-athletic activity for the first time, his expectations for reinforcement would be less influenced by baseball-specific expectations and more influenced by generalized expectancies.

The final social learning theory construct discussed here is known as the psychological situation. The psychological situation is characterized by specific environmental cues that signal the availability of a reinforcer. Behavior potential can be affected by different psychological situations, as environmental cues can signal both the specific reinforcers available to the individual as well as the likelihood that each reinforcer will be received. Since different situations provide for different reinforcement opportunities, one's behavior can differ significantly across situations.

Early research on social learning theory focused on perceptions of control and how such perceptions mediate the relationship between reinforcement and expectations (Rotter, 1966). This research differentiated situations in which the control was believed to stem from internal or external sources. Internal causes stem from an individual's actions or natural abilities or characteristics, while external causes might include luck or other people. In several studies, individuals performed tasks in laboratory settings and received reinforcement according to a fixed-ratio reinforcement schedule. Although the provision of reinforcement was under external control, half of the participants were told that reinforcement was contingent upon their performance. Results of these experiments suggest that the perception of internal control exerted a significant impact on subsequent behaviors. For example, those led to believe that the tasks were skill-based experienced larger and more frequent changes in reinforcement expectancies. In addition, their behaviors were more resistant to extinction under conditions of total (100%) rather than partial (50%) reinforcement, which is contrary to typical research on extinction. Finally, the unique behavior characteristics of those who were told that the tasks were skill-based were not limited to specific experimental situations, as their behavior characteristics generalized to novel experimental tasks.

As a result of experimental studies demonstrating the effect that perceptions of control exerted on behaviors, researchers began to develop self-report rating scales that measured tendencies toward internal and external perceptions of control (Rotter, 1966). Such rating scales hypothesized that the internal/external construct existed on a continuum, as different individuals could have tendencies towards internal or external perceptions of control, and such tendencies could be low, moderate, or high in strength. Furthermore, the rating scales sampled a wide range of situations in which control could be perceived as internal or external. Since statistical analyses found that ratings tended to be similar regardless of the particular domains covered by test items, the scales typically calculated an overall score that represented a general tendency towards internal or external perceptions of control.

Various research findings provided validity for self-report locus of control rating scales (Rotter, 1966). In experimental paradigms, those whose scores were in the "internal" range exhibited behaviors similar to those mentioned in the aforementioned studies, as they had larger and more frequent changes in reinforcement expectancies and were more likely to have behavior patterns that generalized across experimental tasks. Moreover, various real-world behavior differences were documented between "internals" and "externals," as the former group was more likely to gain information about medical conditions, engage in social activist activities, join labor unions, quit smoking, resist pressures for conformity, and be more motivated to succeed in cognitive and academic tasks. Together, Rotter interprets these real-world behavior differences as evidence of the greater desire of those with internal perceptions of control to control their environment.

A plethora of research over the years has investigated the effect of perceived control on performance outcomes and favorable life circumstances, and various terms and theories have been coined to study the construct (Rotter, 1992; Skinner, 1996). One such conceptualization that coincides with Rotter's view is known as locus of control (Lefcourt, 1982; Levenson, 1981). As defined by the locus of control construct, people who feel in control of life outcomes, whether through direct action or innate personal characteristics, hold an internal locus of control. This view of control is contrasted with one in which life outcomes are attributed to forces outside one's control, such as luck or other people. Individuals holding this latter view are said to have an external locus of control.

In the area of academic performance, individuals holding internal loci of control have consistently demonstrated higher academic achievement. Meta-analyses reviewing over one hundred studies between 1973 and 1994 have supported the positive relationship between the two variables (Findley & Cooper, 1983; Kalechstein & Nowicki, 1997). Meta-analytic results also show that an internal locus of control predicts achievement at the primary, secondary, and post-secondary education levels and is an equally strong predictor of classroom grades and performance on standardized tests (Kalechstein & Nowicki, 1997). However, the effect sizes associated with locus of control's prediction of academic performance in these meta-analyses were low. More recent research provides additional evidence of the relationship between academic achievement and locus of control, as those with internal loci of control perform better on standardized academic tests (Borman & Rachuba, 2001; Chang, Singh, & Mo, 2007; Muller, Stage, & Kinzie, 2001; Strayhorn, 2010), hold higher grade point averages (Shepherd, Fitch, Owen, & Marshall, 2006; Tella, Tella, & Adeniyi, 2009), receive higher grades in specific courses (Kirkpatrick, Stant, Downes, & Gaither, 2008; Yazdanpanah, Sahragard, & Rahimi, 2010) and are more likely to complete high school (Madhere, 1997) or earn a postsecondary degree (Hall, Smith, & Chia, 2008; Sciarra & Whitson, 2007). In most instances, locus of control's prediction of favorable academic outcomes remains significant even after other known predictors of achievement are considered. As with meta-analytic results, however, the demonstrated link between locus of control and academic achievement tends to be small.

It is possible that limitations to the locus of control conceptualization offer an explanation why research has consistently shown a small relationship between locus of control and academic achievement. In developing his attribution theory, Weiner (1985, 2009) posits that the relationship of perceived control to performance expectancies is overly simplistic. To provide a deeper explanation of performance outcomes and future expectancies, Weiner claims that internality/externality of a causal agent does not automatically dictate controllability. For example, both innate ability and individual effort represent internal causes of success, but only the latter is typically perceived as controllable. A second criticism aimed at the locus of control construct was its failure to consider the stability of perceived outcome causes, as both internal and external determinants of success can either vary or remain constant over time. Weiner differentiated the external causes of luck and task difficulty as well as the aforementioned internal factors of ability and luck on the basis that luck and effort can vary over time, while the remaining causal agents have higher stability. According to attribution theory, therefore, any given causal agent exists along the three dimensions of internality/externality, controllability, and stability, with shifts in future performance expectancies stemming more from the stability of perceived causal agents rather than their internal or external origin. Specifically, when a particular outcome is attributed to stable causes, the same outcome will be expected when similar performance situations arise in the future.

Another possible explanation why locus of control has been found to be a limited predictor of academic achievement lies in the fact that most locus of control research has failed to address the specific predictions made by social learning theory. Several scholars have criticized previous research for examining the locus of control construct outside the theoretical framework of social learning theory (Peterson & Stunkard, 1992; Rotter, 1975; 1992; 1992). For example, since social learning theory posits that the relationship between perceived control and subsequent outcomes is mediated by the value one places on a particular outcome, its proponents often lament that this latter variable is not considered in studies of locus of control and academic situations.

Expectancy-value Theory

A third explanation for the small relationship between locus of control and academic achievement could reflect the specific causal pathways linking these variables. One theory which proposes an indirect effect of locus of control on academic achievement is Wigfield and Eccles's (1992, 2000) expectancy-value theory. In this theory, locus of control is assumed to predict task-specific self-concept, which in turn influences performance expectancies. It is these performance expectancies which then exert a direct effect on achievement behaviors, which include performance, effort, and persistence.

Expectancy-value theory also hypothesized a direct causal agency between task value and academic achievement. Four specific forms of task value were identified, as people can value tasks because they find them inherently interesting (intrinsic value), have a desire to succeed on a given task (attainment value), feel that the task is relevant to a larger goal (utility value), or feel that the negative effects of engaging in a task are minimal (cost value). Unlike social learning theory, however, task value and locus of control share separate paths in predicting outcomes.

Research of expectancy-value theory has consistently demonstrated the ability of performance expectancies to predict academic achievement and task value to predict future course selection (Crombie et al., 2005; Eccles, Adler & Meece, 1984; Meece, Wigfield, & Eccles, 1990; Wigfield & Eccles, 2000). Although some research has found task value to predict academic performance (Bong, 2001; Cole, Bergin, & Whittaker, 2008; Hulleman, Durik, Schweigert, & Harackiewicz, 2008), the majority of findings suggest that the path from task value to performance is nonsignificant when performance expectancies are considered. Conversely, while performance expectations have been found to predict intended course enrollment for female students (Crombie et. al., 2005), additional studies have not evidenced this relationship for either gender (Eccles et al, 1984; Meece et al., 1990). Investigations of expectancy-value theory have also raised questions regarding the validity of separate self-concept and performance expectancy constructs, as both exploratory and confirmatory factor analyses suggest they represent a unified construct (Eccles, Wigfield, Harold, & Blumenfeld; 1993; Eccles & Wigfield, 1995).

Several questions regarding Wigfield and Eccles's expectancy-value theory remain unanswered. First, since the participants in the aforementioned studies have resided in restricted geographic locations, it remains unclear how their findings would generalize to the overall population. Second, since each of the studies has only monitored the relationships between motivational constructs and subsequent achievement outcomes over a period of one year or less, the long-term predictive effects of the motivational variables are unknown. This limitation appears particularly relevant in the case of task value, as its ability to predict subsequent course enrollment could indirectly lead to higher academic achievement over time. Third, investigations of expectancy-value theory have focused on course grades as achievement outcome measures, but have not considered standardized test performance or college graduation rates.

Current Study

The following study will add to the research base on academic achievement motivation by integrating social learning theory and expectancy-value theory. Math achievement and college graduation serve as the two main outcomes variables in the current analysis, while independent variables will include motivational constructs, standardized test performance, and course-selection patterns. Consistent with social learning theory and its behavior potential construct (Rotter, 1954; Rotter, Chance, & Phares, 1972), the current study will examine how locus of control and task value combine to affect achievement outcomes. Task value is hypothesized to moderate locus of control's impact on achievement by enhancing the positive effects of internal locus of control and the negative effects of external locus of control. Predictions made by expectancy-value theory will also be represented, including a direct effect of task-specific self-concept and performance expectancies on achievement outcomes, a direct effect of task value (as represented by behavior potential) on course enrollment, and an indirect effect of locus of control (as represented by behavior potential) on achievement outcomes as mediated by course-specific self-concept and performance expectations. Although the preponderance of expectancy-value research does not support task value as a predictor of academic achievement, such results could reflect the relatively short durations of these studies. Since the current study examines the effects of predictor variables across longer time spans, it is hypothesized that task value will indirectly predict math achievement as mediated through course enrollment. Specific hypotheses to be tested are listed below, and figures 1-1 and 1-2 present the specific path analyses to be tested.

Hypotheses

Hypothesis 1- Math achievement will be directly or indirectly predicted by prior math achievement behavior potential, math self-concept and math course enrollment.

Hypothesis 1a-Math self-concept will directly predict subsequent math achievement

Hypothesis 1b-Math course enrollment will directly predict subsequent math achievement

Hypothesis 1c-Behavior potential will be an indirect predictor of subsequent math achievement. It will be mediated by math self-concept and math course enrollment.

Hypothesis 1d-Prior math achievement will have both direct and indirect predictive effects on math achievement. It will be partially mediated by math self-concept and math course enrollment

Hypothesis 2-Degree attainment (i.e. college graduation) will be directly and indirectly predicted by expectations for graduation (i.e. college expectations), academic track, behavior potential, prior math achievement, and prior reading achievement.

Hypothesis 2a-Epectations for graduation will directly predict degree attainment.

Hypothesis 2b-Academic track will directly predict degree attainment.

Hypothesis 2c-Behavior potential will indirectly predict degree attainment as mediated by both expectations for graduation and academic track.

Hypothesis 2d-Prior math achievement will indirectly predict degree attainment as mediated by both expectations for graduation and academic track.

Hypothesis 2e- Prior reading achievement will indirectly predict degree attainment as mediated by both expectations for graduation and academic track.

Figure 1-1 Predictors of Math Achievement

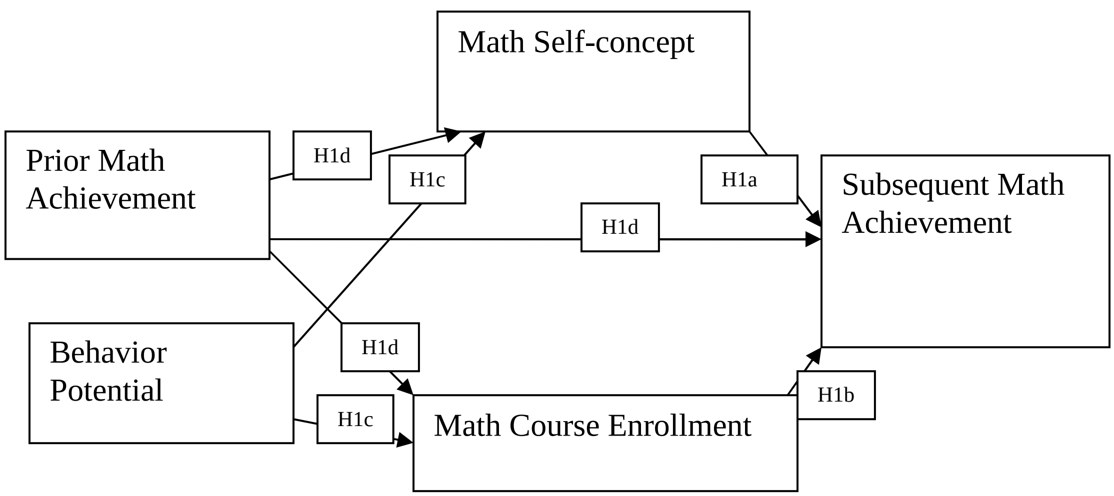


Figure 1-2 Predictors of Degree Attainment

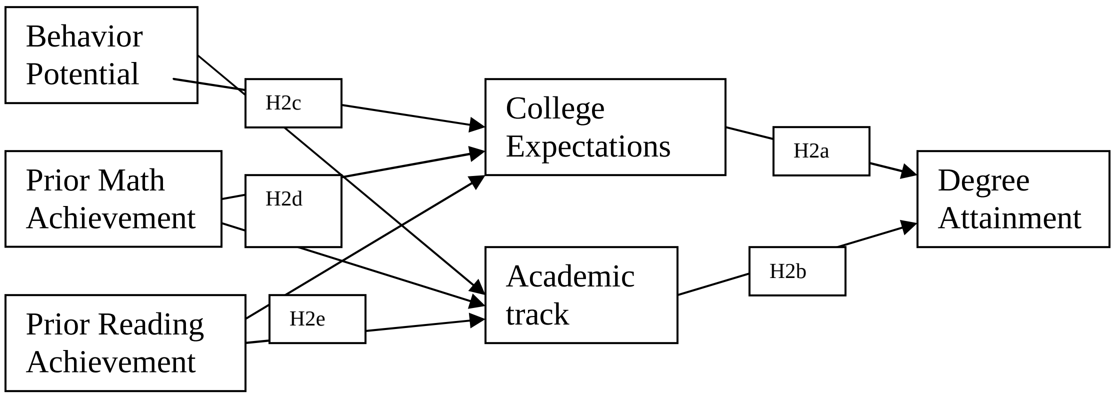


Table1-1. Definitions of Relevant Constructs

Attainment value	A form of *task value* based upon the desire to succeed on a given task
Attribution theory	A theory describing the likelihood of future behaviors based upon the causal explanation people provide for outcomes; describes causal agents on the dimensions of controllability, stability, and internality/externality
Behavior potential	The likelihood of an individual performing a given behavior that is based upon *reinforcement value* and *expectancy*; For the purposes of this dissertation the behavior potential construct is the amalgamation of task value and locus of control.
Cost	A form of *task value* based upon the negative effects of engaging in an activity
Expectancy	The perceived probability that behavior will result in a particular reinforcer; a concept of *social learning theory*
Expectancy-value theory	A belief that performance expectations and perceived task value are the strongest predictors of academic achievement-related behaviors
External locus of control	A tendency to attribute outcomes to factors outside the individual, such as luck or the actions of others
Internal locus of control	A tendency to attribute outcomes to individual factors such as hard work or ability
Intrinsic value	A form of *task value* based upon the inherent interest an individual sees in an activity
Reinforcement value	The relative importance a reinforcer holds to an individual; a concept of *social learning theory*
Social learning theory	A theory designed to predict the occurrence of a behavior or set of behaviors; includes the constructs of *behavior potential*, *reinforcement value*, and *expectancy*
Task Value	A concept of expectancy-value theory that included four types of value: *attainment value*, *cost*, *intrinsic value*, and *utility value*
Utility value	A form of *task value* based upon the belief that a particular task will help one reach a larger goal

CHAPTER TWO
REVIEW OF LITERATURE

The following literature review will focus on research pertaining to relevant theories of academic achievement motivation. The first section will review research demonstrating findings of higher achievement among those with an internal locus of control. Next, studies of attribution theory and its predictions regarding academic achievement will be discussed. Finally, findings related to the expectancy-value theory of achievement motivation will be presented.

Locus of control

Overview

Rotter's social learning theory served as a precursor to the locus of control construct (Rotter, 1954; Rotter, Chance, & Phares, 1972). According to this construct, the likelihood of an individual performing a given behavior, which is known as behavior potential, is a direct function of the perceived likelihood of attaining a favorable outcome and the degree to which this favorable outcome is valued. Thus, individuals who desire a given outcome and feel confident in their ability to attain it have a high probability to engaging in the behaviors necessary to reach their goal. Research employing both experimental paradigms and questionnaire data found that, although individuals differed in the degree to which they expected favorable outcomes, such expectations tended to be similar for a given person across different tasks. This generalized expectation for success or failure, therefore, is analogous to the locus of control construct (Lefcourt, 1982; Levenson, 1981). Locus of control represents the degree to which individuals feel in control of life outcomes. An internal locus of control is characterized by the belief that success in performance situations stems from factors such as ability or hard work that are characteristics of the individual. On the other hand, people holding an external locus of control attribute success and failures to factors outside themselves, such as luck or the actions of others.

