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Needs-Satisfaction, Motivation, and Achievement in High School Students: Testing Predictive Models by Gender and Ethnicity

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Needs-Satisfaction, Motivation, and Achievement in High School Students: Testing Predictive Models by Gender and Ethnicity

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A dissertation submitted in partial satisfaction of the requirements for the degree of

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of the

University of California, Berkeley

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Fall, 2013
Needs-Satisfaction, Motivation, and Achievement in High School Students:
Testing Predictive Models by Gender and Ethnicity

By

Lionel Henry Bialis-White

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Abstract

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Doctor of Philosophy in Education
University of California, Berkeley

Professor Frank C. Worrell, Chair

Student motivation is one proposed contributing factor to disparate rates of high school achievement. Guided by self-determination theory (SDT; Ryan & Deci, 2000a), the purpose of the present study is to investigate whether a process model of the relationship between motivation and achievement varied by gender and racial subsamples of students within one large high school (see Figure 1). First, I examined the reliability and structural validity of the measures within the model. Second, I examined the extent to which the climate of one large urban high school was related to individual perceptions of autonomy, competence, and relatedness across gender and racial/ethnic subgroups. Then, I used structural equation modeling to test a process model in which autonomous motivation mediated the relationship between perceived climate or needs-satisfaction and achievement (with and without accounting for prior year achievement). The sample consisted of 863 students from an urban high school in the Western United States. The reliability and structural validity for the Basic Psychological Needs Scale (BNS) were below acceptable ranges, whereas the reliability and structural validity for the Academic Motivation Scale (AMS) were within the acceptable ranges. The relationships among needs-satisfaction, autonomous motivation, and achievement were not fully consistent with SDT; that is, competence and relatedness were significantly related to achievement (r = .20, r = .19, respectively, p < .01) whereas autonomy was not (r = .09, p > .01). European American and Asian American students showed significantly and meaningfully higher mean-level GPA than African American and Latino students, whereas differences among groups in needs-satisfaction and autonomous motivation were not both meaningful and significant. The process model without prior achievement explained 1% of the variance in achievement and fit indices approached acceptable ranges, whereas the model with prior year achievement showed unacceptable fit indices. This study highlights the importance of valid and reliable measures of psychological constructs before examining their relationships to achievement. Additionally, the value of studying hypothesized models across gender and racial subsamples is demonstrated. Lastly, this study illuminates the importance of continually testing theories, even those that are relatively well established.

Keywords: self-determination theory, motivation, basic needs, process model.
Dedication

I dedicate this dissertation to my wife, Tracy Bialis-White, who provided the initial push for my move to California, the final pull to complete my dissertation, and every ounce of support in between. Thank you, T.
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This dissertation is a product of immense support from family, colleagues, and friends. This dissertation and my journey do not happen without such support. I owe a special thank you to Professor Frank C. Worrell who has been an unwavering mentor and supporter that has pushed my growth since I first met him as an undergraduate in 2007. Professor Rhona Weinstein, you have been a source of support, wisdom, and inspiration. You were more than gracious with your time on my behalf. Lastly, thank you Professor Bruce Fuller for the mentorship. My esteemed committee members are well accomplished within their fields, but their patience and guidance during this process cannot be expressed appropriately on their vitas.

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Needs-Satisfaction, Motivation, and Achievement in High School Students: Testing Predictive Models by Gender and Ethnicity

High school completion and academic achievement are strong predictors of later life chances for individuals (e.g., Rumberger, 1987) and of increased civic and financial contributions to society (Tyler & Lofstrom, 2009). A considerable minority of students, however, does not complete high school; for example, in 2001, the graduation rate was 70%, and less than a third of students left high school qualified to attend a four-year college (Greene & Forester, 2003). African American and Latino students complete high school at lower rates than do European American and Asian American students. From 1989 to 2005, the percent of Latino (22.4 to 35.3%) and African American (10.4 to 14%) students leaving high school prior to graduation was consistently higher than that of European Americans (6 to 9.4%; Kewalramani, Gilbert, Fox, & Provasnik, 2007). A gender achievement gap is present as well. In high school, female students earn higher average grades than male students across major subjects, including math and science (Buchanan, DiPrete, & McDaniel, 2008; Perkins, Kleiner, Roey, & Brown, 2004).

To understand and address such strikingly disparate rates of high school completion and achievement, a substantial body of literature has focused on students’ motivation as a key antecedent to pro-academic behaviors (e.g., Armitage, 2008; see Martin & Dowson, 2009, for a review). This theoretical and empirical corpus has identified multiple individual factors (e.g., self-efficacy, achievement goals, and feelings of belonging) and environmental factors (e.g., school climate, autonomy support, and rewards) that predict motivation (see Skinner, Kindermann, Connell, & Wellborn [2009] for a review). In short, students may differ in their motivation to achieve academically, and within multiple social-cognitive theories, researchers have suggested and studied possible factors to explain disparities in motivation and academic performance.

One social-cognitive theory of motivation and development, self-determination theory (SDT; Ryan & Deci, 2000a), suggests that the extent to which schooling environments promote students’ needs for autonomy, competence, and relatedness leads to increased intrinsic and internalized forms of motivation, and ultimately, increased academic achievement. Commonly, self-determination theorists used general process models to examine the links from environmental factors to individual factors and ultimately to achievement behaviors (e.g., Vallerand, Fortier, & Guay, 1997). The models to date have supported the notion that students’ school environment and their perceptions of that environment are predictors of student motivation and achievement. School policymakers have become increasingly interested in the school environment as a way to support student motivation (Ryan & Deci, 2009). Unfortunately, however, little research has compared the varying strength of any process model among racial/ethnic subpopulations (Cokley, Bernard, Cunningham, & Motoike, 2001), which might address one possible factor in the aforementioned disparate rates of secondary school achievement.

The purpose of the present study is to investigate a process model of motivation and achievement in a secondary education setting by gender and race/ethnicity (see Figure 1). Prior to testing the model, I examine the reliability and structural validity of the scores within the model. This research contributes to the field’s knowledge of the antecedents of motivation and
achievement for gender and racial subgroups of high schools students. Specifically, I examine the extent to which the climate of a large, urban high school is related to individual perceptions of autonomy, competence, and relatedness; I examine this relationship across the whole sample and across racial and gender subgroups. Then, I test a process model in which these individual factors lead to autonomous motivation, and ultimately, to achievement. I also test the model controlling for previous achievement.

I first review SDT and its subcomponents: (a) needs-satisfaction for autonomy, competence, and relatedness, (b) qualities of motivation, and (c) behavioral correlations to needs-satisfaction and one quality of motivation, autonomous motivation. Next, I review gender and racial subgroup differences in needs-satisfaction, autonomous motivation, and achievement. Last, I review the strengths and shortcomings of previous SDT process models that inform the direction of this study.

Self-Determination Theory

Most broadly, SDT posits that humans have an inherent motivation to learn and develop—referred to as intrinsic motivation (Ryan & Deci, 2009). In addition, humans have a natural tendency to assimilate environmental values and practices—referred to as internalization. That is, there is a tendency for humans to endorse extrinsic motivators that are valued within their milieu. As a result, self-determination theorists focus on the social conditions across life domains (e.g., school, work, sport, and relationships) that promote or thwart humans’ intrinsic motivation and internalization of extrinsic motivation.

Needs-satisfaction. SDT posits that one’s motivation is contingent on the capacity of the environment to promote or discourage three innate, psychological needs: (a) autonomy, (b) competence, and (c) relatedness (Ryan & Deci, 2000a). The word, need, refers to a universal necessity (Ryan & Deci, 2009). In other words, psychological needs are conceptualized as the nutrients essential for integrated functioning and ongoing healthy development (Deci & Moller, 2005). Importantly, needs-satisfaction is reliant on the perception of the individual. That is, all three needs are satisfied insofar as they are perceived to be satisfied (Vallerand et al., 1997). In the remainder of the study, I use needs-satisfaction as an omnibus term to refer to autonomy, competence, and relatedness collectively.

Autonomy, which stems from de Charms’ (1968) locus of causality, is the feeling of volition and choice. Autonomous actions are fully endorsed by the actor. Students feel autonomous when they perceive themselves as the agents of their own behavior at school (Deci & Ryan 1985). Autonomous students agree strongly with statements like, “Teachers want to know what I think about how we should do things” (Zimmer-Gembeck, Chipuer, Hanisch, Creed, & McGregor, 2006).

Competence is feeling effective in one’s interactions with the environment (Skinner, Furrer, Marchand, & Kindermann, 2008; White, 1959); alternately stated, students feel competent when they experience mastery and self-efficacy (Bandura, 1997). Students with a high self-perception of competence agree strongly with statements like, “I feel confident in my ability to learn this material” and “I am capable of learning the material in this course” (Williams & Deci, 1996).

Relatedness refers to feeling securely connected with others (Baumesiter & Leary, 1995; Connell & Wellborn, 1991). Within educational contexts, the need for relatedness is satisfied
when students experience enriching relationships with teachers, students, and other school personnel. Additionally, students feel relatedness when they perceive that important social figures at school truly care about them. Students who experience a high level of relatedness agree strongly with statements like, “I really like the people I interact with” or “people in my [context] really care about me” (Baard, Deci, & Ryan, 2004).

**Measurement and validation of needs-satisfaction scales.** Because needs-satisfaction is domain-specific, researchers to date have attempted to assess human’s needs-satisfaction across multiple domains (e.g., physical fitness and work). In the work domain, for example, two scales have been used to measure needs-satisfaction: (a) the Basic Need Satisfaction at Work Scale (Baard et al., 2004; Deci et al., 2001; Vansteenkiste et al., 2009) and (b) the Work Motivation Scale (Ilardi, Leone, Kasser, & Ryan, 1992; Kasser, Davey, & Ryan, 1992). However, as noted by Van den Broeck, Vansteenkiste, De Witte, Soenens, and Lens (2010), these measures have not been formally validated. Looking toward future research, Van den Broeck et al. stated, “The use of a validated need satisfaction measure rather than the reliance on ad hoc need satisfaction measures allows for more consistent cross-study comparisons and contributes to a more unified development of this field” (p. 997).