Research has consistently demonstrated the relationship between locus of control and academic achievement. Early meta-analyses reported higher achievement among those with an internal locus of control, with respective effect sizes of .18 Findlay & Cooper, 1983) and .25 (Kalechstein & Nowicki, 1997). Since that time, research has continued to find positive relationships between the two factors. Factors predicted by locus of control have included general (Finn & Rock, 1997; Madhere, 1997; Ross & Broh, 2000; Shepherd et al., 2006; Tella et al., 2009) and course-specific (Borman & Rachuba, 2001; Chang et al., 2007; Kirkpatrick et al., 2008; Muller et al., 2001; Strayhorn, 2010; Yazdanpanah et al., 2010) academic performance, high school graduation (Madhere, 1997), and postsecondary degree attainment (Hall et al., 2008; Sciarra & Whitson, 2007). Beneficial effects of an internal locus of control have been established for both genders (Muller et al., 2001) as well as for different ethnic groups (Chang et al., 2007; Madhere, 1997; Muller et al., 2001; Sciarra & Whitson, 2007; Strayhorn, 2010). Research has also demonstrated locus of control's impact on the academic resilience of students from low socioeconomic backgrounds (Borman & Rachuba; 2001; Finn & Rock, 1997).

Despite the number of studies highlighting the link between locus of control and academic achievement, the magnitude of this relationship tends to be small. One possible explanation for the small relationship is that research into locus of control and academic achievement has not considered the social learning theory concept of behavior. Typical research designs have included locus of control either as an individual predictor of academic performance or along with other hypothesized predictors of academic achievement, but have done so in an atheoretical manner. Although Kalechstein and Nowicki's (1997) meta-analysis did address some of the predictions made by social learning theory, the concept of behavior potential was not represented in their analysis. In discussing limitations to locus of control research, scholars have voiced concerns that such research failed to consider the degree to which success on particular tasks is valued (Peterson & Stunkard, 1992; Rotter, 1975; Rotter, 1992).

Relevant research

The following section reviews relevant research pertaining to academic achievement and locus of control. Thus review begins with a description of two large-scale meta-analyses. Following this, several more recent studies are discussed.

An early meta-analysis examining the relationship between locus of control and academic achievement was conducted by Findley and Cooper (1983). Studies included in the analysis were those that calculated a relationship between a measure of locus of control and a measure of academic achievement, with the latter category including measures such as IQ tests, standardized academic tests, and classroom grades. Through a thorough review of the literature, a total of 98 studies meeting these inclusion requirements were uncovered. However, since 23 of these studies simply described the relationship between locus of control and academic achievement without measuring this relationship statistically, only 75 studies were used in the analysis.

Findlay and Cooper (1983) assessed the effect size of each study by calculating a correlation coefficient for 67 of the studies. The mean correlation coefficient across these studies was .18, as students with an internal locus of control were found to have higher achievement scores. They cautioned that these results most likely underestimate the relationship between locus of control and academic achievement, citing two reasons why. First, an effect size of zero was assigned to several studies which reported no significant relationship between the variables and provided no effect size estimate. Considering that it is rare to find no relationship between variables and that the majority of the studies analyzed found a positive relationship between locus of control and academic achievement, there is a good chance that the unreported effect sizes were small but positive. The second factor leading to a potential underestimate relates to the 23 studies that simply described the relationship between locus of control and academic achievement without reporting any statistics. Since 16 of these studies were in the positive direction, it is possible that the average effect size between locus of control and academic achievement would be higher than was noted in the current meta-analysis.

Findlay and Cooper (1983) further assessed differences in the locus of control–academic achievement relationship according to the following demographic and measurement characteristics: age, gender, SES, ethnicity, general vs. specific measure of locus of control, and type of achievement measure (classroom grades, standardized achievement tests, and standardized intelligence tests). With the exception of ethnicity, whose effect size was identical for White and Black students, correlation coefficients were calculated for all possible values of each variable. Gender and general vs. specific locus of control measures were both dichotomous variables, while the achievement measure was made dichotomous by contrasting standardized tests and classroom-based assessments. Since SES and age were both ordinal variables, numerical values were assigned according to the relative rank of a variable category. Overall, no correlations between effect size and variable value reached significance at the $p < .05$ level. This suggests that locus of control's effect is consistent across demographic groups and forms of measurement.

Kalechstein and Nowicki (1997) conducted a later meta-analysis on the relationship between locus of control and academic achievement and, in contrast with Findlay and Cooper's work, structured their analysis to be a specific test of Rotter's social learning theory. Since social learning theory differentiates the role of general and domain-specific locus of control, with the former having the greatest effect for novel tasks and the latter increasing in importance as one gains experience with a task, it was predicted that domain-specific measures would be superior to general measures in predicting academic achievement. Also, it was hypothesized that the relationship between locus of control and academic achievement would remain the same across gender groups and specific achievement measures (grades vs. standardized tests). Studies that included measures of locus of control, provided a statistical relationship between the variables, and published prior to 1984 were included in the meta-analysis. In total, 78 studies met these criteria.

Across the studies they reviewed, Kalechstein and Nowicki (1997) found that the average correlation coefficient between locus of control and academic achievement was .23, with higher achievement more likely among those with an internal locus of control. Analyses of variances (ANOVAs) and t-tests were used to test the differences between general and domain-specific locus of control measures, types of achievement measures, and the various demographic factors. Social learning theory's prediction that domain-specific measures would better predict academic achievement was not supported by the analysis, as their predictive ability was no stronger than the predictive ability associated with general locus of control measures. No significant differences were observed across gender groups or achievement measures. Locus of control was a larger predictor for secondary school-age children than for elementary school or college-age students, suggesting that the impact of locus of control on academic achievement is curvilinear across age. Separate two-way ANOVAs were also calculated for the interaction between gender and achievement measure, general vs. domain specific locus of control, and age. Only the age-gender interaction was significant. The relationship between locus of control and academic achievement decreased in size as males grew older, while the effect was stronger for secondary-school age females than for their elementary-age counterparts. Kalechstein and Nowicki advised caution in interpreting the age-gender interaction results, as they found only one study reporting effect sizes for college-age men and college-age women.

Finn and Rock (1997) analyzed factors predicting academic resilience among students from low SES backgrounds. Resilience was defined according to three factors: placement at the 40th percentile or higher on standardized math and reading tests, self-reported GPA of at least a mixture of B's and C's, and maintaining school enrollment in 12th grade. Furthermore, students who did not meet one of these resilience criteria were differentiated according to whether they were still enrolled in high school. A total of 1,803 respondents to the National Educational Longitudinal Survey (NELS:88) were included in the study, with selection criteria based on respondents' ranking in the bottom half on the SES composite score and providing complete information on all of the included variables. Although the major focus of the investigation centered on student engagement factors, the ability of locus of control and self-esteem to predict academic success was also analyzed. Both locus of control and self-esteem were operationalized with separate composite scores from a specific NELS:88 base year survey, when students were enrolled in 8^{th} grade.

A three-way multivariate analysis of variance (MANOVA) found significant differences ($p < .001$) in locus of control and self-esteem between students of different race, gender, and resilience status (Finn & Rock, 1997). Univariate analyses of variance were then conducted for all possible pairs of independent and dependent variables. Significant findings were obtained for locus of control and the category of resilience. In addition to finding greater internal locus of control among the resilient students, the nonresilient students who completed high school were more likely to have internal locus of control than were those who left school before graduating. An effect size in the moderate-to-large range (.69) was found between the resilient and nonresilient students, while a low-to-moderate effect size (.30) separated the nonresilient school completers from those who did not complete school.

Madhere (1997) used data from the US Department of Education's High School and Beyond Survey (1980) to investigate factors predicting both the academic achievement and educational attainment of White, Black, and Hispanic students. Predictor variables were classified into one of four categories. *Home environment* factors included parents' income level, parents' education level, and parents' support for their children's academic pursuits. For the *academic opportunity* category, factors such as school sector, curriculum track, and perceived teacher support were analyzed. Tests of visual memory, processing speed, and spatial relations were included in the *cognitive processing* category. Finally, *psychosocial orientation* consisted of college aspirations, perceived locus of control, and a variable entitled "community orientation." Each of the independent variables was collected when participants were in 8th grade, which was the baseline time point for the survey. Academic achievement was operationalized by a composite rating of math, reading, and vocabulary scores in 12th grade, while educational attainment combined educational aspirations in 12th grade and completion of education six years later.

Madhere (1997) assessed the factors predicting academic achievement and educational aspirations by conducting regression analyses. Separate models were constructed for White (*n*= 988), Black (n=828), and Hispanic (*n*=942) students who provided complete data for all pertinent variables. Locus of control was found to significantly predict academic achievement for White, Black, and Hispanic students, although the regression coefficients for locus of control ranged from only 0.14 to 0.18. For White and Black students, locus of control also predicted educational attainment. This significant locus of control–educational attainment relationship was not observed for Hispanic students, however.

Ross and Broh (2000) designed a study to test the bidirectional effects of academic achievement and locus of control. Data were taken from the baseline, first follow-up, and second follow-up time points of the NELS:88 survey, when the students were respectively in 8th, 10th, and 12th grade. Various variables were analyzed, including gender, ethnicity, family income level, family composition (intact vs. nonintact), parent education level, parental support, locus of control, self-esteem, and academic achievement. Parental support was represented by a composite of specified items in the baseline survey, while items from the first follow-up survey were used to operationalize locus of control and self-esteem. For each of the three constructs, student responses were utilized. To measure academic achievement, a composite measure of standardized test scores and classroom grades for Math and English were calculated, and separate achievement scores were reported for 8^{th} and 12^{th} grade. A sample size of 8,802 participants was used in the study, as this was the number of respondents for whom complete data were available.

In the first step of their analysis, Ross and Broh (2000) examined the effect of gender, ethnicity, family income, family composition, parent education level, prior academic achievement, and parental support on subsequent locus of control. Results of structural equation modeling showed that, with the exception of parent education level and family composition, each of the hypothesized predictors explained significant variance in 10^{th} graders' locus of control. In particular, non-white males who came from wealthier families, had greater academic achievement, and reported stronger parental support had the highest levels of internal locus of control. It should be noted, however, that only 12 percent of the locus of control variance was explained by this model.

For the second part of their analysis, Ross and Broh (2000) hypothesized that 12^{th} grade academic achievement would be predicted by academic achievement and parental support in 8^{th} grade, as well as by locus of control and self-esteem in 10^{th} grade. Results indicated that previous academic achievement and locus of control were predictors of subsequent academic achievement, while self-esteem and parental support had no significant bearing on later academic outcomes. An examination of the results indicates that 8^{th} grade academic achievement was a particularly strong predictor of 12^{th} grade achievement, as it had a standardized coefficient of .967. As noted by the authors, the fact that locus of control, which had a standardized coefficient of .074, could still be a significant predictor after accounting for prior academic achievement was quite remarkable.

In a longitudinal study tracking students from 3rd through 6th grade, Borman and Rachuba (2001) investigated predictors of academic resilience among low-SES students. Participants were selected from data gathered through Prospects: The Congressionally Mandated Study of Educational Growth and Opportunity. Based on findings from this larger study, scores on a standardized 6th grade math test were predicted by student SES and performance on a standardized math exam in 3rd grade. Resilience was defined as students whose 6th grade math performance was at least one-third of a standard deviation greater than expected. Conversely, students whose scores were at least one-third of a standard deviation lower than predicted were labeled non-resilient. Borman and Rachuba applied various criteria for selecting respondents from the overall Prospects data pool. Inclusion was limited to respondents whose SES was at least one-third of a standard deviation lower than the mean, as SES was hypothesized to be the risk factor in this study. Since the current study also focused on differences in resilience factors across ethnic groups, only data from those respondents whose reported ethnicities of White, African-American, or Latino were analyzed. Finally, participants had to have complete data on all relevant predictor and outcome variables. The end result of these criteria was a sample of 925 participants.

Borman and Rachuba (2001) categorized predictors of resilience into five distinct categories: individual characteristics, peer-group characteristics, school resources, effective schools variables, and supportive school environment. Locus of control was placed in the “individual characteristics” category. Separate two-way multivariate analyses of variance were conducted for each variable category, with ethnicity and resilient status (resilient vs. nonresilient) serving as the dependent variables. Results of the “individual characteristics” MANOVA was significant for both ethnicity and resilience status, but not for their interaction. Follow-up univariate analyses found each of the included variables to significantly differentiate the ethnic groups as well as the resilience and nonresilient students. In particular, resilient students showed stronger internal locus of control than their nonresilient counterparts, and the effect size for locus of control and resiliency was in the low-to-moderate range (d = .41). When compared to the 16 additional predictors comprising the five variable categories, the effect of locus of control on resilience status trailed only student engagement (d = .75) in its power to differentiate resilient and nonresilient students.

Muller, Stage, and Kinzie (2001) examined locus of control in their study of science achievement. The purpose of this study was to identify factors predicting differences in 8th grade science achievement, as well as increases in science achievement across racial and gender groups. Locus of control was among the variables believed to predict both achievement levels and achievement growth. Data for this study were drawn from respondents to the first three rounds of the NELS:88 survey. If participants completed at least 80 percent of the variables of interest, their data were included. For cases in which a respondent failed to provide data, he/she was assigned the sample average for that particular variable. A total of eight hierarchical linear models were calculated, as separate analyses were conducted across racial (White, African-American, Latino, and Asian-American) and gender groups.

To predict levels of science achievement in 8th grade, which was measured by a standardized test, Muller et al. (2001) examined several variables. Separate composite scores were computed for students' feelings toward mathematics and science, with items for each composite drawn from specific baseline survey items. Furthermore, a composite locus of control was also constructed from baseline responses. To assess prior academic abilities, students were asked to report their grades from 6th through 8th grade. Finally, socioeconomic status was included as a hypothesized predictor. Results indicate that locus of control, socioeconomic status, and prior grades were significant predictors of 8th grade science achievement. Socioeconomic status and prior grades predicted science achievement across all racial-gender groups, while locus of control was a significant predictor for all groups besides Asian-American males. An analysis of the data reveals that, with the exception of Asian-American males, the effect size for locus of control ranged from 0.21 to 0.45.

Muller et al. (2001) also hypothesized that several variables would predict increases in science achievement from 8th to 10th grade and 10th to 12th grade. With the exception of prior grades, each of the variables in the first analysis was included in the second. However, measurements of locus of control were taken from 10th grade rather than 8th grade. Additional predictors were also added as hypothesized predictors, including the number of science units students completed, the academic track in which students were enrolled, and a composite variable assessing students' level of engagement in science class. The number of science courses completed was the only consistent predictor of science achievement growth across racial-gender groups, although students' academic track was a significant predictor for all but African-American females and Latino males.

Locus of control predicted increases in science scores for African-American males, Latino females, and White males, and the respective effect sizes for these groups were 0.29, 0.32, and 0.53. Finally, socioeconomic status predicted science growth for African-American females, while science engagement was a significant predictor for Latino males.

With the specific intent of including a representative sample of students at all levels of high school and of both African-American and Caucasian ethnicity, Shepherd, Fitch, Owen, and Marshall (2006) studied the relationship between locus of control and academic performance. A total of 187 public school students from Kentucky completed the Nowicki-Strickland Locus of Control Scale for Children and reported their classroom grades. To examine the relationship between locus of control and classroom grades, a t-test compared the locus of control scores of students reporting grade point averages (GPA's) above a 3.0 on a 4-point scale (i.e. a "B" average) to those of students reporting a GPA below 3.0. Differences between African-American and Caucasian students in the locus of control–academic achievement relationship were also analyzed, as separate correlations between GPA and locus of control were calculated for each ethnic group.

Shepherd et al.'s (2006) findings are similar to those of other studies. Specifically, students with higher GPA's were more likely to have an internal sense of locus of control, although effect size estimates (d = .25) indicate that this difference was small. When examining the locus of control-academic achievement relationship for specific ethnic groups, the correlation coefficient for African-American students was -.37, and the corresponding correlation coefficient for Caucasian students was a -.26. Since higher scores on the Strickland Locus of Control Scale for Children represent an external locus of control, these results indicate that, regardless of ethnicity, students with higher GPAs are more likely to have an internal locus of control.

Chang, Singh, and Mo (2007) utilized data from NELS:88 in their recent study of factors predicting science achievement. Specifically, Chang et al. analyzed factors predicting levels of science achievement in 8th grade, 10th grade, and 12th grade as well as predictors of changes in these achievement levels across time. Several variables were hypothesized to predict science achievement, including SES, gender, locus of control, self-concept, time spent on science homework, perceived usefulness of science, and factors theorized by the authors to reflect academic engagement. Science achievement was operationalized by IRT scores from the NELS:88 standardized science assessment.

Chang et al. (2007) analyzed the data for the entire sample (N = 12,144), as well as for individual ethnic groups (Caucasian, African-American, Hispanic, and Asian). Cross-sectional analyses in which three-step hierarchical regression equations to predict science achievement were employed at each time point. Locus of control and self-concept were entered concurrently in the second step of the equation, following inclusion of gender and SES and prior to the inclusion of the remaining independent variables. Results indicate that locus of control was a significant predictor of science achievement for all ethnic groups and at all grade levels, with regression coefficients ranging from 0.10 to 0.24.

The second phase of Chang et al.'s (2007) study consisted of multilevel modeling to predict both levels of science achievement and changes in this level across time. Changes in achievement scores for the science achievement test were hypothesized to vary according to gender, SES, levels of academic engagement, and grade level. Although locus of control and self-concept were not expected to have a direct effect on the rate by which science achievement scores change, they were hypothesized to mediate the effect of gender, SES, and academic engagement on this growth rate. Results demonstrate that changes in science achievement did vary according to gender, SES levels of academic engagement, and grade level. However, levels of self-concept and locus of control did not affect their relationship to science growth rates.

Locus of control was analyzed when Sciarra and Whitson (2007) investigated the postsecondary education attainment of Hispanic youth. Using data from the NELS:88 database, the current study included all students (*n* = 866) who described their ethnicity as Hispanic, provided data while enrolled in 10^{th} grade, and reported postsecondary experience eight years following their expected completion of high school. Hypothesized predictors of postsecondary degree completion included gender, socioeconomic status, standardized math and reading scores, English language dominance, parent support, teacher support, locus of control, and self-concept. The dependent variable was a categorical variable of four possible educational outcomes: no postsecondary degree, certification/licensure, Associate's degree, Bachelor's degree or higher.

To determine predictors of each form of postsecondary education, three separate multinomial regression equations were calculated (Sciarra & Whitson, 2007). Students who completed no postsecondary degree were used as the comparison group for each analysis, and odds ratios were reported for the variables that differentiated those earning each form of postsecondary degree. Locus of control was found to predict the completion of each form of postsecondary education, as increases in locus of control amounted to a 93% greater chance of earning a certification/licensure, more than two-and-a-half times greater likelihood of receiving an Associate's degree, and a nearly three-and-a-half greater probability of holding a Bachelor's degree or higher. Of all the hypothesized variables, locus of control was the only one found to predict each form of postsecondary degree completion and was, in every case, found to be the strongest outcome predictor.

In order to test a theory describing how metacognitive and affective factors interact to influence academic achievement, Hall, Smith, and Chia (2008) investigated various factors that could predict both college grade-point average and timely completion of an undergraduate degree. The hypothesized predictors included the following: locus of control, interpersonal and academic self-efficacies, use of metacognitive strategies, behaviors indicative of academic engagement, interpersonal support networks, and high school grade-point average. Locus of control was measured with a rating scale designed by Levenson (1974, as cited in Hall et al., 2008), which contains 24 items following a six-point Likert response format. These items are equally divided among three separate subscales, one of which is designed to represent internal locus of control.

Participants for Hall et al.'s (2008) study were drawn from two introductory psychology courses at one university. Stepwise regression analyses were conducted with all students ($n = 89$) who remained at the university and graduated up to six years later. Analyses for degree completion found that undergraduate degrees were earned more quickly by those with internal loci of control, as this was the only factor found to be a significant predictor. The effect size estimate for locus of control was 0.06, while the Pearson correlation between locus of control and undergraduate completion time was 0.24. Undergraduate grade-point average, high school grade-point average, academic engagement behaviors, and use of metacognitive strategies were found to combine as predictors of undergraduate grade-point averages. While locus of control did share a positive correlation with this outcome variable, the relationship was not maintained when the aforementioned predictor variables were considered.

Kirkpatrick et al. (2008) employed both questionnaire and performance-based measures to study the relationship between locus of control and academic performance in two separate undergraduate psychology courses. The first part of their study recruited 270 students from 17 sections of a general psychology course, with 232 agreeing to participate. Data collected included overall grade point average, course average following two tests, and a locus of control scale developed by Levenson (1973, as cited in Kirkpatrick et al. (2008). The specific locus of control scale included 24 items scored on an eight-point Likert scale, and its relationship to psychology course grades were analyzed through Pearson correlation coefficients and an independent samples t-test. Results demonstrated a small but significant correlation between locus of control and course grades ($r = 0.17$), with higher grades found for those exhibiting higher internality. A t-test was calculated for those students whose reported locus of control levels were one standard deviation above or below the study sample mean. Results indicated that those with higher locus of control scores, who were operationalized as having an internal locus of control, had higher psychology course grades. No effect size was reported, however.

The second phase of Kirkpatrick et al.'s (2008) study analyzed performance-based measures of locus of control among 34 psychology majors enrolled in one of two sections of a psychology course. Although questionnaire data were also collected, these results were not analyzed due to a limited number of respondents rating one standard deviation above or below the study sample mean. The particular performance-based measure included six questions asking about factors that foster one's academic success. Three of these items reflected behaviors the students themselves could do and, therefore, were hypothesized to represent internal causality. In contrast, the remaining items asked students to indicate factors affecting school performance that were outside their control. Students were allotted 30 seconds to answer each item, and the number of responses given to each question was recorded. The degree to which a student held an internal locus of control was operationalized by the total number of responses provided to the three internal causality questions. Similar to phase one of the study, students whose total number of responses was one or more standard deviations above the study sample mean were classified into one group, while those whose total responses was one or more standard deviations below the mean were placed into the second group. An independent sample t-test was conducted and, although an effect size was not reported, stronger academic performance was found for those who indicated more ways in which they could affect their academic performance. This was interpreted as indicating stronger academic performance for those holding an internal locus of control.

Tella, Tella, and Adeniyi (2009) examined the effect of locus of control, interest and schooling, and self-efficacy on the academic achievement of Nigerian secondary school students. A stratified random sampling procedure was employed to recruit participants for the study, with 25 schools randomly selected and 500 students among these schools invited to participate. Of these students, complete data were supplied by a total of 500 participants. Separate rating scales were administered for each of the three independent variables. In particular, locus of control was operationalized by a scale whose items followed a "true or false" response format and was focused solely on academic scenarios.

Since it was believed that some of the items on each scale would not be appropriate for the target population, two educational psychologists reviewed each scale and designated specific items for revision or exclusion. Following this procedure, the reliability of each scale was assessed and found to be strong. Academic achievement was operationalized by averaging student scores on standardized English Language, Mathematics, and Integrated Science examinations.

Tella et al. (2009) used multiple regression to analyze the joint and individual effects of each predictor variable on academic achievement. As a whole, locus of control, interest in schooling, and self-efficacy predicted 32.2 of the variance in student test performance. Each variable was also found to influence academic achievement independently of the remaining predictor variables, with locus of control exerting the strongest predictor effect ($\beta = .344$).

Strayhorn (2010) used data from the NELS:88 to compare the effects of individual, family, and school characteristics on the 10th grade math performance of Black students. Variables characterized as individual-level factors included gender, parents' education level, prior math achievement, locus of control, self-concept, attitude towards math, and perceived math utility. Locus of control and self-concept were respectively represented by separate NELS:88 composite variables. The locus of control composite contained six-items and had a Cronbach's α of 0.75, while self-concept was measured by a seven-item construct with a Cronbach's α of 0.78. Attitude towards math and perceived math utility were each represented by one item scored on a four-point Likert scale. Family-level variables included parent behaviors believed to be indicative of a parents' involvement in their children's education. Such behaviors included checking homework, speaking with teachers, and visiting classes. Each of these items was reported from the perspective of the student, and was scored either dichotomously or on a four-point Likert scale. Finally, school-level variables included student perceptions of teacher quality, time spent on homework, the percentage of students receiving free lunch at a given school, and a school's status as an urban/rural or suburban school.

Hierarchical linear regression was used to estimate the effects of individual, family, and school factors on math achievement (Strayhorn, 2010). In step one, each of the individual-level factors were added together and accounted for six percent of the variance in Black students' 10th grade math achievement. Locus of control ($\beta = 2.28$) was found to have the largest impact on achievement, with gender, parent education, and prior math performance also exerting significant effects. Family variables were added to the individual variables in step two of the regression equation, with the combination of the two sets of variables accounting for 14 percent of the variance in math achievement. While locus of control remained a significant predictor of math achievement, its predictive ability dropped slightly ($\beta = 1.95$) once family factors were considered. Finally, adding school variables in step three allowed for twenty percent of the variance in math achievement to be explained. When variables from all three categories were considered, locus of control's effect on math achievement ($\beta = 1.63$) remained significant and ranked behind only gender, parental education, and whether teachers encouraged students to pursue scholastic over vocational goals.

In order to study the relationships between locus of control, demographic variables, and academic achievement among foreign language learners, Yazdanpanah, Sahragard, and Rahimi (2010) conducted a study 120 English literature majors enrolled in either their sophomore, junior, or senior year at an Iranian University. A scale designed by Rotter (2003, as cited in Yazdanpanah et al. 2010) was used to operationalize locus of control, and Cronbach's α estimates for this scale (0.78) suggest adequate reliability. Students completed this scale during the middle of a semester, while semester-specific class averages were calculated at the end of the semester. For juniors and seniors, both overall course averages and English Literature course averages were calculated. Only overall course averages were calculated for sophomores.

Yazdanpanah et al. (2010) calculated a Pearson correlation coefficient between course average and locus of control and found that those with an internal locus of control experienced stronger academic performance ($r = .403$). Further correlations between locus of control and academic achievement were calculated after the respondents were split into two groups based upon their scale responses. Students whose scores on the locus of control scale were above the 50th percentile of the study sample were classified as internals, while the remaining students were labeled externals. When data were analyzed in such a manner, locus of control was found to strongly differentiate ($r = .891$) performance levels among those with internal locus of control, but had no significant effect for those with external control ($r = .101$). Among those with internal locus of control, locus of control was found to be a significant predictor of both overall course average ($r = .688$) and English literature course average ($r = .477$), although it predicted the former category more strongly. Neither age, year of study, or gender was found to have a significant effect on overall locus of control levels or the locus of control–academic achievement relationship. However, an independent t-test with follow-up effect size estimates did find large variance in locus of control differences ($\eta^2 = .106$)

according to SES, with low SES students more likely to experience an external locus of control. Follow-up analyses also found that, among those with an above average external locus of control, lower course grades were observed for students classified as mid/high SES. No course average-SES relationship was found for the internal locus of control group, however.

Attribution theory

Based upon perceived weaknesses with the locus of control construct, Weiner (1985, 2009) developed attribution theory. Similar to locus of control research, attribution theory examines explanations for outcomes and their impact on subsequent behavior. However, the theory posits that internality/externality is only one dimension on which potential causal agents exist and is not synonymous with controllability. For example, while both innate ability and hard work are internal causes of performance outcomes, only the latter cause is viewed as controllable. Stability represents a third dimension of causality. Attribution theory claims that the perceived controllability, stability, and internality/externality of causal agents must be considered, as each dimension has implications for performance expectancies.

Phillipson (2006) examined the effect of student and parent attribution styles on academic performance in a study of 158 Hong Kong students enrolled in one of three schools and one of two grade levels (primary 5 and primary 6). Students in the study ranged in age from 8 to 13. Separate questionnaires were administered to measure student and parent attributions for academic performance. Student responses were grouped into one of eight attribution types, as children could attribute success or failure to ability, effort, luck, or strategy use. Factor analyses determined that parent attributions could be grouped into one of six categories, with success or failure being attributed to ability, luck, or effort and strategy.

Due to demographic differences between the student populations of each school, Phillipson (2006) conducted separate hierarchical regressions for Math and English performance at each of the three schools. Results indicated that academic performance was predicted by different factors across the three schools, with no student attribution having a consistently strong effect. Student attributions to effort and ability were significant in two of the regression equations, while attributions to strategy were significant for one of the models. Performance explanations based on luck were not significant for any of the regression models. Overall, these results suggest both controllable unstable (effort, strategy) and uncontrollable stable (ability) factors should be considered when predicting achievement.

Haynes, Ruthig, Perry, Stupnisky, and Hall (2006) tested the effect of an attribution retraining program whose purpose was to decrease attributions to uncontrollable causes and foster attributions to controllable ones. A total of 162 Canadian undergraduate students who were enrolled in an introductory psychology class and participating in a larger study contributed to the current investigation. As part of the larger study, students completed a questionnaire immediately after receiving the results of their first psychology exam, and responses to this exam determined eligibility for Hynes et al.'s (2006) study. One criterion was student perceptions of perceived success, as students were asked to rate on a ten-point scale their level of success in the psychology course. Scores of seven or less were operationalized as low perceived success, and only those students falling into this category were allowed to participate. It should be noted that a

Pearson correlation coefficient found that perceptions of perceived control correlated with actual test performance to a high degree (*r* = .71). The other criterion was based on student responses to an 8-item optimism scale, with students needing to rate in the top- or bottom-third on this scale in order to participate.

Attribution retraining was given to 70 study participants, while the remaining students received no intervention (Haynes et al., 2006). Comparable numbers of low- and over-optimists comprised both experimental groups. Following this training, measures of perceived control, academic attributions, and academic performance were collected. A seven-item scale following a five-point Likert response format was used to represent perceived control. Cronbach's α for this scale was .75, which suggests adequate internal consistency. Students were also asked to rate on a scale of 1-10 the extent to which they attribute academic performance to one of five different causes. These causes could be classified as internal, controllable and unstable (effort); internal stable and uncontrollable (ability); external stable and uncontrollable (test difficulty, instructor quality); and external (unstable and uncontrollable). Since both of these constructs were also measured before the intervention's implementation, a series of paired-sample t-tests compared changes in attributions and control perceptions between low- and over-optimists and the experimental and control groups. Among low-optimists, attribution retraining fostered stronger endorsements of effort as an explanation of performance, but no significant change in perceived control or the remaining attributions. No changes were evident among low-optimists in the control group. Attribution retraining affected several variables for over-optimists. In addition to reporting higher levels of perceived control and stronger attributions to effort, those who received attribution retraining did not experience the increase in attribution to uncontrollable external factors (test difficulty, teaching difficulty) characteristic of over-optimists in the control group.

Haynes et al. (2006) also analyzed the effect of attribution retraining's effect on academic performance, which was operationalized by both final course grade in introductory psychology and overall-semester grade point average. Two-way analyses of covariance were calculated for each dependent variable, with high school, grade point average serving as the covariate. Individuals receiving attribution training outperformed the control group in both the final course grade (74.33%–67.47%) and semester grade point average (2.73–2.39). Interaction effects between optimism levels and attribution retraining were also evident, as over-optimists receiving attribution retraining outperformed the other three groups in course grade and grade point average, and this difference was similar to that between "B" and "C+" letter grades. Attribution retraining had no significant impact for low-optimists, whose performance was also comparable to that of the over-optimists who received no attributional retraining.

Perry, Stupnisky, Daniels, and Haynes (2008) conducted a study of attribution theory with 3,140 first-year college students enrolled in an introductory psychology course at a Canadian university. As part of the study, a questionnaire addressing attributions for academic performance was administered after students received grades for their first class exam. The questionnaire included six possible explanations (effort, strategy, ability, professor quality, test difficulty, and luck) for poor test performance and students were asked to rate on a 10-point scale how strongly each factor explained their test performance. Each of these six factors was assumed to differ according to the three causality domains of internality, controllability, and stability described by attribution theory (Weiner, 1985; 2009). In order to discover common attribution patterns, cluster analyses were conducted and suggested that the students could be classified into one of four categories existing on a continuum from low to high controllability. The first category, which was characterized by an emphasis on low ability, test difficulty, poor instruction, and bad luck, was labeled “relinquished control” and represented a tendency to attribute poor performance to uncontrollable factors. A second cluster was referred to as “devalued control,” as students with this attribution style placed minimal effort on the controllable factors of effort and strategy use but did not place high value on any of the remaining explanations. Students in the “effort-reliant” group placed a strong emphasis on effort and a low emphasis on ability, test difficulty, and instructional quality. Thus, these students had a tendency to minimize the impact of uncontrollable factors. Finally, a group of students tending to use effort, strategy, test difficulty, and professor quality as explanations of poor performance emerged from the cluster analysis and were designated as “self-protective” students. Students with this attribution style, therefore, focused on controllable internal and uncontrollable external factors as explanations for poor performance.

Separate analyses of variance (ANOVAs) were calculated to determine how the four attribution styles predicted emotional and cognitive reactions to test performance, while separate analyses of covariance (ANCOVAs) investigated the ability of attribution style to predict course performance and end-of-year grade point average (Perry et al., 2008). Overall results suggest more favorable outcomes for the attribution patterns emphasizing controllable causes of poor performance. When compared to those in the other groups, students with “effort reliant” and “self-protective” attribution styles had higher grades, took more responsibility for their performance, and were less likely to experience feelings of helplessness. Particularly negative outcomes were observed for the “Relinquished control” group, who were labeled as the least likely to endorse controllable causes for poor performance. In addition to the aforementioned negative outcomes, relinquished control students were characterized as experiencing the most guilt and anger and holding the lowest expectations for future success.

Expectancy-value theory

Expectancy-value theory was a theory designed specifically to predict behaviors related to academic achievement, with such behaviors including performance, course selection, and persistence on academic tasks (Wigfield & Eccles, 1992, 2000). Original conceptualizations of the theory predicted that task-specific performance expectancies and task value would be the direct predictors of achievement behaviors while factors such as prior achievement, locus of control, and course-specific self-concept would indirectly affect achievement behaviors through their influence on the former two predictors.