The use of validated needs-satisfaction measures for secondary students is an understudied topic and population. In previous studies of students’ needs-satisfaction, measurement scales have been largely adapted from work-related scales. For example, Jang, Reeve, Ryan, and Kim (2009) adapted a scale from Sheldon, Elliot, Kim, and Kasser (2001), which was used with a sample of undergraduate students. Lavigne, Vallerand, and Miquelon (2007) measured needs-satisfaction of competence (three items, \( \alpha = .90 \)) and autonomy (three items, \( \alpha = .74 \)) using a 6-item scale, but they provided no evidence that the measures’ scores were validated. Further, the use of American, high school student samples is lacking in the present body of research. The environmental context of secondary schools—that is, the reward structure and the expectation of autonomy, competence, and relatedness—may differ from the domains of work, exercise, and postsecondary school. As a result, testing and validating needs-satisfaction scales with secondary students is a gap in the existing literature.

**Needs-satisfaction and behavioral correlates.** Despite measurement shortcomings, autonomy, competence, and relatedness have predicted multiple positive outcomes within the domain of education, including academic achievement, engagement, and psychological well-being (see Niemiec & Ryan, 2009, and Reeve, 2002, for reviews). For example, Chirkov and Ryan (2001) showed that in both Russian and American adolescent samples, greater needs-satisfaction predicted greater well-being. Jang et al. (2009, Study 2) examined the relationships among South Korean students’ needs-satisfaction, engagement, and academic achievement. Autonomy, competence, and relatedness were strongly and significantly correlated \((p < .01)\) to achievement \((r = .30, .41, \text{ and } .21, \text{ respectively})\) and engagement \((r = .68, .60, \text{ and } .38, \text{ respectively})\). Moreover, autonomy and competence predicted 23% of the variance in achievement and 49% of engagement. However, in Study 4 of the same publication with a sample of 175 10th grade South Korean students, Jang et al. (2009) found non-significant relationships between need-satisfaction constructs (i.e., autonomy and relatedness) and achievement.
SDT theorists argue that autonomy, competence, and relatedness are equal in their importance. Ryan and Deci (2009) have, however, noted that intrinsic motivation requires competence and autonomy, whereas the process of internalizing the values of one’s environment necessitates all three needs. Relatedness, as a construct, has been shown to have the weakest correlations with academic-related outcomes (e.g., Jang et al., 2009). In sum, there is support in the SDT literature that autonomy, competence, and relatedness predict achievement for adolescent samples (Reeve, 2002), but exceptions for autonomy and relatedness (Jang et al., 2009; Study 4) have been found.

**Motivation**

Motivation is the impetus behind action or inaction (Deci, Vallerand, Pelletier, & Ryan, 1991). SDT contends that motivation varies in quantity and quality. Most generally, SDT distinguishes among intrinsic motivation, extrinsic motivation, and amotivation (Lepper & Henderlong, 2000; Ryan & Deci, 2000b; see Figure 2). Intrinsically motivating activities are interesting and enjoyable. These activities promote efficacy and development, but they are sought out solely for the enjoyment that participation provides. As an example, for many children, playing tag with classmates is intrinsically motivating. Extrinsically motivated activities can also be competence building, but in contrast to intrinsically motivating activities, they are sought out for a separable outcome than the actual activity.

Finally, amotivation refers a complete lack of connection between behaviors on the one hand and outcomes (Guay et al., 2000), intentionality, and motivation (Guay, Mageau, & Vallerand, 2003) on the other. Amotivated behaviors are neither intrinsic nor extrinsic, do not promote competency or development, and are considered the least self-determined behaviors. The construct of amotivation is related to learned helplessness (Abramson, Seligman, & Teasdale, 1978), because it encompasses feelings of inefficacy and a lack of personal control (Guay et al., 2000).

**Extrinsic motivational qualities.** Within extrinsic motivation, SDT distinguishes among three types of extrinsic motivation based on the level of internalization with which the activities are sought out. Specifically, extrinsic rewards are separated into (a) external regulation, (b) introjected regulation, and (c) identified regulation. External regulation represents actions that are undertaken because of the presence of purely external contingencies – that is, rewards or punishments. “Regardless of whether the goal of behavior is to obtain rewards or to avoid sanctions, the individual experiences an obligation to behave in a specific way” (Guay, Vallerand, & Blanchard, 2000, p. 177).

Activities motivated by introjected regulation have been partially internalized and commonly involve self-esteem contingent outcomes, such as shame, guilt, and anxiety. A student who studies for a test so as to seek approval from a parent exemplifies introjected regulation.

Identified regulation involves the participant fully identifying with the value and importance of the activity. The student who studies for a test because she authentically values and desires the knowledge for practical purposes demonstrates identified regulation. Across these extrinsic motivation categories, the motive shifts from outside of the individual to inside the individual, and accordingly, the behaviors become more internalized.
Intrinsic motivational qualities. Vallerand and colleagues (Vallerand, Pelletier, Blais, Briere, Senecal, & Vallieres, 1992) distinguished among three types of intrinsic motivational qualities: (a) to know, (b) to accomplish, and (c) to experience stimulation. Intrinsic motivation to know, which relates to constructs like curiosity, exploration, and learning goals (e.g., Gottfried, 1985), involves experiencing pleasure while learning something new. Intrinsic accomplishment motivation involves the satisfaction of completing a task or creating something that one set out to complete or create. This construct is highly related to the concept of mastery (Harter, 1981). Third, intrinsic stimulation motivation involves deriving sensory and aesthetic pleasure and satisfaction from an event. Vallerand et al. (1992) noted similarities between experiences of flow and excitement and intrinsic stimulation motivation (e.g., Csikszentmihalyi, 1975).

Distinguishing adaptive motivational categories. The distinction between extrinsic and intrinsic motivation is not necessarily informative in predicting positive educational outcomes. First, according to SDT, extrinsic and intrinsic motivations are not necessarily antagonistic or mutually exclusive. Second, a purely intrinsically motivating environment is not practically feasible. In other words, it is unlikely that activities that promote all of the knowledge, skills, and abilities obtained from a strong K12 education can be transmitted through activities that are enjoyable in and unto themselves.

As a result, more recent iterations of SDT distinguish between activities that are autonomous and controlled. Within this bifurcation, controlled motivation includes two types of extrinsic motivation, external regulation and introjected regulation; autonomous motivations include the three types of intrinsic motivation and one form of extrinsic motivation, that is, identified regulation. See Figure 2 for a complete delineation of the motivational categories and how they relate to each other both in the extrinsic-intrinsic and autonomous-controlled bifurcations.

As mentioned, identified is the most internalized form of extrinsic motivation, so it is hypothesized to be more similar to intrinsic motivation than less internalized forms of extrinsic motivation. There is empirical support for the contention that autonomous forms of motivation predict greater persistence and higher achievement than controlling forms of motivation and amotivation (see Guay, Ratelle, & Chanal, 2008 for a review). Vallerand et al. (1997), for example, found that students who dropped out had lower autonomous forms of motivation and higher amotivation than students who remained in school. No differences in external regulation (i.e., one type of controlled motivation) were found. Thus, theoretically, the autonomous-controlled distinction has more practical significance than the intrinsic-extrinsic one, although there is not yet a substantial body of empirical research supporting this hypothesis. Given this gap in previous research, this study focused on the use the autonomous motivation and controlled motivation.

SDT contends that motivation varies in both quality and quantity. Most recently, qualities have been bifurcated into autonomous and controlled motivation. Autonomous motivation represents motivations that are intrinsically enjoyable and extrinsic motivation with which the individual values the reward internally. Controlled motivation includes extrinsic motivations that are not internalized to the actor. This study focuses on autonomous motivation.

Behavioral Outcomes of Motivation: Achievement
The importance of motivation holds only as long as it leads to desired behavioral outcomes. Previous studies have recognized engagement (Vallerand et al., 1997), achievement (Guay & Vallerand, 1996), and well-being (e.g., Deci & Ryan, 2000a) as desired outcomes of motivation. Although I recognize the importance of well-being and engagement, here I focus only on achievement. “Achievement is probably the standard indicator of student learning” (Guay, Ratelle, & Chantal, 2008, p. 234). Most commonly, achievement is measured as a student’s self-reported grade point average (GPA; e.g., Hardre & Reeve, 2003; Zimmer-Gembeck et al. 2006). Guay and Vallerand (1996) measured achievement by rank-ordering students’ grades from three compulsory subjects as compared to their classmates. Achievement has also been measured as graduating from a particular level of school. Finally, achievement can also be taken from school records or databases, which provide a more precise measure of achievement than self-reported grades and graduation status.

The literature on the relationship of autonomous motivation and academic achievement has yielded mixed results. Multiple studies have shown positive correlations between autonomous motivation and academic achievement (Fortier, Vallerand, & Guay, 1995; Guay & Vallerand, 1997; Ratelle, Guay, Vallerand, Larose, & Senécal, 2007, Studies 2 & 3). For example, Guay and Vallerand showed that autonomous motivation predicted greater achievement after one year of schooling. Other researchers, however, found weak correlations between autonomous motivation and achievement. For example, using a racially-mixed sample of 687 college students (57.6% African American, 42.4% European American), Cokley (2003) found three of the four subscales of autonomous motivation (i.e., intrinsic-knowledge, intrinsic-stimulation, extrinsic-identified) did not significantly predict achievement as measured by self-reported grades. Cokley et al. (2001) also found no significant connection between any subscales of autonomous motivation and academic achievement in a sample of college undergraduates (N = 263). Finally, in another study of undergraduate students (N = 1,274), Fairchild et al. (2005) found no relationship between achievement and autonomous subscales. Thus, additional research is needed to strengthen the SDT claim that autonomous motivation is a predictor of academic achievement.