Tests of expectancy-value theory have focused on predictors of both academic performance and subsequent course enrollment. Multiple studies have demonstrated differential effects of performance expectancies and task value on these outcomes, with the former variable predicting academic performance and the latter variable predicting course enrollment (Crombie et al., 2005; Eccles, Adler & Meece, 1984; Meece, Wigfield, & Eccles, 1990; Wigfield & Eccles, 2000). Some research has shown a link between task value and academic achievement, although such studies have either examined this relationship without considering the effect of performance expectancies (Cole et al., 2008; Hulleman et al., 2008) or have only found a significant task-value achievement relationship at specified time points (Bong, 2001). In addition, one study has found performance expectancy to predict course enrollment, but this effect was gender-specific (Crombie et al. 2005). Research has also suggested that the task-specific constructs of performance expectancies and self concept represent the same phenomenon and, therefore, need not be differentiated (Eccles, et al., 1993; Eccles & Wigfield, 1995).

Eccles et al. (1984) tested expectancy-value theory with a sample of 200 students enrolled in 8th through 10th grade. Participants were randomly drawn from a pool of students participating in a larger study, although specific information about this larger study's participant selection was not provided. During the spring semester, students completed ten self-report rating scales assessing motivational constructs for math. Cronbach's α estimates for each scale ranged from .72–.83, indicating adequate internal consistency. Subsequent factor analyses were performed on student responses to these rating scales, and the results indicated that each scale could be classified into one of the following three categories: math self-concept, perceived difficulty of math, and math task value. Self-report rating scales were also designed to measure motivational constructs for English. Psychometric qualities of these rating scales were not reported, although it was mentioned that the specific scales and overall factors were designed to mirror those used for math. Math and English grades from the previous school year also served as independent variables. Final course grades in Math and English represented dependent variables in the study and were collected during the same year the self-report rating scales were administered. Math course enrollment was monitored for 122 of the study participants, with such monitoring continuing for the duration of the students' high school careers. Since only one year of high school math was required, only the course enrollment patterns of students enrolled as 9^{th} or 10^{th} grade students (*N* = 122) at the start of the study were monitored.

Predictors of each dependent variable were analyzed through stepwise hierarchical regression. For both English and Math, course grades were predicted by self-concept and prior grades. Self-concept by itself accounted for 22% of the variance in Math grades and 28% of the variance in English grades, while prior grades accounted for ten and five percent of the respective variance in Math and English grades. Perceived task difficulty of English did not correlate with English grades, while task value shared no significant correlation for either subject. Although perceived task difficulty correlated significantly with Math grades ($r = -.22$), it was not a significant predictor when self-concept and prior grades were considered. The regression equation for Math course enrollment predicted 32% of the variance, with prior grades serving as the largest predictor ($R^2 = .22$) and subjective task value also having a significant impact. Neither self-concept nor task difficulty correlated with future Math enrollment.

In their examination of expectancy-value theory, Meece et al. (1990) examined the math achievement and future enrollment patterns of students in 7^{th} to 9^{th} grade. Students were recruited from two different schools, and a total of 250 students completed the study. Study participants were described as being relatively homogenous in their math ability and as attending schools located in “predominantly White middle-class suburban communities” (p.63).

Final-year classroom math grades were used as the achievement measure and were scored on a 13-point scale (Meece et al., 1990). A letter grade of “E” was the lowest grade and was coded as a “2,” while an “A+” was the highest score and coded as a “14.”

Future course enrollment was operationalized by an item asking whether respondents planned to enroll in math courses after they were no longer required. Previous math grades were hypothesized to be a predictor of the two outcome variables, as were four types of achievement-related beliefs. These beliefs included math anxiety, perceived math ability, performance expectancies and perceived math value, with the latter two belief systems being of particular relevance to expectancy-value theory. In the present study, performance expectancies and perceived math value were both defined by scales consisting of two items on a seven-point Likert scale with Cronbach's α estimates of .79 and .67, respectively. The study was conducted over two years, with classroom grades and perceived math ability collected in year one and performance expectations, perceived math value, future enrollment intentions, and classroom grades collected in year two. Across both years, measures of the achievement-related beliefs were collected during the spring semester.

Through structural equation modeling, Meece et al. (1990) found that performance expectancies and previous math performance predicted half the variance in subsequent math performance, while perceived math value predicted one-third of the variance in future enrollment intentions. Although performance expectancies and perceived math value were each found to predict only one outcome variable, it should be noted that Pearson correlation coefficients between the two predictor variables were significant and each predictor was found to correlate positively with both of the outcome variables. Meece et al. (1990) mention this multicollinearity as a potential shortcoming of their design, as it is possible that their analysis underestimated the respective effects of performance expectancies and perceived math value on math performance and future enrollment intentions.

Bong (2001) tested the expectancy-value theory in her study of 168 Korean female undergraduate students, each of whom attended a particular university and was enrolled in one of two sections of a particular course on education technology. Independent variables in the study included an overall measure of task value incorporating Wigfield and Eccles's (1992, 2000) conceptualization of attainment value, intrinsic value, and usefulness value. Since correlations among the different types of task value were found to be high, each of the three items was combined into one construct. The second category of independent variables was self-efficacy, with separate rating scales used to assess students' self-efficacy for overall academic performance, effective use of self-regulated learning strategies, performance in the specific course, ability to master specific course content, and ability to answer specific exam questions. Outcome variables assessed included grades on the midterm and final exams as well as future enrollment intentions at the middle and end of the course.

Through path analytic statistical analyses, Bong (2001) found that, consistent with Wigfield and Eccles's (1992, 2000) earlier work, task value was a significant predictor of enrollment intentions at the halfway ($\beta = .42$) and end of semester ($\beta = .40$) time points. Mixed results were found when test performance was the outcome measure, as task value predicted performance on the midterm ($\beta = .27$) but not on the final. Interestingly, the opposite effect was evident for course-specific self-efficacy, as it was only found to predict course performance on the final exam ($\beta = .21$).

Crombie et al. (2005) examined predictors of math achievement among a sample of 540 9th grade students in Canada. Each of the students was enrolled in one of six schools located in the metropolitan area of one Canadian city. The schools represented in the study were described as “middle SES,” and it was noted that 89% of research participants lived in two-parent households.

Separate self-report scales assessing perceptions of competence, utility value of and intrinsic value for math were administered in April or May of the 9th grade school year (Crombie et al., 2005). Psychometric information extracted from responses by the current sample indicated strong internal consistency (Cronbach’s α = .81–.93) and adequate test-retest reliability (r = .76–.93). A fourth scale measuring future enrollment intentions was also administered at the same time point and served as a dependent variable. Test-retest reliability of this instrument (r = .80) was strong. Additional study variables included final math course grades in 8th and 9th grade, with the former serving as an independent variable and the latter as an outcome variable.

Structural equation modeling was used to analyze causal pathways between the predictor and outcome variables, with separate equations conducted for male and female students (Crombie et al., 2005). Based on prior research, it was hypothesized that, for both genders, perceived competence and math grades would directly predict math grades, and that the predictability of math grades would be partially mediated through perceived competence. Results supported this model for both genders, as it accounted for 69% and 60% percent of the respective variance in male and female math grades. For both genders, perceived competence predicted future grades more strongly than did prior grades.

Although the proposed model predicting enrollment intentions provided an adequate fit to the data, follow-up analyses determined the model could be improved by the addition and deletion of additional pathways (Crombie et al., 2005). Intrinsic value was dropped from both models, as its specific pathway to enrollment intentions was nonsignificant. For female students, competence beliefs and utility value predicted enrollment intentions by a similar magnitude, and the relationship between prior grades and enrollment intentions was fully mediated by these two predictors. Different results were obtained for males, whose enrollment intentions were predicted by utility value and prior grades with utility value having the stronger direct impact. An indirect effect of prior grades was confirmed, as its effect on the outcome variable was partially mediated by utility value. Overall, the current model accounted for 34% and 33% of the variance in respective male and female enrollment intentions.

Recent investigations have studied the relationship between task value and academic performance, but have done so outside of the concept of success expectancies. For example, Hulleman et al. (2008) examined the effects of intrinsic value, utility value, and achievement goals on performance in an undergraduate psychology course and interest in psychology subsequent to completing a psychology course. A total of 663 students enrolled in an introductory psychology course at a Midwestern university completed the study. Data for the study were collected at three time points. Measures of initial interest in psychology, desire to learn as much as possible about psychology (mastery-approach goals) and desire to outperform peers (performance-approach goals) were collected at the time of the second class lecture. At time two, scales tapping the intrinsic and utility values this particular class held for students were administered. Each of these scales consisted of three items, with the respective Cronbach's α of intrinsic value and usefulness value scales equating to .72 and .82. The general measure of interest in psychology was also administered at this time. Finally, course grades and subsequent interest in psychology were collected at the final data point, as was a measure of students' intentions to enroll in future courses.

Hierarchical regression analyses were used to test the direct and indirect effects of the two types of value and achievement goals on class performance and subsequent interest in psychology (Hulleman et al., 2008). Results indicate that utility value ($\beta = .19$) and performance-approach goals ($\beta = .18$) yielded direct effects on final course grade, as those who saw the course as relevant to the future and had a desire to outperform their classmates earned higher grades. Although having a mastery-approach goal orientation and a higher level of initial interest in psychology exerted no direct effect on course grade, it had an indirect effect by influencing the utility value variable. For subsequent interest in psychology, initial interest ($\beta = .36$), utility value ($\beta = .25$) and intrinsic value ($\beta = .14$) each had a direct effect. A mastery-approach goal orientation again had an indirect effect on outcomes, as those who held it reported higher levels of utility and intrinsic values. The mastery-approach goal orientation was also found to be most important for those who were initially interested in psychology as the interaction between the two variables had a direct impact on subsequent interest levels ($\beta = .17$).

Cole et al. (2008) also analyzed the impact of task value on the academic performance of college students. Scores from the CollegeBASE exam, which covers English, Mathematics, Science, and Social Studies, was used as the outcome variable, and a total of 1,005 students from four different universities participated in the study. Since none of the represented universities used performance on this test as a criterion for graduation or grade point average, the investigators classified this exam as a “low stakes” assessment. Path analytic procedures were used to test a hypothesized model of performance on the CollegeBASE exam. According to this model, the task values of usefulness, interest, and importance would influence the effort expended on the exam, and this effort would combine with gender and scores on previous achievement measures (ACT) to predict scores on the CollegeBASE exam. Data relating to task value and effort were collected immediately after the exam was completed. The items which represented the three task values were modeled after items on a previous motivation questionnaire and tailored to fit the current testing scenario. Several items scored on a seven-point Likert scale were used to represent the task values, and Cronbach’s α values for each value ranged from .75 to .97.

Predictors of College BASE test performance were analyzed through direct, indirect, and direct and indirect models (Cole et al., 2008). Partial correlations found that the task values of importance and usefulness predicted test performance in all subject areas, while interest was a significant but relatively small predictor of math (.083) and science (.12) scores. Direct effects models for task value found that, with the exception of usefulness and English, each of the three task values predicted performance in all four subject areas. Indirect models found that, in all subject areas, usefulness and importance affected test performance through their influence on effort. On the other hand, the indirect effect on interest was only meaningful for English performance. When direct and indirect models were considered concurrently, results show that full mediation occurred between the impact of usefulness and importance on math and social studies achievement and between the impact of importance and interest on English achievement. In science, partial mediation occurred for usefulness and importance, which were the only two variables exerting an indirect effect on achievement via effort. Although most of the task value–achievement correlations were no longer significant once effort was considered, the effects of interest on social studies performance and all three variables on science performance could not be fully explained by test effort.

Conclusion

As indicated by the findings discussed above, research has consistently supported the link between an internal locus of control and academic achievement. This relationship is evident for both males and females as well as for different ethnic groups. Locus of control has been found to predict multiple indicators of academic performance, such as standardized test scores, course grades, and degree attainment. In addition to predicting overall levels of performance, research indicates that locus of control can predict increases in academic achievement over time. Finally, locus of control's impact on academic achievement has been demonstrated even after other known predictors of achievement have been considered.

While locus of control was consistently shown to predict academic achievement, the relationship between these factors is typically small. Although certain studies demonstrated that locus of control was a moderate predictor of academic achievement for specific populations (Muller et. al., 2001; Tella et al., 2009) and that locus of control is a relatively strong differentiator of high and low achievers (Borman & Rachuba, 2001; Ross & Broh, 2000), the majority of statistical relationships between the two variables were of a small effect size. Further research is needed to determine whether any additional variables can increase locus of control's ability to predict academic achievement. One variable whose moderating effects on locus of control have not received due consideration is task value. Critics of locus of control research are quick to point out that this variable should be considered in conjunction with task value, as this would represent the behavior potential construct defined by social learning theory (Peterson & Stunkard, 1992; Rotter, 1975, 1992).

The studies reviewed above also offer support for attribution theory, as multiple dimensions of causality could be used to explain academic performance. While the internal/external contrast was useful in explaining attribution achievement links, attributions varying in stability and controllability also yielded different effects on achievement. Similar to research into locus of control, the aforementioned studies of attribution theory did not consider the effects of task value and how they could moderate the attribution-achievement relationship.

The preponderance of expectancy-value theory has found performance expectancies to be a predictor of course performance but not of future course enrollment. For task value, many studies have demonstrated its ability to predict future enrollment. While task value has also been correlated with future task performance, this relationship has been typically nonsignificant in studies where performance expectancies and task value are both hypothesized to be direct predictors of performance. The limitations of previous expectancy-value studies deserve discussion, however, as this research has predominantly focused on participants in restricted geographic areas over time spans of one year or less and has primarily operationalized academic achievement by classroom grades only. Moreover, since task value and locus of control are assumed to follow separate paths in predicting achievement outcomes, it remains unclear whether interactions between the two variables can exert a stronger effect on academic achievement.

The current study will address limitations to previous studies of perceived control by integrating the predictions made by social learning and expectancy-value theories. Rather than examining the separate effects of task value and locus of control on achievement outcomes, the current study hypothesizes an interaction between the variables. Such a combination of variables is analogous to social learning theory's concept of behavior potential. Behavior potential will be studied through an expectancy-value framework, as its effects on math achievement and college graduation are assumed to be mediated by its respective effects on math self-concept, expectations for college graduation, and course enrollment. The designation of math self-concept and expectations for college as mediators is based upon conceptualizations of expectancy-value theory, while the inclusion of course enrollment as a mediator stems from research showing that it is predicted directly by task value. The current study also addresses weaknesses in previous expectancy-value research by employing a large, nationally-representative sample and examining prediction over multiple years.

CHAPTER THREE
METHODS

Overview of Participants

Data collected for the current study were derived from the National Educational Longitudinal Study of 1988 (NELS:88). NELS:88 was a project tracking students from 1988 through 1994. Each of the students was in 8th grade during the base-year data collection period, and subsequent information was collected every two years. Data for the project included survey questions answered by students and their teachers, parents, and school administrators. In addition, standardized academic assessments were administered to students at each interval. The current study focuses on relevant student survey data, academic assessments, and school records provided at the base year (1988) and first (1990), second (1992), and fourth (2000) follow-up collection periods. Descriptions of NELS:88 recruitment methods pertaining to the current investigation are provided below.

Base Year Participant Recruitment

Participants for the 1988 base year data collection phase were recruited according to a two-stage stratified probability design (Spencer, Frankel, Ingels, Rasinski, & Tourangeau; 1990). In phase one, participating schools were selected from a database containing a list of public and private schools throughout the United States. Potential participating schools were then grouped into appropriate strata based upon various demographic characteristics (region, urbanicity, % minority enrollment, private/public). Within each stratum, a designated number of public schools were randomly selected for participation. To ensure that the selected schools represented overall US eight-grade enrollment, the number of selected public schools was proportional to the number of 8th grade students in each particular stratum. Selection of private schools, which were oversampled in general, was skewed towards those with eight or more eighth-graders enrolled in their schools.

To account for problems associated with nonparticipation, a pool of alternate schools was selected in each stratum (Spencer et al., 1990). Whenever a school refused participation, an alternate school from the corresponding stratum was randomly selected. Once the designated number of schools for a given stratum agreed to participate in the study, the selection of schools from the alternate pool ceased.

Although the schools selected in phase one were designed to represent the total population of 8^{th} grade public and private school students, certain schools were excluded from consideration (Spencer et al., 1990). The category of excluded schools included schools run by the Bureau of Indian Affairs, schools that solely service students with special education services, vocational schools with direct student enrollment programs, and schools intended for students whose parents are military personnel stationed outside the country. Furthermore, schools that had no 8^{th} grade enrollment in spring 1988 were excluded from the study. A total of 1,734 schools were invited to participate in phase one. Of these schools, 815 public schools and 237 private schools agreed to participate, yielding a total of 1,052 schools contributing students for the study.

Stage two of the recruitment process involved the selection of students from the participating schools (Spencer et al., 1990). Certain students were excluded from selection. For instance, it was believed that some students would have difficulty completing necessary study activities as the result of limited English proficiency, physical disability, or mental disability. In addition, students who were deceased or who had dropped out of school or transferred before data collection began were excluded from selection. Prior to participant selection, all 8th grade students within each of the NELS:88 schools were classified by ethnicity, with Asian and Hispanic students occupying specific ethnic groups and all remaining ethnicities grouped together. A specified number of students per school and ethnic classification were then selected randomly. Although the specific selection probabilities for each ethnic classification were not given, the *Base Year Sample Design Report* mentioned that Asian and Hispanic students were oversampled. The target number of students to be selected from each school was 24. None of the participating schools contributed more than 24 students to the sample. However, among schools whose 8th grade enrollment was less than 24, each 8th grade student at the school was selected.

In total, 26,432 students were selected from the 1,052 NELS:88 schools, and ninety-three percent of these students (*N* = 24,599) agreed to participate (Spencer et al, 1990). Participation rates according to ethnicity, geographic location, school type, and percentage of minority enrollment were provided. Asian (90.12%) and Hispanic (90.24%) students had a slightly lower participation rate than students from other ethnic groups (93.63%). Across geographic location, participation rates were higher among students from the North Central (94.79%) and Southern (94.03%) regions of the country than from the Northeast (91.85%) and Western (91.17%) areas. Participation was also higher for those attending private school, particularly when such private schools were Catholic (94.99%). Students at non-Catholic private schools participated at a rate of 93.15%, while 92.79% of selected public school students agreed to participate. Finally, participation was higher for students whose schools had minority enrollment figures of

19% or lower (93.51), as the only demographic group posting student participation rates lower than 90% was schools where the minority enrollment exceeded 19%.

First Follow-up Participant Recruitment

The first follow-up data collection included students who completed the Base Year survey, students deemed ineligible to participate in the base-year survey, and newly-recruited students (Ingels, Scott, Lindmark, Frankel, & Myers, 1992). For the purposes of recruitment, base year respondents were grouped into four categories. First, 96 of the respondents had either moved out of the country or died sometime after base year data collection and, therefore, were deemed ineligible for the first follow-up. An additional 348 students had dropped out of school by the time follow-up data were collected, and each of these students was recruited. The largest category of base year respondents was comprised of students attending schools with more than ten base year respondents. As with the aforementioned students who dropped out of school following initial data collection, each of the 19,568 members of this group was recruited for follow-up participation. The remaining 6,420 base year respondents were enrolled in schools where 10 or fewer students participated with base year data collection. The recruitment of these students was not guaranteed, although their likelihood of selection increased depending on the number of students at their school who provided base year data.

Newly-recruited students were students who were classmates of longitudinal participants but were not enrolled as eight grade students in 1988 themselves (Ingels t al., 1992). Recruitment of these students involved reviewing an alphabetized list of students at each school, identifying the students who were selected for both NELS:88 time periods, and looking for the next-listed student. If this student was not enrolled as an eighth grade student, he/she was invited to participate and recruitment efforts targeted the next student listed alphabetically. This process continued until a student who was a U.S. eighth grade student in 1988 was discovered. In total, 1,229 students were recruited to participate, with an average of less than one student from each targeted school. As in the base-year sample, students were excluded if their participation would be difficult due to a mental or physical disability or to limited English proficiency. It was mentioned that Language proficiency criteria for first follow-up participation was not as strict as that at for base-year participation, however.

Following initial participant selection, there were several factors that decreased the number of students completing the study (Ingels et al., 1992). Subsampling procedures eliminated a certain percentage of students who transferred schools between data collection points. Also, students who were absent from their respective schools on days when data were collected were labeled as “hidden dropouts” and were not included in the follow-up. These subsampling procedures left 19,645 members of the longitudinal cohort, 17,424 of whom completed questionnaires and 15,763 completed academic assessments. In addition, 1,043 newly-recruited students remained in the final first follow-up sample.

Selection of students deemed ineligible at the base-year time point mirrored the general base-year student selection process (Ingels et al., 1992). Within the 1,057 schools who participated in the base-year study, a total of 10,853 were deemed ineligible to participate. At the time of the first follow-up study, 1,598 of these students were randomly selected as possible participants and were subsequently classified by ethnicity and reason for ineligibility. A total of 673 students were invited to participate, and 653 enrolled in the study.

Second Follow-up Participant Recruitment

Similar to the first follow-up survey, the 1992 sample was composed of both previous participants, newly-recruited students, and previously ineligible students (Ingels et al., 1994a). Unlike the previous follow-up, however, all first follow-up students, including participants and nonresponders, were selected. The procedure for selecting newly-recruited students was similar to that employed in the first follow-up, with the exception that students were selected from schools attended by either base-year or first follow-up respondents. In total, 366 new students were selected to participate, with 266 determined to be eligible for participation based on criteria similar to that used for the first follow-up. To include students previously found to be ineligible, recruitment efforts targeted those found ineligible at base-year, newly recruited first follow-up participants eventually found to be ineligible, and base-year participants who became ineligible at the first follow-up period. Overall figures for second follow-up participants ineligible at previous stages were not provided.

A unique feature to the second follow-up study was its addition of transcript records from the respective schools of study participants (Ingels et al., 1995). In order to obtain these records, which included attendance history, grade point average, and graduation status,1,500 schools were selected to participate (Ingels et al., 1995). These schools were randomly selected at a probability level determined by the number of participating students enrolled in their schools. Schools with four or more participating students were selected with 100% probability, while schools with three (75%), two (65%), and one participating student(s) (31.85%), had varying selection probabilities (Ingels et al., 1995). In total, 1,287 schools provided transcript records for 17,285 participants. Of these participants, 14,283 students participated during the base year and first follow-up data collection periods (Ingels et al., 1995).

Fourth Follow-up Participant Recruitment

Data for the fourth follow-up study were collected in 2000, when it was expected that the students would be 26 years old and out of high school for eight years (Curtin, Ingles, Wu, & Heuer, 2002). All students who responded to the third follow-up data collection, where the probability that a student would be asked to participate varied according to factors such as ethnicity, income level, school sector, and previous participation, were invited to participate. A total of 12,144 students provided data for the fourth follow-sample, which represented a participation rate of 77.6%. The current study will focus solely on these students.

Variables

Locus of control

The first follow-up questionnaire of NELS:88 contains two composite measures of locus of control (Ingels et al., 1992). One of these scales contains three items ("In my life, good luck is more important than hard work for success;" "Every time I try to get ahead, something or somebody stops me;" "My plans hardly ever work out, so planning only makes me unhappy") originally included in the High School and Beyond and National Longitudinal Study of 1972 surveys. In order to enhance the reliability of NELS:88's locus of control measure, a six-item scale was constructed by taking the original three items and adding three items that were modified from Rotter's original scale (1966). Slight alterations to these items were made for the NELS:88 survey, and a comparison of NELS:88 and Rotter items are presented below in Table 3-1. It should be noted that the response formats of Rotter's scale and the NELS:88 scales also differed. Rotter's scale contained sixty-six biserial items in which respondents are presented with two statements and asked to choose the one that best represents them. In contrast, items for the NELS:88 scales followed a four-point Likert scale (strongly, disagree, disagree, agree, or strongly agree) format with higher scores indicating an internal locus of control. One of the items ("When I make plans, I am almost certain I can make them work") is reverse scored.

The current study will employ the composite score of the six-item locus of control scale, as it was calculated from a greater number of survey items. The composite score was calculated in two steps. First, each item was standardized to have a mean of "0" and a standard deviation of "1" across the entire sample. Thus, a respondent's score for a particular item reflects the number of standard deviations his/her score is higher or lower than that of average first follow-up respondent. The second step involved averaging the standard scores of all valid responses given by a particular respondent. If responses to particular items were missing or invalid, these items were excluded from calculations of the composite score.

Table 3-1. Comparison of NELS:88 and Rotter items

NELS	Rotter
When I make plans, I am almost certain I can make them work	When I make plans, I am almost certain THAT I can make them work.
I don't have enough control over the direction my life is taking.	SOMETIMES I FEEL THAT I don't have enough control over the direction my life is taking.
Chance and luck are very important for what happens in my life.	IT IS IMPOSSIBLE FOR ME TO BELIEVE that chance and luck are very important for what happens in my life.

Reliability estimates for the locus of control scale include measures of both internal consistency and test-retest reliability. Ingels et al. (1992) found the scale to have adequate internal consistency, as the Cronbach's α for this composite was .71. Test-retest reliability was done by calculating a Pearson correlation coefficient between first follow-up and second follow-up locus of control composite scores. While the composite scores correlated to only a low-to-moderate degree (r = .48), it should be noted that a two-year time period existed between test intervals.

The predictive validity of the first follow-up locus of control composite was tested by comparing responses to individual items with educational outcomes and survey responses at the second follow-up time period (McLaughlin, Cohen, & Lee, 1997). On each individual composite item, students reporting a greater than average degree of internal locus of control held higher grade point averages, had higher scores on standardized math assessments, were enrolled in curricula of greater academic rigor, and were more likely to be high school graduates. It was also found that locus of control ratings predicted educational expectations respondents held two years later and, with the exception of one item, also predicted the occupational expectations students held two years later.

Task Value

A composite task value variable will be constructed for the current study based upon three NELS:88 First Follow-up Survey items that are hypothesized to measure the importance one places on academic achievement. Selection of these items was based upon their similarity to the task value construct of expectancy-value theory (Wigfield & Eccles, 1992, 2000). The first question represents the attainment value construct of expectancy-value theory and asks respondents to indicate the importance they place on earning good grades. This item was scored on a four-point Likert scale, with the possible responses including “not important,” “somewhat important,” “important,” and “very important.” The remaining items were selected from a larger series of items offering possible reasons for school attendance. These items, which respectively represent the intrinsic and utility value constructs of expectancy-value theory, were “I think the subjects I’m taking are interesting” and “Education is important for getting a job later on.” Respondents indicated the degree to which each of these two factors influenced their school attendance by rating each item on a four-point Likert scale. Possible ratings for each item were “strongly disagree,” “disagree,” “agree,” and “strongly agree.”

Although theories of task value conceptualize different ways that a task can be valued, previous research has supported the measurement of task value by a unified construct (Bong, 2001). Therefore, an overall composite score was calculated by averaging all valid responses to these items provided by a given respondent. As a result, composite scores range from values of one to four. Internal consistency for the construct was calculated, with the results yielding a Cronbach's α value of 0.58.

Behavior Potential

Behavior potential is a composite variable designed to represent the like-named construct of social learning theory, in which the combination of task value and locus of control is hypothesized to predict behavior outcomes (Rotter, 1954; Rotter, Chance, & Phares, 1972). Since Rotter (1954) provided no specific guidelines for behavior potential operationalization, the current study hypothesized that task value would enhance both the benefits of internal locus of control and the detrimental effects of external locus of control. Therefore, locus of control was treated as a mean-centered variable with respective positive and negative values for internal end external loci of control, and this variable was multiplied by task value (operationalized on a scale of 1-4).

Math Self-concept

Math self-concept was operationalized for the current study by three first follow-up items. These items ("I have always done well in mathematics" "I get good marks in mathematics" "I do badly in tests of mathematics") are scored on a six-point Likert scale. One item is reverse scored, and higher scores on the scale indicate stronger math self-concept. Internal consistency of this scale was found to be strong (Cronbach's α = 0.83). Previous research with the NELS:88 database has employed math-related constructs containing each of these three items (O'Connor et al., 1999; O'Conner & Miranda, 2001). These previous scales were not utilized by the current investigation, because they included items that were not operationalized as measures of math self-concept.

College Expectations

Expectation for completing college was operationalized by an item at the second follow-up period (“As things stand now, how far in school do you think you will get?). Since one path analyses included an dichotomous exogenous variable to represent students’ attainment of a Bachelor’s Degree, college expectations was also operationalized in a similar dichotomous. Students responding “finish college,” “master’s degree or equivalent” or “Ph.D. or other professional degree” were coded as a “1.” Scores of “0” on this variable were assigned for the following student responses: “less than high school”, “high school only”, “less than two years of school”, “more than two years of school”, “trade school degree”, “less than two years of college”, “more than two years of college”, or “I don’t know.” A total of 6,938 students (66.2% of respondents) indicated expectations for completing at least a college degree.

Academic Program

Student responses at the second follow-up were used to operationalize academic program. Since the survey item was categorical in nature and included 15 response options (Table 3-2), these responses were transformed into a dichotomous variable in the current study. A total of 4,861 students, which amounted to 47.6% of the students provided legitimate responses, described their academic program as “college preparatory” and were coded as a “1.” Students (n = 592) whose response to this item was recorded as “refused,” “missing,” or “multiple responses” were not included in the current study. Students who provided any of the remaining 14 responses were coded as “0.”

Table 3-2. Original academic track response options

Responses coded as "1"	College Preparatory
Responses coded as "0"	General H.S. Program Industrial Arts Agricultural Occupation Business Occupations Marketing Education Health Occupations Home Economic Occupation Consumer Education Trade Occupations Specialized H.S. Program Other I Don't Know Never Attended H.S.

Math Course Enrollment

Transcript data from the second follow-up provided the number of math course units completed by each respondent (Ingels et al., 1995). The Classification of Secondary School Sources created by the National Center of Educational Statistics was used to determine which courses were considered math courses. Carnegie units were then calculated for each math course completed, as this enabled standardized reporting of completed course credits across schools. Three different variables representing math course completion were created for the NELS:88 database. The current study used the variable designed to exclude courses of insufficient degree of rigor, such as "Basic Math" or math courses designed for 7^{th} and 8^{th} grade students.

Prior Math Achievement

Prior math achievement was operationalized by the math assessment given during the base-year time period (Rock & Pollack, 1995). This assessment included forty questions, and internal consistency estimates of this test (Cronbach's $\alpha = 0.90$) indicate that it had strong reliability.

Subsequent Math Achievement

Three versions of varying difficulty were developed for the NELS:88 second follow-up time period math assessment. The easiest and most difficult exams were respectively reserved for those whose score at the first follow-up time period placed in the lowest and highest quartiles and the remaining students received a test of moderate difficulty (Ingels et al., 1994a, 1994b). To allow comparisons of test performance across different exam versions, IRT procedures were employed to estimate the number of items a student would answer correctly on all three test versions (Rock & Pollack, 1995). In the present study, subsequent math achievement served as an outcome variable.

Prior Reading Achievement

The current analyses utilized the reading assessment given during the base-year time period of the NELS:88 study. Reading assessments were administered to NELS:88 participants at the base-year, first follow-up, and second follow-up time periods (Rock & Pollack, 1995). At each time period, the reading exam was composed of several reading passages and 21 multiple-choice comprehension questions. All base-year respondents completed the same version of the reading exam, and Cronbach's α (0.84) estimates suggest that this test had strong reliability (Rock & Pollack, 1995). Although reading assessments were administered at the first and second follow-up time periods, this variable was not selected as an outcome variable due to the fact that the NELS:88 database does not provide reading self-concept and reading course enrollment data.

Degree Attainment

Student responses to the fourth follow-up survey, which was conducted eight years after participants' scheduled high school graduation date, were used to determine college graduation status. For purposes of the current investigation, the variable *Bachelor's Degree or higher* was operationalized through a series of questions ascertaining the highest postsecondary degree earned by NELS:88 fourth follow-up participants. A total of 12,029 students indicated their highest level of degree attainment, which was 99.1% of the total fourth follow-up respondents. Students reporting a Bachelor's degree, "Master's degree/equivalent", or a "PhD. or a professional degree" as their highest degree (n=4,060) were classified into one group, which was coded as a "1" for data analysis purposes. The remaining students (n=7,969), who reported earning an Associate's degree, earning a certificate/license, having no postsecondary education experience, or having postsecondary experience but no degree, received a *Bachelor's degree or higher* score of "0." Overall, 33.8% of students provided information of postsecondary degree reported earning at least a Bachelor's degree or higher. It should also be noted that, since a similar question about degree attainment at the third follow-up time period found no NELS:88 participants holding a Bachelor's degree or higher at the time, the current *Bachelor's degree or higher* variable represents all fourth follow-up participants who have attained this level of postsecondary education.

Current Study

Statistical Analyses

Path analysis was employed to test the hypothesized direct and indirect predictors of math achievement and degree attainment. The type of path analysis used was structural equation modeling (SEM). SEM uses modeling to depict relationships among variables to quantitatively test researchers' hypotheses or explanations. There are basically two types of variables, namely, exogenous and endogenous. An endogenous variable depends on other variables and can be compared to a dependent variable in a regression. An exogenous variable does not depend on other variables and can be equated to an independent variable. A major difference between SEM and regression is that SEM allows variables can be both endogenous and exogenous in the same model (Arbuckle, J., personal communication, Spring 2007; Schumacker & Lomax, 2010). In SEM, there are two major types of variables, observed and latent. Observed variables are direct measures from tests, surveys, etc. Observed variables can be used to create latent variables, also known as constructs, hence these construct variables are indirect measures which are inferred from a set of actually observed variables (Schumacker & Lomax, 2010). In this study, instead of treating variables operationalized by multiple scale items as latent variables, an overall composite score will be used for these constructs. Such multi-item constructs have been treated in a similar manner in previous path analytic studies (Bong et al., 2001; Roth, Wiebe, Fillingim, & Shay, 1989; Kelleher & O'Malley, 2006; Wai-Kit Ma, Anderson, & Streith, 2005).

Path analysis was selected as the current study's method of analysis for several reasons (Suhr, 2012). First, the current study looked to confirm specific predictive models for math achievement and college graduation, both of which included direct and indirect pathways. Second, path analytic techniques can simultaneously estimate the prediction of multiple outcome variables and standard regression techniques do not, the likelihood of a type one error would be inflated with standard regression techniques. Finally, regression analyses typically show statistical significance even when the relationship between predictors and outcomes is small. While this problem is not eliminated in path analysis, the likelihood of its occurrence is smaller.