**Gender and Racial/Ethnic Group Comparisons in Needs-Satisfaction and Motivation**

According to SDT theorists, the role of needs-satisfaction in the domains of autonomy, competence, and relatedness in promoting motivation is universal, inclusive, and unchanging (Ryan & Deci, 2009). However, there is evidence that needs-satisfaction varies across gender and racial/ethnic groups, which in theory, would manifest itself in varying levels of motivation (e.g., Stevens, Olívárez, & Hamman, 2006; Vallerand at al., 1997). Alternately stated, schooling environments may satisfy the needs of some subgroups more fully than for others.

In this section, I review gender and racial/ethnic comparisons separately; within each subsection, I review the literature regarding subgroup variation in motivation and needs-satisfaction. Importantly, however, ethnic and gender comparisons do not illuminate the diversity and variance within these groups. Subgroup comparisons can be informative for inter-group differences, but they neglect the wide intra-group variance present in all subgroups (Betancourt & Lopez, 1993; Kuperminc, Blatt, Shahar, Henrich, & Leadbeater, 2004; Phinney, Landin, McLoyd, & Steinberg, 1998).
Gender comparisons. To date, research indicates that males and females tend to report different mean levels of autonomous motivation and amotivation (Vallerand et al., 1997; Vansteenkiste, Sierens, Soenens, Luyck, & Lens, 2009). For example, in a sample of over 4,000 high school students, Vallerand et al. (1997) found females had significantly higher levels of autonomous motivation (extrinsic identified regulation $d = .30$; intrinsic motivation $d = .31$) and lower levels of amotivation ($d = -.33$) than did males ($F = 28.90, p < .0001$). Vansteenkiste et al. (2009) found a similar relationship ($d = .25$) for autonomous motivation. In a sample of African American undergraduates, Cokley (2003) reported females having higher autonomous and controlling motivations and lower amotivation than males, but Cokley did not report effect sizes (or standard deviations). Similarly, Renaud-Dube, Taylor, Lekes, Koestner, and Guay (2010) found females to have significantly higher autonomous motivation than males ($F = 14.16, p < .001$) with gender explaining over 5% of the variance in motivation toward school. In contrast, Cokley et al. (2001) found no significant differences in autonomous motivation between males and females in a sample of undergraduates.

The relationship between gender and motivation may be subject-specific. Preckel, Goetz, Pekrun, and Kleine (2008) found that males, on average, have higher intrinsic motivation for mathematics (as measured by interest) than did females ($d = .27$). In a sample of 8th grade physics students ($N = 254$), Ziegler, Finsterwald, and Grassinger (2005) found female students to have meaningfully higher levels of amotivation as measured by helplessness than did male students ($d = .69$).

Regarding needs-satisfaction in academic contexts, there is little research on gender differences in autonomy and the research on competence is subject-specific. For relatedness, however, there is empirical support that, in academic settings, females tend to report higher levels of relatedness than males. Axler (2008) found non-significant differences between male and female high school students on autonomy, and in a meta-analysis of perception of computer competence, high school males had meaningfully higher levels than females ($d = .66$; Whitley, 1997). Females also tend to report higher levels of relatedness—as measured by school belonging—that males (Goodenow, 1993, Goodenow & Grady, 1993; Sánchez, Colón, & Esparza, 2005; Smerdon, 2002). For example, in a sample of Latino 12th graders ($N = 143$), Sánchez, Colón, and Esparza (2005) found that females reported significantly higher mean-levels of relatedness than males ($d = .31; p < .05$). As noted for many of these studies, however, effect sizes are small, suggesting little practical differences between males and females.

To summarize, there is evidence that females show higher mean levels of autonomous motivation than males, but this difference may be subject-specific. There is not an empirical consensus on gender differences in needs-satisfaction of autonomy within school, yet there is support that females tend to report higher level of relatedness than males.

Racial/ethnic comparisons. To date, there are only four studies in the peer-reviewed literature with explicit comparisons among racial/ethnic groups’ autonomous and controlled motivational qualities or their needs-satisfaction. Stevens et al. (2006) found that despite having lower achievement in math, Mexican American students, on average, had significantly higher levels of autonomous motivation for mathematics (intrinsic motivation $d = .25$, $p = .002$; identified regulation $d = .20$, $p = .016$) than did European American students. Stevens et al. found no significant or meaningful differences between the two groups’ on controlled motivation
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(i.e., introjected and external regulation). Cokley et al. (2001) compared motivational qualities between African American and European American college students; among the different qualities of motivation, the only significant difference was in external regulation, with African American students reporting higher levels than European American students.

Regarding needs-satisfaction, the empirical research is equally sparse. Stevens et al. (2006) found European American students had significantly higher means on mathematics competence as measured by self-efficacy than did Mexican-American students ($d = .20, p = .013$). In a one-year longitudinal study, Kuperminc et al. (2004) compared levels of relatedness—as measured by peer relationships—among Latino, African American, and European American students (11-14 years of age). At Time 1, they found no significant differences among the groups, but one year later at Time 2, European American students reported significantly higher rates of relatedness than African American students ($d = .28; p = .01$); no differences in Time 2 were found between Latino students and the other groups. In a cross-national comparison, Ferguson, Kasser, and Jahng (2011) found that suburban, Midwestern American students reported significantly and meaningfully higher levels of autonomy than did Korean students ($d = 1.27, p < .05$); of note, though, the race/ethnicity of the American sample was not reported. As with the gender comparisons, the differences reported to date among American racial/ethnic groups are not practically significant, although the small differences tend to favor European Americans.

To summarize, although all groups may have the same needs of autonomy, competence, and relatedness, there is preliminary evidence that the extent to which schooling environments satisfy those needs and promote motivation may vary across subgroups. Gender differences for needs-satisfaction and motivation are present with females who report higher levels of autonomous motivation than males—though differences may be subject-specific. Racial and ethnic comparisons are less uniform and an under-researched area of inquiry. Thus, the literature is too sparse for conclusive subgroup comparisons. Hyde and Durik (2005) concluded, "A thorough understanding of gender, competence, and motivation should involve a consideration of the cultural contexts in which gendered beliefs develop and change over time. This includes a consideration of how variations across gender roles and beliefs about gender and competence, and how achievement is demonstrated by and expected from each [group]." (p. 386)

A similar conclusion can be drawn for racial/ethnic comparisons on these variables.

**Process Models**

A process model represents a hypothesized path or sequence of relationships among variables. By incorporating multiple predictors in a sequence, process models afford researchers the ability to include multiple predictors in a theoretically-unidirectional model. Process models only test the hypothesized pathways, versus testing all possible relationships among variables.

**Review of previous process models.** To connect SDT’s needs-satisfaction, motivation, and behavioral outcomes, multiple motivational models have been proposed and tested with high school students (Fortier et al., 1995; Guay & Vallerand, 1996; Hardre & Reeve, 2003, Lavigne, Vallerand, & Miquelon, 2007; Vallerand et al., 1997). Harde and Reeve (2003; Figure 3) tested a process model in which teacher autonomy support predicted autonomous motivation and perceived competence, and these two variables predicted school performance ($R^2 = .43$) and
combined with student achievement to predict intention to persist in school ($R^2 = .27$). In the model, school performance contributed 17% of the variance explained in intention to persist, and students’ perceptions of their teacher’s autonomy support explained the remaining 10% of the variance. Harde and Reeve reported that the structural equation model showed acceptable fit (GFI = .94, CFI = .97, RMR = .04). This study provided support that autonomous motivation and competence can predict rural students’ intention to persist beyond the effect of achievement differences, as measured by self-reported grades.

Vallerand and colleagues (Fortier, Vallerand, & Guay, 1995; Guay & Vallerand, 1996; Lavigne et al., 2007; Vallerand et al., 1997) have examined similar models in Canadian samples. Fortier et al. (1995; Figure 4) tested a model from needs-satisfaction (i.e., autonomy and competence only) to academic achievement via autonomous motivation. The model explained 28% of the variance in academic achievement. With the exception of a significant chi-square, $\chi^2(df = 47, N = 263) = 109.81, p < .001$, goodness of fit measures supported the model, GFI = 0.94, NNFI = 0.93, RMSR = 0.071. The authors concluded that the results showed support for SDT insofar as two needs predicting autonomous motivation and ultimately school performance.

Guay and Vallerand (1996; Figure 5), in two studies with Canadian high school students, examined a process model in which parents’, teachers’, and administrators’ support for student autonomy positively related to students’ perceptions of competence and autonomy; in turn, students’ perceptions positively related to academic motivation and ultimately, academic achievement. In the first study, Guay and Vallerand reported that their model showed acceptable fit indices (CFI = 0.92, NNFI = 0.90, GFI = 0.93); the model explained 13% of the variance in academic achievement, as measured by rank-ordering of Math, French, and Geography grades. In study two, the model was tested again with a different sample and prior achievement was controlled. Although the effect from motivation to achievement diminished, the relationship remained significant.

Vallerand et al. (1997; Figure 6) examined a motivation model with school dropout as the final outcome variable. Tested antecedents included—in block order—parents, teachers, and administrators’ support of autonomy (Block 1); competence and autonomy (Block 2); autonomous motivation (Block 3); behavioral intentions to leave school (Block 4); and dropout behavior (Block 5). Results showed that the less competence ($\beta = .32$) and autonomy ($\beta = .65$) students reported, the less autonomous motivation they reported. Further, low levels of autonomous motivation related to dropout intentions ($\beta = -.67$), which related to actual dropping out of school ($\beta = .24$). Fit indices for the model were as follows: $\chi^2(df = 197, N = 4,537) = 2,176.06, p < .001$; GFI = .96; AGFI = .94. The model explained 65% of dropout behavior. Relevant to the current study, comparisons of the model fit indices for male and female students were almost identical, suggesting no differences by gender.