The hypothesized path analyses in this study were calculated by the SEM package, Analysis of Moment Structures (AMOS), version 16.0 computer program (Arbuckle, 2007). The specified path analytic models are shown in Figures 3-1 and 3-2. Subsequent math achievement serves as the main exogenous variable for model 1 (Figure 3-1), as it is the main outcome variable to be predicted by the other variables. Math self-concept and math course enrollment are modeled as both endogenous and exogenous variables, as they are hypothesized to predict subsequent math achievement and be predicted by prior math achievement and behavior potential. Prior math achievement and behavior potential are solely endogenous variables, as the current study does not explore factors predicting them. For model 2 (figure 3-2) degree attainment serves as the main exogenous variable and is hypothesized to be predicted directly by academic track and college expectations (these are both endogenous and exogenous variables). Prior math achievement, math self-concept, and math course enrollment served as endogenous variables for academic track and college expectations and, therefore, are indirect predictors of degree attainment.

Figure 3-1. Predictors of Math Achievement

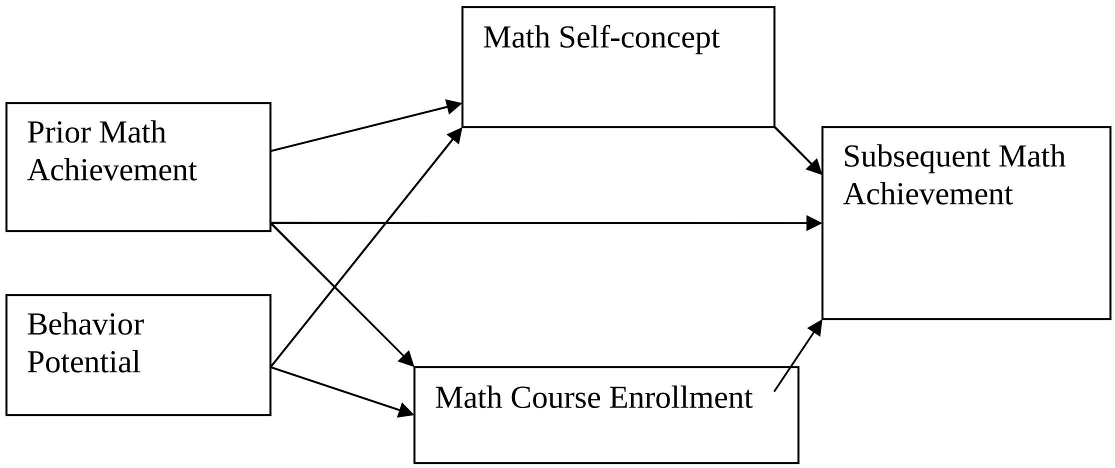
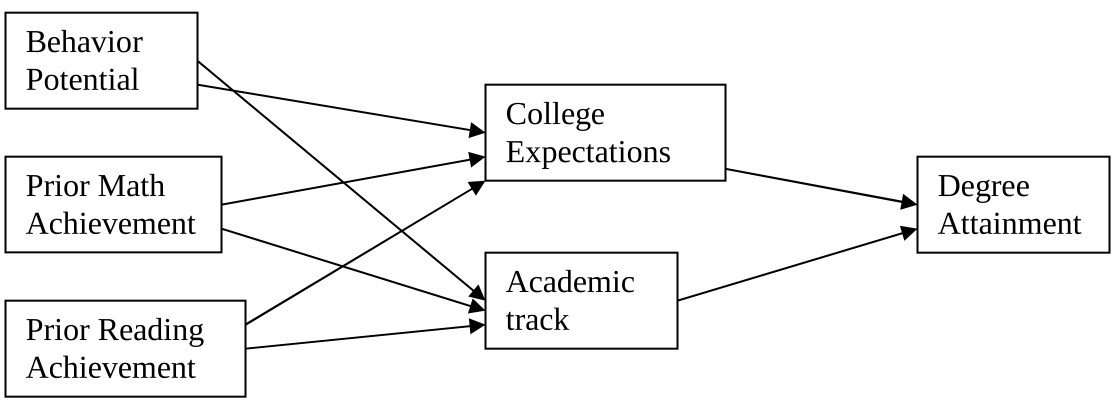


Figure 3-2. Predictors of Degree Attainment.



In order to determine if those who completed all relevant study data differed from those who did not, one-way analyses of variance (ANOVAs) compared the two groups on each study variable. As indicated in Tables 3-3 and 3-4, meaningful differences were found in some variables between participants who completed the study versus those who did not. To ensure that the current study's participants mirrored the overall NELS:88 sample, all participants (those who did and did not complete the study) were chosen for the study and the incomplete data were handled statistically by SEM. As noted by Kline (2005) this is the preferred method to account for missing data. The AMOS 16 default method using maximum likelihood estimation was employed to calculate means and intercepts of missing values (Arbuckle, 2007). As Arbuckle (2007) notes, this method is superior to strategies that simply delete all cases that are missing one or more pertinent variables.

Table 3-3. Comparsions of Model 1 Variables for Participants and Non-Complete Participants

Variable	Model 1 Participants			Model 1 Non- Complete Participants	
	M	SD	Partial η^2	M	SD
Prior Math	38.02	11.95	*.02	34.16	11.83
Subsequent Math	50.34	14.22	*.04	43.63	14.86
Math Self-Concept	4.24	1.44	.00	4.07	1.44
Locus of Control	.06	.61	.00	-.05	.62
Task Value	1.71	.48	.00	1.78	.57
Math Course Enrollment	3.19	1.07	**.08	2.96	1.21

*Exceeds standards small effect size
**Exceeds standards for moderate effect size

Table 3-4. Comparsions of Model 2 Variables for Participants and Non-Complete Participants

Variable	Model 2 Participants			Model 2 Non-Complete Participants	
	M	SD	Partial η^2	M	SD
Prior Math	28.07	8.55	*.04	23.33	8.13
Reading	37.63	11.97	*.04	31.14	10.99
College Expectations	.64	.48	*.03	.41	.49
Academic Track	.38	.49	*.02	.23	.42
Locus of Control	.04	.62	.01	-.11	.66
Task Value	1.74	.49	.000	1.74	.6□
Degree Attainment	.38	.49	*.03	.19	.39

*Exceeds standards for small effect size

Appropriate tests of model fit were employed to determine if the hypothesized models fit the data (Table 3-5). These tests include calculations of chi square (CMIN), normed fit index (NFI), comparative fit index (CFI), root mean square error of approximation (RMSEA), Hoelter index, Akaike Information Criterion (AIC), and Browne-Cudeck Criterion (BCC). After model fits were estimated, follow-up procedures examined whether the hypothesized models could be improved through the addition of analyzed causal pathways or the deletion of any causal pathways lacking in predictive power.

Table 3-5. Recommended Cutoff Scores for Model Fit Indices

*Chi Square (CMIN)	$p > .05$
NFI	>.90
CFI	>.90 (Kline, 2010) or .95 (J.L. Arbuckle, personal communication).
RMSEA	<.10 is acceptable; <.05 is desired
Hoelter Index	>75 is acceptable; >200 is recommended
AIC	Lowest value among comparable models
BCC	Lowest value among comparable models

*Only ChiSquare values require calculation of *p* values

CHAPTER FOUR
RESULTS

Multicollinearity

Prior to testing both models through SEM procedures, multicollinearity tests of the variables were conducted including correlations, and more accurate tolerance and variance inflation factor statistics. Statistically significant low correlations among study variables ($p < .01$) were found and are presented in Tables 4-1 and 4-2. Due to the large sample, however, it is not surprising that all correlations were found to be significant. Analysis of the correlation coefficients indicates that, in several cases, correlations of a relatively low magnitude were determined to be significant. Thus, although correlation testing is an indicator of multicollinearity, additional multicollinearity tests were also employed. These collinearity statistics were conducted through Statistical Program for Social Sciences (SPSS) to ensure neither model would be compromised by multicollinearity among the predictor variables. Using accepted standards for tolerance statistics (tolerance statistics >0.10 and variance inflation factor <2.5), it was determined that multicollinearity did not pose a statistically significant hindrance to the forthcoming path analyses.

Table 4-1. Correlations Among Model 1 Variables

	PM	MSC	TV	LC	SM	MCE	BP
PM	*	.35	.17	.24	.84	.48	.23
MSC	.35	*	.30	.23	.42	.32	.22
TV	.17	.30	*	.35	.21	.30	.33
LC	.24	.23	.35	*	.27	.24	.99
SM	.84	.42	.21	.27	*	.59	.27
MCE	.48	.32	.30	.24	.59	*	.23
BP	.23	.22	.33	.99	.27	.23	*

Note. PM=Prior math Achievement; MSC=Math Self-Concept; TV=Task Value; LC=Locus of Control; SM=Subsequent Math Achievement; MCE=Math Course Enrollment; BP=Behavior Potential
Note: For the purposes of this dissertation the BP construct is the amalgamation of TV and LC variables

Table 4-2. Correlations Among Model 2 Variables

	PM	PR	TV	LC	BP	CE	AT	DA
PM	*	.71	.17	.24	.23	.43	.36	.47
PR	.71	*	.15	.24	.24	.40	.35	.42
TV	.17	.15	*	.35	.33	.34	.22	.24
LC	.24	.24	.35	*	.99	.28	.18	.22
BP	.23	.24	.33	.99	*	.27	.18	.22
CE	.43	.40	.34	.28	.27	*	.36	.45
AT	.36	.35	.22	.18	.18	.36	*	.33
DA	.47	.42	.24	.22	.22	.45	.33	*

Note. PM=Prior math Achievement; PR=Prior Reading Achievement; TV=Task Value; LC=Locus of Control; BP=Behavior Potential; CE=College Expectations; AT=Academic Track; DA=Degree Attainment
Note: For the purposes of this dissertation the BP construct is the amalgamation of TV and LC variables

Demographics

Demographic statistics are presented below in Table 4-3. This table shows demographic comparisons between the overall NELS:88 longitudinal sample and study completers for both models as well as the overall demographic percentages in the study. Separate univariate analyses of variance (ANOVAs) were calculated for each demographic variable, and Scheffe post hoc tests were calculated when ANOVA results were significant. Due to the large sample size, only differences exceeding the standard for low effect size (partial η^2 >.001) will be discussed.

Study completers were less likely to have a history of high school dropout in both models. For the model predicting math achievement (model 1) study completers were more likely to live in the Midwest region of the United States. Ethnic differences were evident for the model predicting college graduation (model 2), as White and Asian students were more likely to have completed the study than were Black, Hispanic, and American Indian students.

Table 4-3 Model 1, Model 2, and NELS:88 Longitudinal Participant Demographics

Category	Model 1	Model 2	Longitudinal
	Percentages	Percentages	Percentages
Gender			
Male	48.3	47.8	47.6
Female	51.7	52.2	52.4
Ethnicity			
White	71.8	71.5	68.4
Black	8.6	8.7	9.7
Asian	6.8	6.8	7.0
Hispanic	11.6	11.8	13.3
American Indian	1.0	1.0	1.2
SES			
Low	21.6	21.8	23.6
Medium	49.5	49.2	48.3
High	27.6	27.4	25.8
Urbanicity			
Urban	25.2	25.7	27.3
Suburban	38.5	39.6	38.5
Rural	33.8	31.6	30.2
Geographic Location			
Northeast	18.0	19.0	18.4
South	32.3	31.5	32.6
Midwest	29.6	28.0	25.9
West	17.7	18.5	19.3
School Sector			
Public	84.5	84.1	84.3
Non-public	13.1	12.9	11.9
History of dropout			
No	91.0	89.3	86.9
Yes	9.0	10.7	13.1

Descriptive Statistics

Descriptive statistics for SEM variables are presented below in Table 4-4. A detailed explanation of how these variables were operationalized is provided in Chapter 3.

Table 4-4. Means and Standard Deviations for Study Variables

Variables	*M*	*SD*	*N*
Prior Math Achievement	36.68	12.05	10965
Math Self-Concept	4.19	1.44	10527
Task Value	3.26	.51	11053
Locus of Control	.02	.62	10901
Subsequent Math Achievement	48.87	14.63	9145
Math Course Enrollment	2.96	1.21	10310
Behavior Potential	.20	2.05	10591
Prior Reading Achievement	27.38	8.66	10964
College Expectations	.60	.49	11488
Academic Track	.35	.48	11372
Degree Attainment	.34	.47	12029

Model Analyses

The hypothesized pathways for both math achievement (Model 1) and degree attainment (Model 2) were separately analyzed through the AMOS program. These models are presented in Figures 4-1 and 4-2, with the specified hypotheses for both models listed in Table 4-5. Coefficients for the proposed direct and indirect causal pathways were calculated and appropriate fit tests were conducted to determine if the hypothesized models provided an adequate fit to the data. In addition, several additional models were considered, as linear regression analyses in SPSS suggested that model fit could be improved by adding or deleting casual pathways to each model. Results of these analyses are provided below.

Figure 4-1. Predictors of Math Achievement (Model 1)

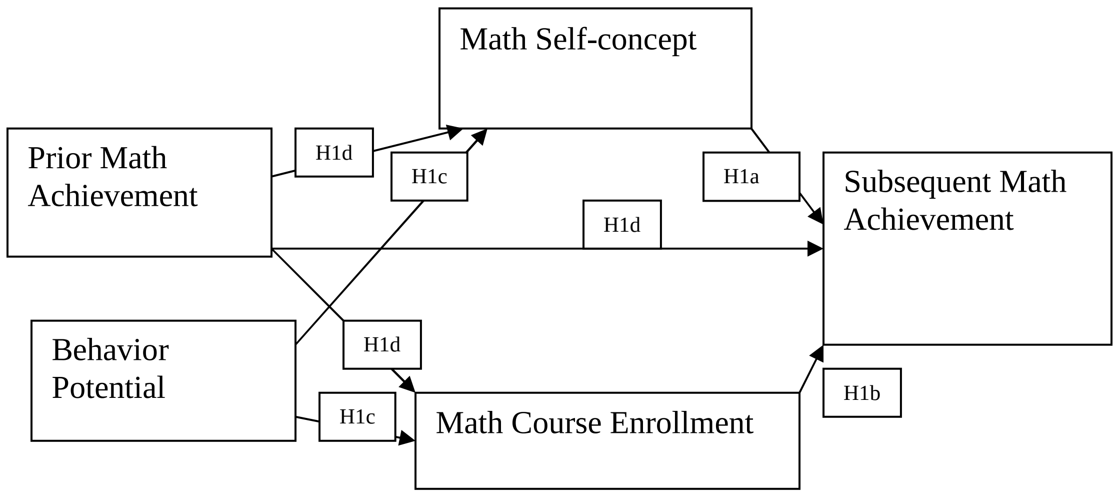


Figure 4-2. Predictors of Degree Attainment (i.e. College Graduation) (Model 2)

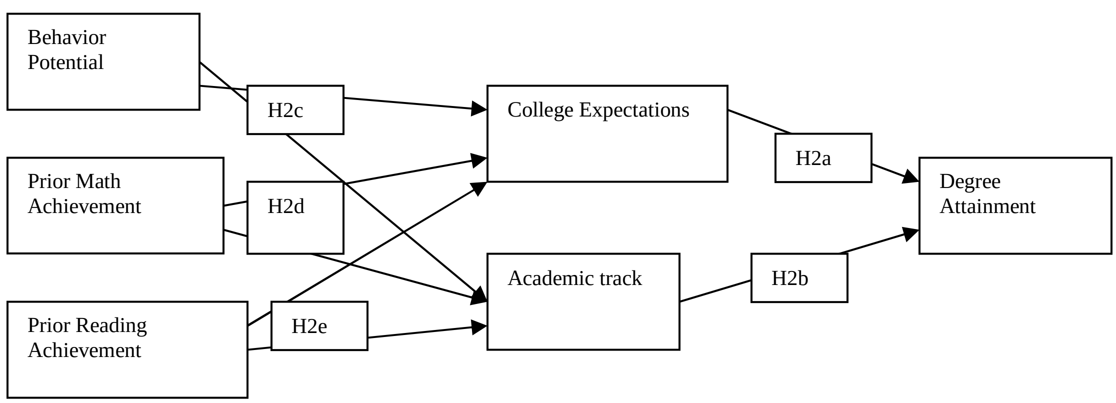


Table 4-5. Specific Hypotheses for Models 1 and 2

Hypothesis 1	Math achievement will be directly or indirectly predicted by prior math achievement, behavior potential, math self-concept and math course enrollment.
Hypothesis 1a	Math self-concept will directly predict subsequent math achievement
Hypothesis 1b	Math course enrollment will directly predict subsequent math achievement
Hypothesis 1c	Behavior potential will be an indirect predictor of subsequent math achievement. It will be mediated by math self-concept and math course enrollment.
Hypothesis 1d	Prior math achievement will have both direct and indirect predictive effects on math achievement. It will be partially mediated by math self-concept and math course enrollment.
Hypothesis 2	Degree attainment (i.e. college graduation) will be directly and indirectly predicted by expectations for graduation (i.e. college expectations), academic track, behavior potential, prior math achievement, and prior reading achievement.
Hypothesis 2a	Expectations for graduation will directly predict degree attainment.
Hypothesis 2b	Academic track will directly predict degree attainment.
Hypothesis 2c	Behavior potential will indirectly predict degree attainment as mediated by both expectations for graduation and academic track.
Hypothesis 2d	Prior math achievement will indirectly predict degree attainment as mediated by both expectations for graduation and academic track.
Hypothesis 2e	Prior reading achievement will indirectly predict degree attainment as mediated by both expectations for graduation and academic track.

Model 1: Predictors of math achievement

Hypothesis 1.

Figure 4-1 presents the hypothesized indirect and direct effects of the variables on *subsequent math achievement.* Overall, the hypothesized model explained 76.5% of the variance in subsequent math achievement, 23.3% of the variance in *math course enrollment*, and 12.5% of the variance in *math self-concept* (see Table 4-6). In addition, each of the hypothesized effects yielding a significant impact on math achievement (Table 4-7).

Calculations of model fit are provided in Table 4-8 and were inconsistent in their estimations. Estimates employing the Normed Fit Index (NFI) and Hoelter Index formulas suggest that the hypothesized model fits the data adequately, (Arbuckle, 2007; Kenny, 2011), while those following the Chi Square and Root Mean Square Estimate of Approximation (RMSEA) formulas suggest the hypothesized model poorly fits the data (Arbuckle, 2007; Kenny, 2011; Kline, 2005). The inability of the Chi Square test to demonstrate adequate model fit is not surprising, as such a finding is quite rare when sample sizes exceed 400 (Kenny, 2011). Although there is no apparent reason for the RMSEA findings, it should be noted that, since no specific model fit test is viewed as the gold standard, multiple tests of model fit are always recommended (Kenny, 2011). Interpretations of the Comparative Fit Index (CFI) for the current model vary according to the standards of different scholars yet this model passes for acceptable CFI fit. In order to improve overall model fit, linear regression analyses were conducted in SPSS to target specific causal pathways for potential addition or deletion. As a result of these analyses, behavior potential was eliminated entirely from the model. This revised model is presented in Figure 4-3, with corresponding fit estimates provided in Table 4-8. Overall, results indicate that the model without behavior potential represents an improved fit to the data, as the NFI, CFI, and Hoelter Index were higher and the Chi Square, Akaike Information Criterion (AIC), and Browne-Cudeck Criterion (BCC) were lower.

As indicated in Table 4-6, the revised model accounted for a similar proportion of the math self-concept, math course enrollment, and subsequent math achievement variance.

Table 4-6. Explained variance for model 1

	Original Model			Revised Model		
	Math Self Concept	Math Course Enrollment	Subsequent Math Achievement	Math Self Concept	Math Course Enrollment	Subsequent Math Achievement
	12.5%	23.3%	76.5%	12.4%	23.9%	76.9%

Table 4-7. Standardized Path Coefficients for Model 1

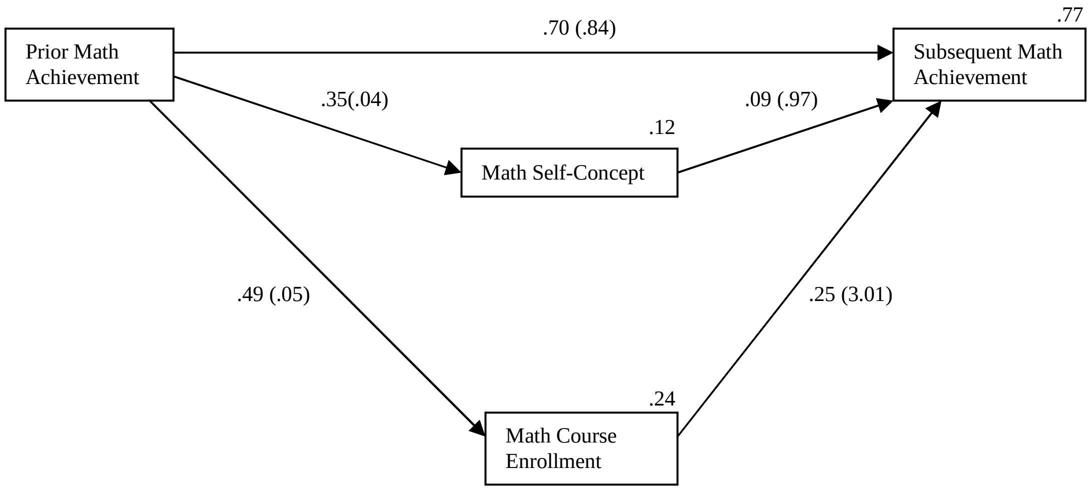
	Original Model			Revised Model		
	Math Self Concept	Math Course Enrollment	Subsequent Math Achievement	Math Self Concept	Math Course Enrollment	Subsequent Math Achievement
Prior Math Achievement	.320	.467	.697	.35	.49	.692
Math Self Concept	*	*	.094	*	*	.094
Math Course Enrollment	*	*	.247	*	*	.247
Behavior Potential	.151	.123	*	*	*	*

*Paths not specified in given model

Table 4-8. Model Fit Tests for Math Achievement Models

	Original Model	Revised Model
Chi Square (CMIN)	958.15 (p<.001)	341.56 (p<.001)
NFI	.95	.98
CFI	.945	.98
RMSEA	.16	.17
AIC	992.15	367.56
BCC	992.16	367.57
Hoelter Index	100	137

Figure 4-3. Final model for Math Achievement (Revised Model)



Note: Standardized path coefficients are noted on each line with unstandardized path coefficients in parenthesis.
Note: Variance is noted on top right of each box

Hypothesis 1a.

Hypothesis 1a was confirmed. Math self-concept yielded a direct effect on subsequent math achievement with a standardized coefficient =.094 in both the original and revised models, explaining less than one percent of the variance in math achievement. Although both models demonstrated acceptable model fit, the revised model showed an overall better fit than its original.

Hypothesis 1b.

Hypothesis 1b was confirmed. Math course enrollment directly predicted *subsequent* math achievement, as it had a standardized coefficient=.247 in both the original and revised models and explained 6.1% of the variance in math achievement. Although both models demonstrated acceptable model fit, the revised model showed an overall better fit than the original model.

Hypothesis 1c.

Hypothesis 1c was not confirmed. The original model, which was shown to be acceptable by some model fit estimates, found behavior potential to predict both math course enrollment (.123) and math self-concept (.151). However, a follow-up analysis found that the model was improved once this variable was eliminated. Therefore, its indirect effects on subsequent math achievement were not confirmed by the current analysis.

Hypothesis 1d.

Hypothesis 1d was confirmed as prior math achievement predicted subsequent math achievement for both models; however, the revised model had a better fit than its original. Specific direct, indirect, and total measurements regarding this hypothesis are as follows:

In both the original (.70) and revised models (.69), its direct effects respectively accounted for 48.58% and 47.89% of subsequent math achievement's variance. The current analysis also confirmed prior math as a predictor of math self-concept and math course enrollment, thereby showing it also had an indirect effect on subsequent math achievement. The indirect path coefficient was .145 in the original model and .154 in he revised model. The indirect effect through self-concept had a standardized coefficient of .030 (.320 * .094) for the original model and .033 (.352 * .094) for the revised model. Indirect effects through math enrollment on math achievement were .115 (.467 * .247) for the original model and .121 (.489 *.247) for the revised model.

Total effects include direct and indirect effects on math achievement. Total effects for model 1 had a standardized coefficient of .842 (.145 + .697) and .746 (.154 + .692) for model 2. Note: Calculations above were based on Table 4-7 – table rounds to two decimal places, yet these calculations used three decimal places for better accuracy.

Model 2: Predictors of Degree Attainment

Hypothesis 2.

Figure 4-2 (on page 77) presents the hypothesized indirect and direct effects of the variables on degree attainment. Overall, this model explained 19.7% of the variance in degree attainment, 15% of the variance in college expectations, and 9.8% of the variance in academic track (Table 4-9). As noted in Table 4-10, each of the hypothesized path coefficients were significant. Model fit estimates, however, showed the proposed causal model to be an inadequate fit to the data (Table 4-11).

In order to improve model fit, linear regression analyses were conducted in SPSS, with results suggesting model fit could be maximized if prior reading achievement and academic track were deleted from the model and if a direct path from prior math achievement to degree attainment was added. Model fit estimates (Table 4-11) suggest that this revised model, which is depicted in Figure 4-4 on page 85, provided a better fit to the data. In this model, the AIC and BCC estimates decreased and the NFI and Hoelter Index met suggested criteria for acceptable model fit (Arbuckle, 2007; Kenny 2011). However, Chi Square and RMSEA estimates suggested poor model fit (Arbuckle, 2007; Kenny 2011 Kline, 2005). The inability of the Chi Square test to demonstrate adequate model fit is not surprising, as such a finding is quite rare when sample sizes exceed 400 (Kenny, 2011). Although there is no apparent reason for the RMSEA findings, it should be noted that, since no specific model fit test is viewed as the gold standard, multiple tests of model fit are always recommended (Kenny, 2011). Interpretations of the Comparative Fit Index (CFI) for the current model vary according to the standards of different scholars, as minimum criterion for adequate model fit as estimated by the CFI have ranged from .90 (Kline, 2005) to .95 (Arbuckle, J., personal communication, Spring 2007). Overall, the revised model explained 28.9% of the variance for degree attainment and 18.9% of the variance for college expectations.

A second revised model (Figure 4-5) depicted on page 85, in which behavior potential yielded a direct effect on degree attainment, was considered. Since adding this effect yielded a significant improvement on five of the seven model fit tests (Table 4-10), it was deemed to provide the best fit to the data and became the final model.

Table 4-9. Explained variance for model 2

Original Model			Revised Model		Final model	
Degree Attain.	College Expect.	Academic Track	Degree Attain.	College Expect.	Degree Attain.	College Expect.
19.7%	15.0%	9.8%	29.3%	18.9%	28.9%	18.9%

Table 4-10. Standardized Path coefficients for Model 2

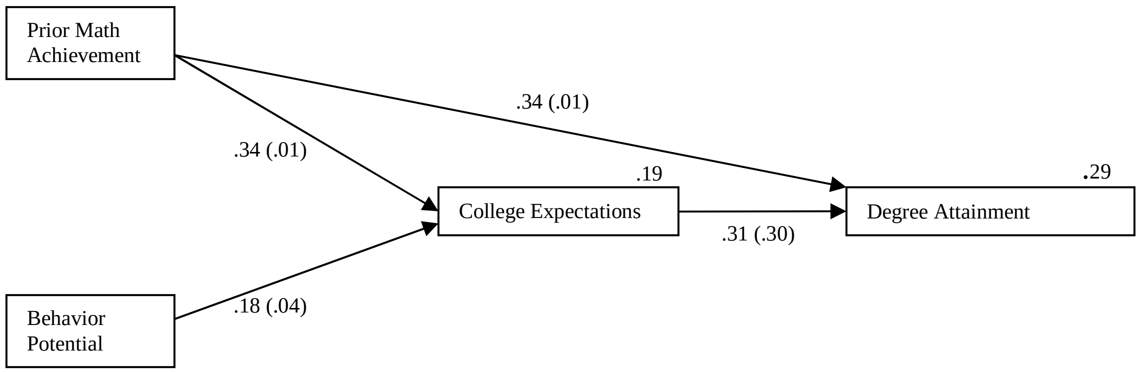
	Original Model			Revised Model		Final model	
	Degree Attain.	College Expect..	Academic Track	Degree Attain.	College Expect.	Degree Attain.	College Expect.
Behavior Potential	*	.179	.098	*	.183	.064	.184
Prior Math Achievement	*	.296	.244	.394	.342	.336	.394
Prior Reading Achievement	*	.175	.170	*	*	*	*
College Expectations	.380	*	*	.306	*	.294	*
Academic Track	.190	*	*	*	*	*	*

*Paths not specified in given model

Table 4-11. Model Fit Tests for Degree Attainment (i.e. College Graduation) Models

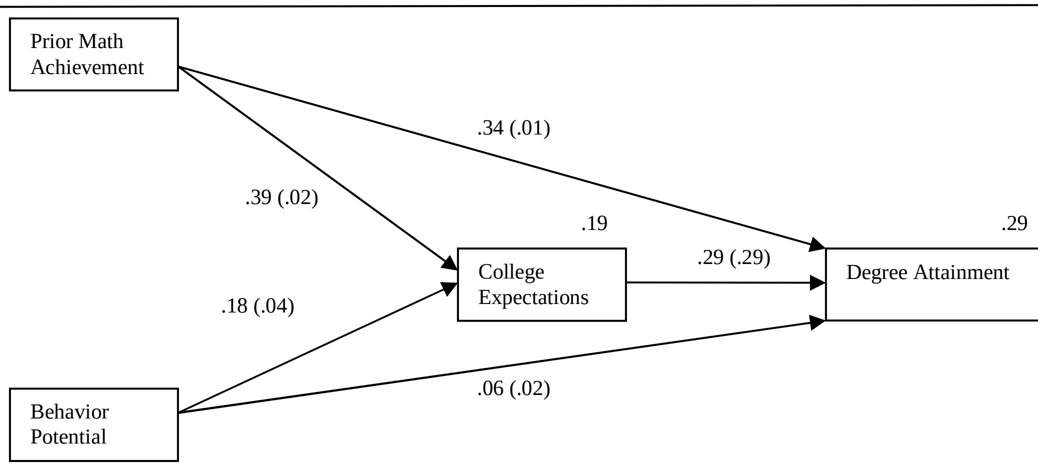
	Original Model	Revised Model	Final model
Chi Square (CMIN)	10048.13 (*p*<.001)	641.99 (*p*<.001)	583.77 (*p*<.001)
NFI	.43	.91	.92
CFI	.43	.91	.92
RMSEA	.34	.16	.22
AIC	10088.13	665.99	609.77
BCC	1088.16	666.00	609.79
Hoelter Index	17	114	80

Figure 4-4. Degree Attainment (Revised Model)



Note: Standardized path coefficients on each line with unstandardized path coefficients in parenthesis.
Note: Variance is noted on top right of each box

Figure 4-5. Final model for Degree Attainment (Final model)



Note: Standardized path coefficients on each line with unstandardized path coefficients in parenthesis.
Note: Variance is noted on top right of each box

Hypothesis 2a.

In the original model, college expectations explained 14.4% of the variance in degree attainment. For the two revised models, each of which adequately fit the data (see Table 4-11) it explained 9.4% (revised model 1) and 8.6% (revised model 2) of the variance. Thus, hypothesis 2a was supported.

Hypothesis 2b.

Although the original model found academic track (0.19) to predict degree attainment, there was no model fit. Model fit was found to improve after this variable was eliminated. Therefore, hypothesis 2b was not supported.

Hypothesis 2c.

Partial support was found for behavior potential's indirect effect on degree attainment. All three models found college expectations to mediate the relationship between behavior potential and degree attainment. However, the indirect effect of behavior potential as mediated through academic track was not supported, as overall model fit improved upon the deletion of academic track. Indirect effects for behavior potential on degree attainment had a standardized coefficient of .059 (.183 * .294).

The final model also demonstrated a direct effect for behavior potential which had a standardized coefficient of .064 for degree attainment that accounted for .4 % of the variance. This direct effect for behavior potential was not part of the original hypothesis, but was added following regression analysis.

Total effects include direct and indirect effects on degree attainment. Total effects for the final model had a standardized coefficient of .123 (.059 + .064). Note: Calculations above were based on Table 4-7 – table rounds to two decimal places, yet these calculations used three decimal places for better accuracy.

Hypothesis 2d.

Partial support for hypothesis 2d was found, as all three models supported the indirect effect of prior math achievement on degree attainment through college expectations. In the final model, the indirect effect through college expectations rendered a standardized coefficient of .105 (.342 * .306). Since academic track was removed from the model following subsequent analyses, the hypothesized indirect effect of prior math achievement through academic track was not supported.

On page 85 it is noted that prior SPSS analysis showed the researchers that adding a direct effect of prior math achievement on degree attainment would improve the overall model. The standardized coefficient direct effect was .342, which accounted for 11.7% of the variance of degree attainment in the final model. Total effects for degree attainment for prior math achievement was .447+ (.105 + .342).

Hypothesis 2e

Model fit was improved following the deletion of prior reading achievement. Thus, hypothesis 2e was not supported.

CHAPTER FIVE
DISCUSSION

Summary of Findings

The current study sought to integrate the social learning and expectancy-value theories of academic motivation as predictors of math achievement and college graduation (i.e., degree attainment). Included below is a discussion of the current study's findings in regard to key constructs of each theory. Following this is a discussion of study limitations and directions for future research.

The hypothesized and final models for math achievement are presented in figures 5.1 and 5.2, respectively. With the exception of behavior potential, each variable's hypothesized predictive effect was confirmed. A revised path model excluding behavior potential passed five of the seven employed tests of model fit and predicted 76.9% of the variance in math achievement. Overall, three of the model's four predicted hypotheses were confirmed.