With a sample of 728 French Canadian high school students, Lavigne et al. (2007; Figure 7) tested a process model from science teachers’ autonomy support to students’ autonomous motivation and perceptions of competence in science to students’ intentions to pursue science education and eventually work in a science-specific domain. Results of the model showed satisfactory fit, $\chi^2(df = 16, N = 342) = 24.93, p > .05$; RMSEA = .04; NNFI = .99; CFI = .99. The model explained 52% of students’ intentions to pursue science in future education. Additionally, the relationships within the model were invariant across gender; that is, using
multi-sample path analysis, fit indices provided support that model fit the data equally for each gender, $\chi^2[df = 16, N = 342] = 24.93. p > .05; \text{NNFI} = .99; \text{CFI} = .99; \text{RMSEA} = .04; \text{GFI} = .99; \text{NFI} = .98$. This study provided subject-specific support for an SDT process model in which an environmental factor (i.e., teacher support) predicted needs-satisfaction for autonomy and competence, science motivation, and ultimately intention to pursue a science-related career.

**Summary and limitations of previous process models.** The motivational process models to date support a predictive multi-stage relationship from environmental support of autonomy to needs-satisfaction of autonomy and competence to autonomous motivation, and from autonomous motivation to achievement, persistence, and intentions to pursue subjects later on in life. In other words, there is empirical support that autonomous motivation serves as a mediator between students’ perceptions of autonomy and competence and observable behavioral outcomes. In the three studies that used academic achievement as the final stage in the process model, 10% to 28% of the variance was explained by the models.

However, there are three factors that challenge how well these studies will generalize to the present study. First, as mentioned, the needs-satisfaction scales that were included in the previous literature were largely adapted from different domains (i.e., work and athletic domains) and have not been validated. As a result, these relationships may rest upon measures of autonomy and competence that are not psychometrically sound for secondary students. Second, all five models relied predominately on samples of European descent—in Canada or in a rural American school. Therefore, the process model findings may not generalize to students of color and students in urban settings. Last, no process model within an academic context has included SDT’s third basic psychological need—relatedness. In other words, there is no evidence that all three basic psychological needs put forward by self-determination theorists contribute to pro-academic outcomes. More research is needed in each of these three areas.

**The Present Study**

As discussed, studies of motivational process models based on SDT lack a validated measure of needs-satisfaction, a diverse sample of secondary students, and the inclusion of relatedness as a third basic psychological need. In this study, I aim to fill these gaps in the existing literature. Therefore, the purpose of this study is to explore high school students’ autonomous motivation, the antecedents and consequents of their motivation, and the strength of a broadened process model for different subgroups of students who vary by gender and race/ethnicity.

I propose to test a similar process model (see Figure 1) with SDT using a diverse, urban high school population. Like previous models, this model is multi-stage with autonomy and competence in Block 1; unlike previous models, but in accord with SDT, I add relatedness as a third need to Block 1. In Block 2 is autonomous motivation, which leads to achievement in Block 3. The autonomous motivation to achievement pathway has been studied in process models, but more broadly, previous research has shown an inconsistent relationship between these constructs. Thus, this design will address important next steps in the SDT literature.

Five questions guide this study. First, what are the structural validity and reliability of scores on the Basic Psychological Needs Satisfaction (BNS) Scale, and the Academic Motivation Scale (AMS)? As described, measures of needs-satisfaction have not been sufficiently validated, especially in the secondary school contexts. In order to make claims on a process model, I
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hypothesize that both BNS and AMS will show adequate structural validity and reliability within the current sample.

Second, do levels of autonomy, competence, relatedness, autonomous motivation, and achievement differ among gender, racial/ethnic, and grade level subgroups? That is, are there subgroup gaps in needs-satisfaction and motivation that mirror achievement gaps? Although there is considerable research supporting mean-level differences in achievement among racial/ethnic groups and between genders, there is less evidence for grade level differences. In accord with previous research, I hypothesize that European American and Asian American students will have higher achievement than African American and Latino students, and that females will have higher achievement than males; however, I do not expect to find differences among grade levels in achievement. I also expect autonomy, competence, relatedness, and autonomous motivation—as hypothesized antecedents to achievement—to have the same pattern of gender and racial/ethnic differences.

Third, what are the interrelationships among needs-satisfaction, motivation, and academic achievement? Based on tenets of SDT, I expect the basic needs of autonomy, competence, and relatedness to significantly predict autonomous motivation and achievement. Fourth, how well do the data fit a structural equation model (SEM) in which needs-satisfaction predicts autonomous motivation, which in turns predicts actual school achievement (see Figure 8) tested without controlling for previous achievement and controlling for previous achievement? Fifth, how well do the data fit the same structural equation model in samples disaggregated by race/ethnicity and gender?

The comparison of mean-level differences in needs-satisfaction, autonomous motivation, and achievement among subgroups (the second research question) and comparing process models among subgroups (the fifth research question) afford two conceptually distinct analyses. That is, do the relationships among variables (i.e., the predictive power and fit of the process models) hold across subgroups, and do the subgroups have similar levels of reported needs-satisfaction, autonomous motivation, and achievement? First, if the relationship among the variables is the same for all subgroups and those subgroups have different mean-levels of the aforementioned variables, then mean comparisons will be meaningful and significant, but the process models will show similar levels of fit and predictive validity. However, if the relationships among the examined variables are not the same, then process models will not show the same fit and predictability of achievement. The latter finding would be evidence for different models and variables for different subgroups.

**Method**

**Participants**

The sample consisted of 863 students from an urban high school in the Western United States. Participant subgroup details are shown in Table 1. English-only learners made up 70% \((n = 612)\) of respondents, whereas 14% \((n = 122)\) were reclassified fluent English proficient, 9.2% \((n = 80)\) were initially fluent English proficient, and 6.9% \((n = 60)\) as English learners. One thousand, nine-hundred and sixty-one students returned a survey. Students excluded from the final sample were those without both 2010 and 2011 GPA from the high school (including all of the 9th graders, \(n = 531\)); those who omitted an entire core motivation scale \((n = 88)\); and those who identified as a member of a racial group outside of the focal four groups (i.e., Native
American or Other/Mixed; \( n = 479 \)). In total, 1,098 students were removed. For students with incomplete responses on either the BNS or AMS, single imputation was used. Single imputation organizes the item responses by patterns of missing data so as to perform missing-value regressions (StataCorp, 2007).

**Measures**

The study used two scales, the Basic Needs Satisfaction Scale (BNS) and the Academic Motivation Scale (AMS), and academic achievement. Academic achievement was measured using school grades, which were obtained from district records. District records provided students’ GPA, which represents an average of all high school report card cards and ranged from 0 to 4.0.

**Basic Psychological Needs Satisfaction Scale (BNS).** The BNS (Leone, 1995), which was originally adapted from Ilardi, Leone, Kasser, and Ryan’s (1993) measure of needs-satisfaction, is a 21-item scale that assesses needs-satisfaction: (a) competence (6 items), (b) autonomy (7 items), and (c) relatedness (8 items). Participants respond to each item on a 7-point Likert scale (1 = *Not at all true*, 4 = *Somewhat true*, 7 = *Very true*). Scores are calculated by averaging scores within a scale after reverse coding negatively-worded items. Example items include, “Most days I have a sense of accomplishment from my schoolwork” (competence); “My feelings are taken into consideration at high school” (autonomy); and “I really like the people I go to school with” (relatedness). Alpha coefficients found in university student samples by Faye and Sharpe (2008) and Gagne (2003), respectively, were acceptable but sometimes less than desirable: Autonomy = .67 and .69; Competence = .66 and .71; and Relatedness = 0.81 and .86. Although no formal validation studies have been conducted, all three subscales have been shown to be positively and significantly related to motivation (e.g., Faye & Sharpe, 2008; Gagne, 2003).

**The Academic Motivation Scale (AMS).** Using a 7-point Likert scale (1 = *Does not correspond at all*, 4 = *Corresponds moderately*, 7 = *Corresponds exactly*), the AMS (Vallerand et al., 1992, 1993) is a 28-item scale that assesses high school students’ motivation and includes seven sub-scales assessing three types of intrinsic motivation (i.e., knowledge, accomplishment, stimulation), three types of extrinsic motivation (i.e., identified, introjected, external regulation), and amotivation. On this scale, participants are asked “Why do you go to school” and use the verbal and numerical anchors to respond to explanations such as, “Because I experience pleasure and satisfaction while learning new things” (intrinsic-to know); Because eventually it will enable me to enter the job market in a field that I like” (extrinsic-identified); Because I want to show myself that I can succeed in my studies” (extrinsic-introjected); “Because I need at least a high-school degree in order to find a high-paying job later on” (extrinsic-external regulation); and “I can't see why I go to school and frankly, I couldn't care less” (amotivation).

Scores on the English version of the AMS have been shown to have adequate levels of reliability, factorial validity (Vallerand et al., 1992), and concurrent validity with other motivational measures (Vallerand et al., 1993). The AMS has been used in studies with a wide range of age groups and geographic settings (Faye & Sharpe, 2008). In line with previous research (Vansteenkiste et al., 2009), an autonomous motivation score was created by averaging scores on the three intrinsic motivation subscales and the extrinsic-identified motivation scale, and a controlled motivation score was created by averaging scores on the introjected-extrinsic and external-extrinsic subscales. Using this method, Vansteenkiste et al. (2009) obtained
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internal consistency estimates of .88 and .84 for autonomous and controlled motivation scores, respectively. This organization of subscales has been supported using principal component analysis (Vansteenkiste et al., 2009).

Procedure

Data collection occurred from February to April 2011. Teachers used a full class period to introduce and administer a 16-page survey to the students. The BNS and AMS were the first two scales on the survey. Teachers were instructed by the researchers to assure students of the anonymity of their responses. Students and teachers were not compensated for their participation. School administration collected the surveys, and the researchers secured the data. The school district provided achievement and demographic information from the school records. School records and survey responses were matched using unique student identification codes. The data were compiled into one dataset and analyzed in Stata 10 (StataCorp, 2007). Then, composite variables were created from individual items. The data—in both electronic and hardcopy form—were secured in a locked laboratory.

Results

Preliminary Analyses

Descriptive statistics for the AMS scale, for the original and reduced BNS scale, and for achievement are shown in Table 2. Subscale means for self-reported variables fell between 3.84 and 5.20, with standard deviations fall between .78 and 1.57. All constructs were minimally and negatively skewed (-.11 to -.87) and kurtosis values ranged from 2.40 to 3.60. Intercorrelations are shown in Table 3. For all analyses, p-values below 0.01 are considered statistically significant.

Reliability. The reliability of BNS subscale scores in the whole sample were below .63 for autonomy and competence, but higher for relatedness (see Table 2). Individual items that decreased reliability estimates were removed, resulting in the removal of all negatively-worded items. The reduced subscales consisted of 3 items each for autonomy, 3 items for competence and 4 items for relatedness. For all three subscales, the reduced version yielded slightly higher reliability coefficients for the scores for the total sample (see Table 2), and estimates for scores for the gender and racial/ethnic subgroups were similar (see Table 4).

The reliability of AMS scores was examined at two levels, the four autonomous motivation subscales individually and the combined autonomous motivation scale. All coefficients were .80 or higher (see Table 2). As shown in Table 4, alpha coefficients for scores on all four subscales and on the combined scale were also acceptable across subgroups, ranging from .75 to .91.

Factor Structure. Using confirmatory factor analysis (CFA), I examined the three-factor structure of BNS based on the original model and the reduced model. I also examined two levels of the AMS—this is, Level 1 included a seven-factor structure and Level 2 included a one-factor structure of autonomous motivation. CFA enables the analysis and testing of theoretical models that explain relationships among manifest variables (Fairchild et al., 2005). CFA was chosen because the factor structures (i.e., three-factor structure for the BNS and the four-factor at Level 1 and one-factor structure at Level 2 for the AMS) are based on underlying theories and empirical support (e.g., Ryan & Deci, 2000a; Vansteenkiste et al., 2009). Alternately stated,
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because a pre-determined pattern was available to test, CFA was a more appropriate analysis than exploratory factor analysis.

Estimations of fit were based on the recommendations of Hair, Black, Babin, and Anderson (2010), Byrne (2001, 2006), and Thompson (2004); the non-normed index (NNFI), the comparative fit index (CFI; Bentler, 1990), the standardized root mean square of approximation (RMSEA), standardized root mean square residual (SRMR), and chi-square to degrees of freedom were used to determine fit. NNFI and CFI at or above .92, RMSEA and SRMR at or below .08, and $x^2/df$ between 1 and 2 are considered adequate fit statistics. The RMSEA is an absolute index that assesses lack of fit due to model misspecification and provides a measure of discrepancy per degrees of freedom (Browne & Cudeck, 1993). The CFI is an incremental index and represents the improvement of fit of a hypothesized model over a model in which all variables are considered uncorrelated (Bentler, 1990). The NNFI is an incremental fit index that includes a penalty for the addition of parameters. The SRMR, an absolute measure of fit, represents the standardized difference between the observed and predicted correlation (Hu & Bentler, 1998).

**BNS.** The CFA for the original BNS—three factors each comprised of six to eight items—had poor fit at the item level for both NNFI and CFI, although the RMSEA and SRMR values were in the acceptable range (see Table 5). Using the reduced item-set, a CFA resulted in an improved fit (see Table 5) for the total sample (three of four fit statistics). The reduced-item three-factor structure also had acceptable fit in four fit statistics for the subsamples based on racial and gender subgroups. Thus, the reduced-item BNS was used for structural analyses.

**AMS.** CFAs were run at the item level (Level 1; four factors each with individual items loading) and at the subscale level (Level 2; autonomous motivation with four subscales loading) for AMS scores. The item-level CFA was run only for the whole sample and three of four fit statistics were in the acceptable range (see Table 6). All fit statistics at subscale level were more than adequate, with one exception. For females, the RMSEA estimate remained outside the acceptable threshold at .10. Based on the results from CFA, the original AMS scale was used for structural analyses.

Comparing mean-level needs-satisfaction, autonomous motivation, and achievement across subgroups. To determine if there were significant between-group differences for gender, race, and grade level, analyses of variance (ANOVAs) were conducted for all variables in the process model (Tables 7, 8, and 9). Effect sizes were calculated to measure the magnitude of the differences among groups on basic needs, autonomous motivation, and achievement. Olejnik and Algina (2003) recommended partial eta-squared for effect size testing within ANOVA, and Moore and McCabe (2003) and Olejnik and Algina (2000) recommended .01, .06, and .14 as thresholds for small, medium, and large effect sizes, respectively. Tables 7, 8, and 9 show means, standard deviations, effect sizes of needs-satisfaction, autonomous motivation, and achievement in gender, racial, and grade level subgroups, respectively. For some comparisons in academic achievement among racial subgroups, Cohen’s $d$ is reported (see Table 10).

**Gender.** As shown in Table 7, gender groups showed no significant differences in autonomy, competence, or relatedness using the reduced-item three factor scale. Although females had statistically significantly higher autonomous motivation, 2010 GPA and 2011 GPA,
the effect sizes were small (see Table 7). All effect sizes based on male and female means, as measured by Cohen’s $d$, were below .26.

**Race/ethnicity.** Comparisons of the racial subgroups on the six variables yielded no meaningful differences, except on academic achievement (Tables 8 and 10). Autonomy, competence, and relatedness were measured using the reduced-item three factor scale. The most meaningful differences were in 2010 GPA and 2011 GPA. European American and Asian American students had meaningfully and significantly higher average GPAs than African American and Latino students in 2010 GPA and 2011 GPA (Table 10). Other significant differences among racial groups were on relatedness and autonomous motivation, but the effect sizes were small. With both relatedness and autonomous motivation, the magnitude of the differences among racial/ethnic groups was in the small range.

**Grade levels.** Comparisons of grade level were also examined (Table 9). With the exception of 2010 GPA, there were no significant differences among grade levels. For 2010 GPA, 10th grade students had higher achievement than both 11th and 12th grade students, but the effect sizes were small. Moreover, this advantage disappeared in the subsequent school year.

In sum, subgroup differences in needs-satisfaction of autonomy, competence, and relatedness were non-significant or small across subgroup comparisons. The same was true for autonomous motivation across subgroups. Significant differences in achievement occurred between genders and grade levels, but they were small in practical significance. The most meaningful differences where the disparities in achievement across racial groups.

**Examine the relationship patterns among needs-satisfaction, motivation, and academic achievement.** The relationships among needs-satisfaction, autonomous motivation, and achievement as proposed by SDT were examined. Multiple linear regression analyses were used to determine what variables, including need-satisfaction and autonomous motivation, were significant predictors of academic achievement, as measured by their GPA.

Correlations among variables are shown in Table 3. Autonomy, competence, and relatedness showed statistically significant correlations with autonomous motivation and 2010 GPA. Autonomy was not significantly correlated to 2011 GPA. In other words, the average levels of autonomy for high-achieving students are not significantly different than that of low-achieving students. Even though autonomy was significantly related to 2011 GPA, this relationship was weaker than competence and relatedness with 2011 GPA.

Although the correlation between autonomous motivation and 2011 GPA was statistically significant, it showed little practical significance. That is, autonomous motivation explained only 1% of the variance in 2011 GPA. In general, the relationships among needs-satisfaction, autonomous motivation, and achievement were positive.

**Testing the Predictive Relationship to Achievement**

My fourth research question was related to the relationship among the variables as outlined in Figure 1. I used structural equation modeling (SEM) to test the fit of the model to the data in the total sample and in gender and racial ethnic subgroups. A multivariate statistical technique, SEM is used in non-experimental designs to test theoretical causal pathways among latent constructs (Shumacker & Lomax, 1996). In other words, SEM is a confirmatory technique to examine “the plausibility of theoretical models that might explain the interrelations among a set of variables” (Hu & Bentler, 1999, p. 2). Like fit statistics used for CFA, chi-square to
degrees of freedom, RMSEA, NNFI, SRMR, and CFI were used to examine the fit of the model. A satisfactory or good fit would be indicated by a non-significant chi-square statistic, a value less than or equal to .10 for the RMSEA and SRMR, and a value greater than or equal to .90 for the NNFI and CFI. Models with acceptable fit indices provide support for the inclusion and orientation of the variables in the model in question.

In the model, autonomy, competence, and relatedness are endogenous variables, and autonomous motivation and achievement are exogenous. Previous achievement was not controlled in the first set of model runs, but was controlled in the second set of runs. The same analytical and statistical strategy used to examine the process model in six subgroups: (a) females, (b) males, (c) African Americans, (d) Asian Americans, (e) European Americans, and (f) Latinos. That is, I ran the SEM with and without controlling for achievement for all four racial groups and both gender groups.

**Model runs without controlling for 2010 GPA.** Table 11 shows the parameter estimates, significance levels, and variance explained in predicting autonomous motivation and achievement. For the total sample, autonomy, competence, and relatedness explained 30% of the variance in autonomous motivation. Competence was the only significant contributor to autonomous motivation. The model in its entirety explained 1% of the variance in 2011 GPA. Fit indices for these models are reported in Table 12. Although the CFI and SRMR were generally in the acceptable range, the NNFI and RMSEA were not for any of the models.