Figure 5-1 Hypothesized Model for Math Achievement

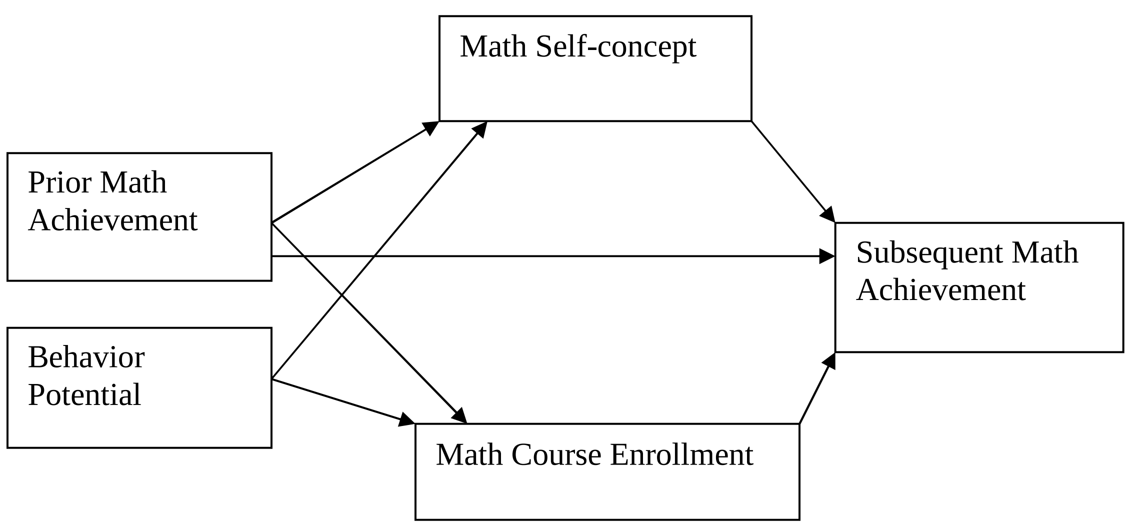
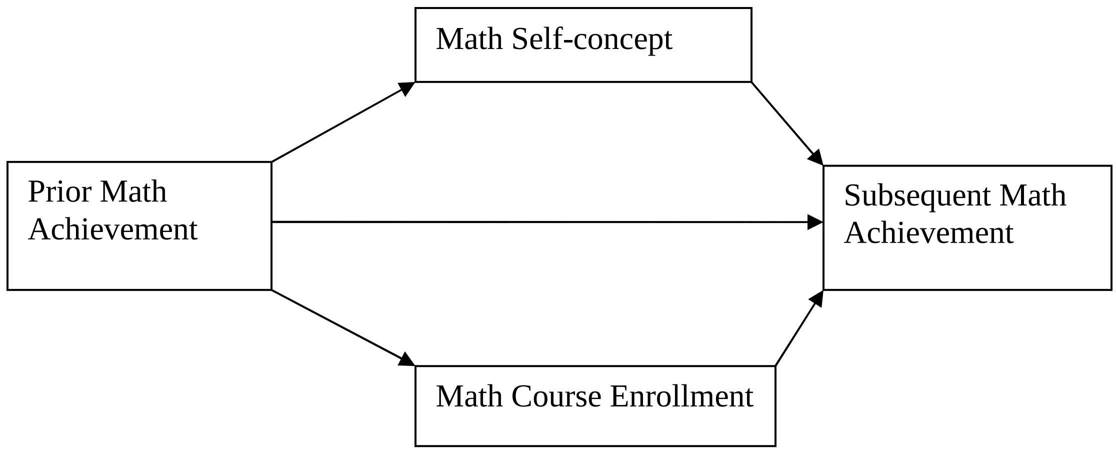


Figure 5.2 Revised Model for Math Achievement



The current study was less successful in predicting degree attainment, as two of the five hypotheses were not confirmed and two of the remaining hypotheses only received partial confirmation. As depicted in figures 5.3 and 5.4, significant changes were made to the hypothesized path model, including the deletion of prior reading achievement and academic track as predictor variables and the addition of a direct effect for prior math achievement. This model passed five of the seven model fit tests employed and predicted 28.9% of the variance in college graduation. The following subsections discuss how the specific variables were found to predict math achievement and degree attainment.

Figure 5.3 Hypothesized Model for Degree Attainment (i.e., College Graduation)

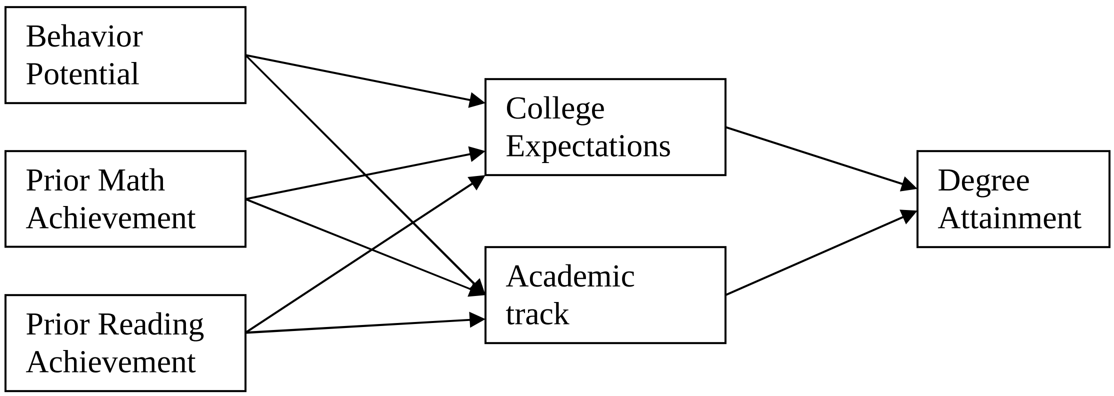
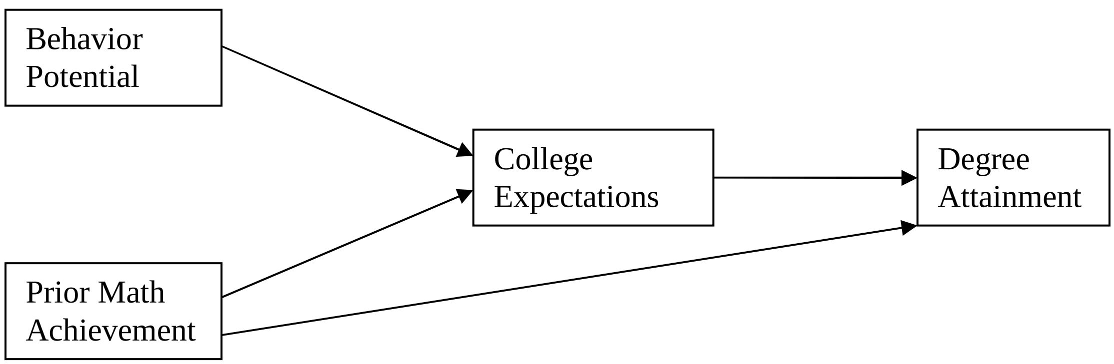


Figure 5.4 Revised Model for Degree Attainment



Behavior Potential

Locus of control was viewed through the social learning theory concept of behavior potential (Rotter, 1954; Rotter, Chance, & Phares, 1972), in which expectancies for success are viewed in conjunction with task value rather than as a separate construct. It was assumed that the construct of behavior potential, which considers expectancies locus of control in relation to task value, would significantly predict math achievement and college graduation (i.e., degree attainment). Moreover, it was assumed that this effect would be stronger than that previously demonstrated in previous research where locus of control was studied as an isolated construct. Consistent with expectancy-value theory, the current study hypothesized behavior potential to be an indirect predictor of math achievement and college graduation by its influence on course selection patterns, self-concept, and performance expectancies.

Results of the current study did not support behavior potential as an indirect predictor of math achievement. Although a relationship was found between the variables, the path analytic model without this variable provided a superior fit to the data.

Behavior potential was found to directly and indirectly predict college graduation by influencing expectations, albeit its predictive effect was rather weak. Analysis of the correlations between study variables, which are depicted in Tables 4-3 (p. 75) and 4-4 (p. 76) shows that locus of control's correlations with subsequent math achievement and degree attainment was similar to the behavior potential-subsequent math achievement and behavior potential-degree attainment correlations. Thus, it appears that the behavior potential construct did little to enhance locus of control's ability to predict either of the current study's main outcome variables.

One possible explanation for the inability of the behavior potential construct to enhance the predictability of locus of control could lie in the current study's conceptualization of task value. As can be seen in Tables 4-1 (p. 73) and 4-2 (p. 74), locus of control explained a far greater portion of the behavior potential variance. Moreover, Table 4-4 (p. 76) presents descriptive statistics for both locus of control and task value. Examination of the mean values for each variable indicates that, while locus of control captured the variability among those with different degrees of internal control, respondents were far less likely to report low or medium levels of task value. This particular finding was further highlighted by analyses of skewness and kurtosis statistics.

Locus of control had respective skewness and kurtosis variables of -0.152 and 0.303, while the respective statistics for task value yielded values of 0.303 and 0.996. Although the skewness and kurtosis statistics for both variables were in the acceptable range (absolute values less than one), the task value variable captured less variability across respondents. This skew towards high task value ratings is not unique to the current study, as this response pattern has been observed in previous expectancy-value research (Crombie, et al., 2005; Eccles, et al., 1993; Hulleman, et al., 2008; Meece, et al., 1990).

A second explanation for behavior potential's limited predictability could lie in locus of control's variability over time. The current study found locus of control's test-retest reliability over a two year time period to be in the low-to-moderate range, which was similar to prior research findings (Kulas, 1996; Layton, 1985). It should be noted, however, that only one of the aforementioned studies employed a nationally-representative sample (Kulas, 1996), and this sample differed in age from the one used in the current study.

Locus of Control

Contrary to previous research examining locus of control as an isolated construct, the current study viewed locus of control through the social learning theory construct of behavior potential (Rotter, 1954; Rotter, Chance, & Phares, 1972), which states that the impact of perceived control on behavior will vary depending on the degree to which a particular task is valued. The current study's findings, as behavior potential predicted less than one percent of the variance in college graduation and was eliminated from math achievement's predictive model. However, since locus of control contributed nearly all of the variance in behavior potential, the failure to support social learning theory could be a function of the current study's methodological limitations.

Task-specific Self-concept and Performance Expectancies

The current study confirmed math self-concept as a predictor of subsequent math achievement. However, it should be noted that the demonstrated relationship between the variables in this study differed from that of previous studies. The current study found math self-concept to predict only 0.8 percent of the variance in math achievement. In contrast, previous studies found a larger impact for math self-concept and also showed math self-concept's predictive effects to be stronger than those of prior achievement (Crombie et al., 2005; Eccles, Adler & Meece, 1984; Meece, Wigfield, & Eccles, 1990; Wigfield & Eccles, 2000). These findings could be explained by methodological factors unique to the current study. First, previous expectancy-value studies focused on populations from more-restricted geographic locales and, as a result, may have samples more homogenous in ability and demographic categories. In contrast, the current study included a large, nationally-representative sample. It is possible that the relationship between self-concept and academic achievement is stronger for some demographic groups and ability levels than it is for others. A second explanation for the smaller relationship in the current study lies in the way math achievement was operationalized. Since the current study utilized standardized math tests rather than classroom-based achievement measures, it is possible that the effect of self-concept is stronger for the latter type of performance domain. Finally, since the correlation between math self-concept and subsequent math achievement (Table 4-1) accounted for over 17% of the latter's variance, the effect of math self-concept could have been marginalized by the impact of the other predictors. In particular, prior math achievement accounted for a significant amount of the variance in subsequent math achievement (see below).

The current study is believed to be the first of its kind to expand the expectancy-value theory of achievement to the prediction of degree attainment. As predicted, expectations for college graduation predicted the actual attainment of a college degree. Although this is an important finding, it should be noted that the current model was not a strong predictor of college graduation. Thus, it would be necessary to include predictions from other theories in developing a more comprehensive model for college graduation.

Course Enrollment and Academic Track

The current study found that the number of math courses a student takes throughout high school predicts his/her math achievement even after prior math achievement and math self-concept are considered. In predicting college graduation, it was hypothesized that such outcomes would be more likely for those in an academic track designed to prepare students for college. These results were not confirmed in the current study. One possible explanation for this finding could be that high school curriculum was determined by student self-report and, as a result, did not provide an accurate depiction of students' particular academic track. Also, the fact that NELS:88 dichotomous nature by which course enrollment was defined (college prep vs. not college prep), which was necessitated for the current analysis due to the categorical nature of the variable in NELS:88, may have been insufficient for differentiating curricula of different rigor. It is possible that a numerical operationalization of curriculum rigor (i.e. total credits earned; # college prep, honors, or AP courses selected; would be a stronger predictor of degree attainment.

Prior Achievement

Prior math achievement was found to be a significant predictor of both subsequent math achievement and degree attainment (i.e., college graduation). It was found to be the largest direct predictor for both outcomes. Indirect predictive effects were also uncovered, as prior math achievement predicted math self-concept, math course enrollment, and expectations for college graduation. On the contrary, prior reading achievement was not found to be a meaningful predictor of college graduation, as model fit improved upon its deletion. While this result was surprising, analyses of the correlations depicted in tables 4-1 and 4-2 provide an explanation for this finding. Although aforementioned tests of multicollinearity suggested that this would not be a significant limitation for the current study, prior reading achievement was found to correlate strongly with both prior math achievement and expectancies for college graduation. Thus, once these two variables were considered, the impact of prior reading achievement decreased substantially. An alternative approach to considering these variables' effects on college graduation would have been a structural equation modeling analysis where prior reading and math achievement would contribute to a latent variable of general academic ability, which in turn would be an exogenous variable predicting college graduation and expectancies for college graduation.

Limitations

Findings from the current study could be hard to generalize due to several methodological limitations. As previously mentioned, there were limitations to the behavior potential construct. First, the behavior potential construct was limited by the *task value* construct's limited variance across respondents and could have been limited by the locus of control construct's instability over time.

Several characteristics of the study sample also caused limitations for the current study. First, since the two-stage nature of participant selection meant that only students attending participating schools could be selected, the current study did not account for school-level factors that may have affected study variables. This limitation could have been accounted for by employing multi-level path analytic techniques for statistical analysis, as such an approach would increase the generalizabilty of study findings. Second, the current study only used data for those who responded at the NELS:88 fourth follow-up data collection period. Since data for those who refused participation at this time point were excluded from the study, it is unknown if these participants differed in a meaningful way from those who agreed to participate. Third, Tables 3-2, 3-3, and 4-3 indicate that, for both path analyses, participants providing complete data for all variables differed in meaningful ways from the overall sample. Although the recommended method of maximum likelihood estimation was used to estimate missing data (Arbuckle, 2007), it cannot be said for sure how those with missing data would have responded to study items. Finally, the NELS:88 study excluded the following groups of students: schools run by the Bureau of Indian Affairs, schools that solely serve students with special education services, vocational schools with direct student enrollment programs, and schools intended for students whose parents are military personnel stationed outside the country. Therefore, findings of the current study cannot be generalized to these unique populations.

Implications

Predicting Math Performance

The current study found prior math achievement to be a strong predictor of subsequent math achievement. Math course enrollment patterns were also found to predict math achievement, with higher math scores observed among those completing more math classes. Thus, while performance on standardized math assessments remained quite stable over time, findings suggest that students can enhance their ability through additional coursework. The current study questions the importance of self-concept established in previous expectancy-value research. Although math self-concept was found to affect math achievement, the magnitude of this effect was considerably smaller than that shown in previous research (Crombie et al., 2005; Eccles, et al. 1984; Meece et al., 1990; Wigfield & Eccles, 2000). Finally, the current study failed to support social learning theory's hypothesis that consideration of task value would enhance locus of control's ability to predict favorable outcomes (Rotter, 1954; Rotter, et al., 1972). The combination of these two concepts, which was represented by the behavior potential construct, provided no significant enhancement to predictions of math achievement. This lack of significance could be due to the aforementioned problems with the variable's operationalization, however.

Predicting College Graduation

The current study showed math achievement to also be a strong predictor of college graduation. Furthermore, expectations for degree attainment were found to be important in predicting subsequent graduation, with this finding representing an extension of expectancy-value theory to a new domain of academic achievement. Finally, social learning theory's prediction (Rotter, 1954; Rotter, et al., 1972) that locus of control would be a stronger outcome predictor when seen through the context of task value was not supported. Although behavior potential was found to both directly and indirectly predict college graduation, this effect was rather weak.

Future Research

Future research with a task value measure of better psychometric quality should be conducted, as such research could indeed support the predictions of social learning theory and shed more light on the mechanisms through which perceived control affects performance outcomes. Future investigations should also consider the separate effects of attainment, intrinsic, and utility value on achievement behaviors. Although research supports the operationalization of task value as one unified construct (Bong, 2001), differentiation of the different types of task value would be consistent with expectancy-value theory (Wigfield & Eccles, 1992, 2000).

The current study also differed from previous expectancy-value investigations in that task-specific self-concept had less of an impact on academic performance. This finding could reflect differences in the current study's methodology, which include sample population, achievement measure, and time span. Future investigations are needed to determine if the impact of task-specific self-concept varies across demographic groups, ability levels, and performance domains.

Another potential line of further research would be the combination of attribution theory concepts (i.e., controllability and stability) with those of expectancy-value and social learning theories. It is not believed that any such studies have been conducted to date. However, a consideration of these theories together could shed greater light on the mechanisms of academic motivation.

A final goal for future research would be to create latent variables from some of the exogenous variables used in the current investigation. Based on the high correlation between reading and math achievement, it would make sense to have these two variables contribute to a latent variable of academic achievement. Furthermore, rather than operationalizing the behavior potential construct by multiplying the locus of control and behavior potential variables together, behavior potential construct could be defined as a latent variable.

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