Across subgroups, fit indices ranged considerably (see Table 12). Although CFI was acceptable for all subgroups, NNFI and RMSEA were acceptable only for male and African American subgroups. SRMR was acceptable for all subgroups with the exception of the Asian American subgroup. In short, fit indices suggest a better fitting model for males than for females, and for African Americans than for Asian Americans.

Trends in parameters statistics and variance explained emerged in the subgroup comparisons of the same model. In the model variation without 2010 GPA (see Table 11), autonomy was not a significant predictor of autonomous motivation in any model and all of the parameter estimates were less than .08. However, competence was a significant predictor in all of the models with substantial estimates ranging from .38 to .55. Relatedness was only significant in the model for males and African Americans. Variance explained in autonomous motivation ranged from ranged 21% in the Asian American subsample to 38% in the Latino America subsample. Variance explained in 2011 GPA ranges from 0% in the male subsample to 7% in the European American subsample. In all of the models, autonomy, competence, and relatedness accounted for more than 20% of the variance in autonomous motivation, but autonomous motivation accounted for between 1% and 7% of the variance in 2011 GPA.

**Model runs controlling for 2010 GPA.** Next, I ran the model controlling for 2010 GPA. Parameter estimates are shown in Table 13, and fit statistics and variance explained of autonomous motivation and 2011 GPA are shown in Table 14. In this model, the fit is considerably weaker than without 2010 GPA. No fit statistics fall within the acceptable range. Twenty-six percent of the variance in autonomous motivation is explained when the whole sample is included. Although 72% of the variance in 2011 GPA is explained in the model, 2010 GPA is by and large the driver behind that result.
With previous achievement included in the model (Table 14), all fit statistics across all subgroups fall outside of the acceptable range. As shown in Table 13, variance explained in autonomous motivation ranged from 18% in the African American subsample to 33% in the Latino subsample. Variance explained in 2011 GPA ranges from 61% in the African American subsample to 76% in the female subsample.

Although these models—especially those incorporating previous achievement—fall short of robust, patterns emerged in comparing subgroups. Parameter estimates between competence and autonomous motivation were consistently strong and significant (ranging from .38 to .55) beyond the contribution of prior year achievement. Conversely, in no subgroup was the parameter estimate between autonomy and autonomous motivation significant. In all racial and gender groups, 2010 GPA was by far the strongest predictor of 2011 GPA.

Discussion

This study examined motivation and its antecedents as a potential contributing factor in low and disparate rates of achievement among subgroups of high school students. Within SDT and process models in particular, there is a need to better understand the relationships among students’ perceptions of needs-satisfaction (i.e., autonomy, competence, and relatedness), motivational qualities, and achievement. The hypothesized model was chosen to reexamine the variables of autonomy and competence of previous models and include relatedness as a third need based on SDT. This study used a diverse, urban sample to contribute to a research literature that is especially sparse in examinations of multiple racial and gender subgroups.

The goals of this study were five-fold: (a) examine the factor structure and reliability of scores of the Basic Psychological Needs Satisfaction (BNS) Scale and the Academic Motivation Scale (AMS); (b) compare levels of autonomy, competence, relatedness, autonomous motivation, and achievement among gender, racial, and grade level subgroups; (c) explore the correlational patterns among autonomy, competence, relatedness, autonomous motivation, and academic achievement; (d) test a motivational SEM wherein needs-satisfaction predicts autonomous motivation, which in turns predicts actual school achievement (see Figure 1); and (e) test motivational SEMs among racial and gender subgroups.

To summarize, reliability and structural validity of BNS scores were outside the acceptable range (despite a reduction in the item-set), whereas reliability and structural validity for the AMS scores were acceptable. Subgroup differences in needs-satisfaction of autonomy, competence, and relatedness, and autonomous motivation were non-significant or small in magnitude across all subgroup comparisons. Differences in achievement across racial groups were the most pronounced—in magnitude and statistical significance. Autonomy, competence, and relatedness showed statistically significant correlations with autonomous motivation and 2010 GPA, but autonomy was not significantly correlated to 2011 GPA. The correlation between autonomous motivation and 2011 GPA was statistically significant but showed little practical significance.

The model run without accounting for previous achievement showed adequate fit but accounted for 1% of the variance in achievement. Subgroup analysis showed higher fit statistics for males and African Americans than for other groups; variance explained for achievement was highest in European Americans. The model run accounting for 2010 achievement explained 72% of the variance in 2011 achievement, but this was largely driven by 2010 achievement.
Subgroup analysis showed poor fit across all groups, and variance explained for achievement ranged from 61% in Latinos and African Americans to 76% in females.

**Measurement of Needs-Satisfaction and Autonomous Motivation**

**BNS.** At the heart of SDT are three needs constructs: (a) autonomy, (b) competence, and (c) relatedness. However, in the study, the use of the BNS provided little efficacy to examine these constructs. Using the original 21-item scale, alpha coefficients and CFA showed unacceptable levels of reliability and structural validity. Exploratory factor analysis was used for item elimination. Despite reducing the original scale to 10 items to afford a stronger fit in the CFA, the alpha coefficients for competence and autonomy were less than ideal at best and unacceptable at worst.

Autonomy and competence (and a related construct, self-efficacy) have been measured in adolescents and secondary school students with more acceptable reliability estimates. For example, Diseth, Danielsen, and Samdel (2012) used an autonomy scale from the Learning Climate Questionnaire, and they developed a 4-item competence scale and a self-efficacy scale. Scores from their Norwegian sample of 240 8th and 10th grade students yielded reliability estimates of .76 for autonomy, .80 for competence and .90 for self-efficacy. Similarly, using a sample of 117 vocational students (Mage = 18.5 years), Krapp (2005) found reliability estimates of .93 for autonomy scores and .83 for competence scores. Therefore, more reliable measures of competence and autonomy in adolescent students exist, and the use of competence and autonomy subscales in the BNS prevented more dependable analyses in the present study.

Further, subsequent research questions in the present study rest on the foundation of appropriate measurement of theoretical constructs. The conclusions based on the results from the BNS merit caution. Future research must first establish valid and reliable scores of measures for autonomy, competence, and relatedness prior to testing multi-staged models.

**AMS.** In contrast to the BNS, AMS scores were reliable—as defined as alpha coefficients in the acceptable range for the whole sample and across subgroups. These findings align with previous research in African American college students (Cokley et al., 2001) and Canadian high school students (Vallerand et al., 1997). In the present study, the extrinsic-identified subscale (α = .80) was higher than in previous studies (e.g., Cokley, 2003; Cokley et al., 2001; Vallerand et al., 1992). Although the present study included only four of the seven factors of the AMS, the factor structure of these four subscales was supported by fit statistics; the RMSEA and SRMR were in the acceptable range and the NNFI and CFI indices were approaching the acceptable range. In sum, in accord with previous studies, the AMS at Level 1 showed adequate reliability and structural validity in the sample, which suggests that items are contributing to four conceptually distinct factors.

The Level 2 factor structure with extrinsic-identification, intrinsic-knowledge, intrinsic-stimulation, and intrinsic-accomplishment feeding into autonomous motivation was supported, as all four fit statistics were within the acceptable range, which is consistent with previous research (Vansteenkiste et al., 2009). Reliability for the AMS Level 2 scores were acceptable (α = .80). Support for the structural validity of Level 2 and reliability of scores was also found in previous studies (e.g., Vansteenkiste et al.). Reliability estimates and CFA at Level 2 for the AMS suggest that autonomous motivation as comprised of intrinsic-accomplishment, intrinsic-
knowledge, intrinsic-stimulation, and extrinsic-identification is a reliable construct and aligned
with the theoretical model in both the total sample and its subgroups.

In sum, within this sample, the BNS—even in a reduced form—is problematic from a
measurement standpoint, whereas the AMS factor structures at Level 1 and 2 show acceptable fit
and reliability. Thus, the subsequent analyses with the AMS can be considered stronger than
those with the BNS.

**Group Differences in Needs-Satisfaction and Autonomous Motivation**

Based on SDT, one would expect mean levels of needs-satisfaction and autonomous
motivation to parallel the mean levels in achievement. That is, if one group is significantly lower
in achievement than another, then the same relationship should exist in needs-satisfaction and in
autonomous motivation. This overall pattern was not found in the present study. Even though
hypothesized achievement gaps existed, no statistically significant and meaningful differences
were found in needs-satisfaction and autonomous motivation across gender, racial, and grade
level subgroups. Consistent with extensive corpus of research on racial achievement gaps, this
sample shows gaps in achievement with European American and Asian American students
presenting with significantly and meaningfully higher mean levels of achievement than those of
their African American and Latino peers. Contrary to my hypothesis, the results do not support
parallel patterns of achievement and proposed motivational antecedents. It is possible that poor
measurement was a factor with regard to mean level needs-satisfaction, yet it is also possible that
among students, various subgroups perceive needs-satisfaction differently than other subgroups.
For example, group work or all-school rallies may promote relatedness in some populations more
so than in others. Next, I speculate on explanations within each subgroup.

**Gender.** The present study, in accord with multiple previous studies (Cokley, 2003,
Renaud-Dube et al., 2010; Vallerand et al., 1997, & Vansteenkiste et al., 2009), found that
females reported higher levels of autonomous motivation than did males. This suggests that
across secondary school and into tertiary school, there is a difference in the way schooling
environments engender autonomous and volitional motivation in males and in females. Yet,
because needs-satisfaction between males and females did not differ, one might speculate that
other variables and other units of analysis would explain disparate rates of achievement and
autonomous motivation. I suspect that schooling and larger society may socialize students
during and before secondary school to identify with school and its activities differently based on
gender. Further, value-expectancy theory (Eccles & Wigfield, 2000) may provide more
theoretical application than the SDT’s emphasis of the satisfaction of needs. In Eccles and
Wigfield’s model, gender role stereotypes and the beliefs and behaviors of socializers predict
students’ schemata, goals, and choices.

**Race.** Gaps in average achievement among racial groups are a heavily researched topic.
The self-determination theorist might speculate that gaps in the needs-satisfaction or in levels of
autonomous motivation would occur because the schooling environment has not promoted those
perceptions. These data, however, do not provide evidence that discrepancies in autonomous
motivation, autonomy, or competence contribute to achievement gaps. In fact, European
Americans showed significantly lower autonomous motivation than all other racial groups,
including African American and Latino students.
Regarding needs-satisfaction, there were no significant differences among subgroups in autonomy or competence, which also contradicts hypotheses based on SDT. Differences did exist for relatedness; African American and Asian American students did show incrementally—yet statistically significant—lower perceptions of relatedness than did European American and Latino students. Kuperminc et al. (2004) also found significantly lower perceptions of relatedness for African American students than for European American or Latino students (Asian Americans were not included in the study). Previous research supports relatedness and belonging as being predictive of student success (Niemic & Ryan, 2009), and these data show a similar connection. That African American and Asian American students report lower relatedness than their peers is noteworthy, and I speculate that their lower levels of relatedness contribute to their academic performance in this environment.

**Grade level.** Although not focal to the present study, I examined differences among grades 10, 11, and 12 as a check for confounding variables. A large majority of non-significant findings suggests that grade level is not a pertinent variable to understanding basic needs or autonomous motivation. As a result, grade level was not a variable included into SEMs.

**Testing the Predictive Relationship to Achievement**

SDT posits that needs-satisfaction, autonomous motivation, and achievement should be highly correlated. However, past research has yielded mixed results (e.g., Cokley et al., 2001, Jang et al., 2009). The present study also resulted in mixed support for SDT. Satisfaction of all three needs strongly correlated with autonomous motivation with correlations above .32. Competence showed the strongest predictive relationship to autonomous motivation, but the relationships of autonomy, competence, and relatedness to achievement were considerably lower than previously found by Jang et al. (2009) in their first study, yet comparable to what they found in their fourth study. Last, autonomous motivation did significantly predict 2011 GPA, but contrary to SDT, this relationship was weak and suggests little to no predictive validity.

In sum, the relationships among autonomy, competence, relatedness, autonomous motivation, and achievement are positive and in the predicted direction. The strength of these relationships, however, is considerably lower than those found by SDT researchers (Fortier et al., 1995; Guay & Vallerand, 1996). Thus, these results to do not support the notion that competence, relatedness, and autonomy—as measured by the BNS—are strong requisite predictors of subsequent achievement. Taken further, the limited magnitude of these relationships does not support the exclusivity of these three basic needs, and these results open the possibility for other self-perceptions to be included in subsequent analysis of contributions to achievement. For example, other social-cognitive theories include perceptions of self-worth (Covington, 1984) and attributions of success or failure (Weiner, 1974).

**Testing the Process Model Among Sample and Subgroups**

The present process model did not replicate the predictive relationship of needs-satisfaction and autonomous motivation to achievement. The process models of Fortier et al. (1995), Guay and Vallerand (1996; Study 1), and Hardre and Reeve (2003) explained 28%, 13%, and 43% of the variance in achievement, respectively. As mentioned, the studies by Fortier et al. and Guay and Vallerand relied on French Canadian samples, and Hardre and Reeve relied on a rural, primarily European American sample. None of the studies controlled for previous achievement or included relatedness as part of needs-satisfaction.
In contrast to previous models, the present model run without accounting for previous achievement explained 1% of the variance in 2011 achievement. Autonomy was not a significant predictor of autonomous motivation. The same model run using only the European American sample explained 7% of the variance in 2011 achievement. The results suggest that in the given sample, there may be other variables that contribute more strongly to subsequent achievement and would thus be components to a better fitting and more predictive process model.

There is a paucity of motivational process models that have examined more than two racial groups. Comparisons of fit indices of the same process model across four racial subgroups and two gender subgroups suggest that there are notable differences. For example, the model with African American students had more acceptable fit statistics than any other racial group. As mentioned, the model with European American students explained more variance than any other racial group. Only for males and African American students was the relationship between relatedness and autonomous motivation significant. This latter finding suggests that the social-cognitive processes that students undergo to develop an impetus to identify or act may differ across subgroups. Further, I speculate that a more model excluding autonomy and with stronger, more validated measures might produce stronger, more predictive results.

Commonalities across subgroups also emerged. For all subgroups, autonomy had non-significant parameter estimates with autonomous motivation, and competence had significant parameter estimates with autonomous motivation. These patterns support the findings of Jang et al. (2009, Study 4) and the notion that competence has a stronger relationship to achievement behaviors than autonomy. They also bolster the notion across social-cognitive motivational theories that one’s expectation of can-do-it-ness (be it called efficacy or competence) is a consistent predictor for actual success (e.g., Bandura, 1997).

Controlling for achievement. The present study was unable to replicate the findings of a similar model. Guay and Vallerand (1996; Study 2) used a similar research design to the present study – that is, controlling for previous achievement. And like the present study, achievement was measured using school records. In Guay and Vallerand’s model controlling for achievement, their model explained 50% of the variance in subsequent achievement, and the relationship between autonomous motivation and achievement remained significant. In addition, autonomy and competence remained significant predictors of autonomous motivation. Lastly, fit statistics were acceptable.

In contrast, the present study showed unacceptable fit indices and explained more variance. With prior achievement included in the model, competence and relatedness were significant predictors of autonomous motivation, and autonomous motivation was significant predictor of subsequent achievement, although parameter estimates in the aforementioned pathways were lower than in Guay and Vallerand’s model (1996; Study 2).

Differences in the Guay and Vallerand’s study (1996; Study 2) and the present one are three-fold. As mentioned, Guay and Vallerand’s model was a four-stage model, which included needs-satisfaction support from parents, teachers, and administrators, and it did not include relatedness in the needs-satisfaction phase (Block 2). Lastly, the sample was comprised of French-Canadian adolescents, and race membership was not reported.
Incorporating previous achievement into the process model shifted all of the fit statistics outside of the acceptable range and drastically increased the variance explained in 2011 GPA. For all models—using the whole sample and for each subgroup—competence was significantly related to autonomous motivation, even after controlling for previous achievement, and previous achievement accounted for a large majority of the variance in 2011 GPA. The path from autonomous motivation to subsequent achievement was significant only for the whole sample and for European Americans. The pathway from relatedness to autonomous motivation was significant for males and African Americans, whereas the pathway from autonomy to autonomous motivation was not significant for any subgroup.

Thus, keeping in mind the limitations of the model fit and measurement limitations, these data may provide preliminary support that beyond previous achievement, relatedness may predict autonomous motivation more strongly for specific subgroups than for others; that across all groups, autonomy does not predict autonomous motivation; and that across all subgroups, competence predicts autonomous motivation. Lastly, unacceptable fit indices suggest that the variables included and their hypothesized interrelations did not match those in the present sample. Future research may test this model with the exclusion of relatedness.

The strategy of controlling for previous achievement is intended to better isolate the contribution of the motivational variables to explaining achievement, yet with unacceptable fit indices, interpretation of pathways should be cautioned. I speculate that this analytical strategy would be more fruitful in intervention studies when researchers can actively manipulate a variable between measurements. In the present study, no manipulation was made.

Reevaluating SDT

The correlational relationships and process models show weak support for SDT. These data do not suggest that autonomy and relatedness make up two-thirds of a set of universal, unwavering nutrients to motivation. Moreover, these data do not support a strong relationship between autonomous motivation and achievement. One possible explanation is that perceptions of autonomy and relatedness and highly identified extrinsic motivation and forms of intrinsic motivation are not crucial at the high school level, especially in an environment that rewards individual work and compliance rather than group-oriented, creative tasks. In other words, the more extrinsic subtypes of motivation, such as external and introjected may also suffice to motivate students in this particular environment. In layperson terms, it is possible that at this school perceptions of autonomy, relatedness, and autonomous motivation are nice for one to have, rather than perceptions one needs to have in order to achieve academically.

The most consistent finding in the present sample and its subsamples is the relationship of competence to autonomous motivation and to achievement. These findings support the emphasis in multiple prominent social-cognitive motivation theories. Along with SDT, attribution theory (Wiener, 1974), self-efficacy theory (Bandura, 1997), and expectancy-value theory (Wigfield & Eccles, 2000) incorporate the appraisal of one’s ability to accomplish a task into their models of motivation.

Taking a larger step back, these data suggest that in one high school context in the Northwestern United States, among the three hypothesized needs, only competence and relatedness predicted subsequent achievement. Moreover, the motivational model that incorporated all three basic needs and autonomous motivation provided little insight to student
NEEDS-SATISFACTION AND ACHIEVEMENT

achievement. As the corpus of research extends to additional conditions and populations, the practical significance of SDT’s qualities of motivation—that is, amotivation, controlled motivation, and autonomous motivation—should become clearer. In its current state, the research does not show a strong relationship between the latter two variables and students’ ability to achieve.

The present model did not meaningfully predict academic achievement as previous motivational models have (Fortier et al., 1995; Guay & Vallerand, 1996). An explanation of racial group differences is not supported by the present findings, because the model of European Americans (Table 11) accounted for only 7% of the variance in achievement. An explanation of poor measure of needs-satisfaction may have contributed to the predictive power of autonomy, competence, and relatedness to autonomous motivation. However, poor measurement of needs-satisfaction does not explain the weak relationship between autonomous motivation and achievement. I speculate that, in the context of the 21st century, American schooling, autonomous motivation – the feeling of volition and endorsement of one’s actions – may not predict academic achievement. As mentioned, in an environment of compliance and completion, it is possible that autonomous motivation is not an asset or pro-academic perception.

Limitations
The primary limitations of this study are four-fold. First, the sample contains a selection bias; participants who were present on the day of data collection were able to self-select into participating. As a result, students who were absent or did not feel motivated to complete the survey were not included. As a result, it is possible that the most unmotivated students were excluded, which could result in a restriction of range in the constructs assesses. Second, although SEM is theoretically a causal process test, the data are correlational. That is, regardless of the strength of the results, one can only speculate on the directionality of the relationships among the variables. It is possible that rather the needs-satisfaction and autonomous motivation causing achievement, it is high achievement that leads students to perceive their needs are satisfied and to feel motivated.

Third, the scope of the study examines one school setting rather than comparing schools settings where needs-satisfaction of students may differ. This approach omits the variation in units within the school and prevents comparisons among other whole-school units. Previous research suggests that motivation and its antecedents may be domain specific and consequently may vary across academic subjects (e.g., language arts versus science). Last, the variables examined may vary across time—within the day and across development—and yet the sampling method used in the proposed study treats them as stable constructs.

Conclusion
The problem of low and disparate achievement among high school students is well-defined. This study highlights the importance of valid and reliable measurement of psychological constructs before examining their relationships to achievement. In addition, this study provides evidence of the benefit of testing measures and process models across multiple demographic groups. Lastly, this study illuminates the importance of continually testing theories, even those that are highly esteemed and well established. In practice, the importance of motivation seems self-evident. Future research should seek to better operationalize needs-satisfaction, consider additional perceptions that predict achievement, and understand how and
why perceptions may vary across subgroups. However, understanding the ways in which motivation and its antecedents predict and fail to predict achievement in secondary schools is vital to shaping the classroom experiences and subsequent futures for the nation’s students.
References


NEEDS-SATISFACTION AND ACHIEVEMENT


Ilardi, B. C., Leone, D., Kasser, T., & Ryan, R. M. (1993). Employee and supervisor ratings of motivation: Main effects and discrepancies associated with job satisfaction and
NEEDS-SATISFACTION AND ACHIEVEMENT


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Steinberg (Eds.), *Studying minority adolescents: Conceptual, methodological, and theoretical issues* (pp. 89-109). Mahwah, NJ: Lawrence Erlbaum Associates.


Table 1
*Sample Size and Age Means and Standard Deviations of Total and Subgroup Samples*

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<tr>
<th></th>
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<th>% of Total</th>
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<th>SD</th>
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<td>102</td>
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<td>339</td>
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<td>12th Grade</td>
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<td>35.11%</td>
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<td>17.46</td>
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Table 2
Descriptive Statistics for Original BNS Scale, AMS Scale, and Achievement

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<th>Mean</th>
<th>SD</th>
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<th>Kurtosis</th>
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<td>0.78</td>
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<td>Competence (original)</td>
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<td>1.00</td>
<td>-0.60</td>
<td>3.36</td>
<td>0.57</td>
</tr>
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<td>Relatedness (original)</td>
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<td>0.81</td>
</tr>
<tr>
<td>Autonomy (reduced)</td>
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<td>-0.57</td>
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<td>Extrinsic-Identification</td>
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<td>2011 GPA</td>
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<td>0.81</td>
<td>-0.58</td>
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<td>–</td>
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</table>

Note. With the exception of GPA (range 1 to 4), all variables have a range of 1 to 7.
<table>
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<tr>
<td>2011 GPA (Autonomous Knowledge)</td>
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<td>0.70</td>
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<td>0.89</td>
<td>0.03</td>
<td>0.74</td>
<td>0.02</td>
<td>0.45</td>
<td>0.35</td>
<td>0.47</td>
</tr>
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<td>0.02</td>
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**Table 3**: Correlation Matrix among Learning Constructs and Achievement.
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<tr>
<th></th>
<th>Autonomous Motivation</th>
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<th>Accomplishment</th>
<th>Intrinsic-Stimulation</th>
<th>Extrinsic-Stimulation</th>
<th>Relatedness</th>
<th>Competence</th>
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<td>88'0</td>
<td>98'0</td>
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<tr>
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<table>
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<tr>
<td>Latino</td>
<td>91%</td>
<td>102%</td>
<td>215%</td>
<td>41.5%</td>
<td>41.5%</td>
<td>115%</td>
<td>88.3%</td>
<td>31.3%</td>
</tr>
<tr>
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<td>215%</td>
<td>41.5%</td>
<td>41.5%</td>
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<td>102%</td>
<td>215%</td>
<td>41.5%</td>
<td>41.5%</td>
<td>115%</td>
<td>88.3%</td>
<td>31.3%</td>
</tr>
<tr>
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<td>91%</td>
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<td>215%</td>
<td>41.5%</td>
<td>41.5%</td>
<td>115%</td>
<td>88.3%</td>
<td>31.3%</td>
</tr>
<tr>
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<td>102%</td>
<td>215%</td>
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<td>41.5%</td>
<td>115%</td>
<td>88.3%</td>
<td>31.3%</td>
</tr>
<tr>
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<td>91%</td>
<td>102%</td>
<td>215%</td>
<td>41.5%</td>
<td>41.5%</td>
<td>115%</td>
<td>88.3%</td>
<td>31.3%</td>
</tr>
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</table>

Table 4: Alpha Coefficients of Salient Constructs of Total and Subgroup Samples
Table 5

*Confirmatory Factor Analysis Fit Statistics for Original and Reduced BNS*

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<td><strong>CFI</strong></td>
<td><strong>RMSEA</strong></td>
<td><strong>SRMR</strong></td>
<td></td>
</tr>
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<td>.79</td>
<td>.07</td>
<td>.07</td>
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</tr>
<tr>
<td>Reduced BNS</td>
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<td><strong>CFI</strong></td>
<td><strong>RMSEA</strong></td>
<td><strong>SRMR</strong></td>
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<td>0.01</td>
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<tr>
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<td>0.95</td>
<td>0.06</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
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<td>0.97</td>
<td>0.05</td>
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<td>0.96</td>
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*Confirmatory Factor Analysis Fit Statistics for AMS at Level 1 and Level 2*

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<td>.07</td>
<td>.06</td>
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<table>
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<td>0.04</td>
<td>0.01</td>
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<td>0.99</td>
<td>0.08</td>
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<td>0.00</td>
<td>0.01</td>
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<tr>
<td>European American</td>
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<td>1.00</td>
<td>0.00</td>
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<td>0.00</td>
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<td>0.99</td>
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<td>0.03</td>
<td>0.01</td>
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### Needs Satisfaction and Achievement

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<th>SD</th>
<th>N</th>
<th>ANOVA</th>
<th>Partial η²</th>
<th>F</th>
<th>P</th>
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<th>Female</th>
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**Table 7:** Means, standard deviations, and effect sizes of BNS and AMS by GPA by Gender.
NEEDS-SATISFACTION AND ACHIEVEMENT

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<th>0.8</th>
<th>1.0</th>
<th>1.2</th>
<th>1.4</th>
<th>1.6</th>
<th>1.8</th>
<th>2.0</th>
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<tbody>
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<td>115</td>
<td>88</td>
<td>102</td>
<td>73</td>
<td>216</td>
<td>0.73</td>
<td>216</td>
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<td>119</td>
<td>11</td>
<td>216</td>
<td>4.19</td>
<td>12</td>
<td>216</td>
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<td>1.5</td>
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<td>119</td>
<td>11</td>
<td>216</td>
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<td>216</td>
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<td>6.7</td>
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<td>119</td>
<td>11</td>
<td>216</td>
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<td>216</td>
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<td>11</td>
<td>216</td>
<td>4.19</td>
<td>12</td>
<td>216</td>
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Table 8: ANOVA, Mean, Standard Deviations, and Effect Sizes of BVS and ANS by Racial Group.
### Table 9

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<th>GPA</th>
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<th>10.0</th>
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<th>2.86</th>
<th>0.74</th>
<th>0.03</th>
<th>3.03</th>
<th>3.93</th>
<th>0.78</th>
<th>3.93</th>
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<td>10.0</td>
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<td>0.03</td>
<td>3.03</td>
<td>3.93</td>
<td>0.78</td>
<td>3.93</td>
<td>0.78</td>
</tr>
<tr>
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<td>10.0</td>
<td>10.0</td>
<td>3.55</td>
<td>1.72</td>
<td>0.88</td>
<td>4.88</td>
<td>1.44</td>
<td>2.82</td>
<td>1.44</td>
<td>2.82</td>
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<td>4.00</td>
<td>10.0</td>
<td>10.0</td>
<td>3.55</td>
<td>1.72</td>
<td>0.88</td>
<td>4.88</td>
<td>1.44</td>
<td>2.82</td>
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<td>0.88</td>
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<td>4.88</td>
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<td>10.0</td>
<td>3.55</td>
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<td>0.88</td>
<td>4.88</td>
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<td>2.82</td>
<td>1.44</td>
<td>2.82</td>
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<td>10.0</td>
<td>10.0</td>
<td>3.55</td>
<td>1.72</td>
<td>0.88</td>
<td>4.88</td>
<td>1.44</td>
<td>2.82</td>
<td>1.44</td>
<td>2.82</td>
</tr>
</tbody>
</table>

With the exception of GPA (range 1 to 4), all variables have a range of 1 to 7.
Table 10  
*Effect Size Comparison for Achievement, by Racial/Ethnic Groups*

<table>
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<tr>
<th>Comparison</th>
<th>Cohen's d</th>
<th>2010 GPA</th>
<th>2011 GPA</th>
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<tbody>
<tr>
<td>European American – African American</td>
<td>1.38</td>
<td>1.48</td>
<td></td>
</tr>
<tr>
<td>European American – Latino</td>
<td>1.00</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Asian American – African American</td>
<td>1.09</td>
<td>1.10</td>
<td></td>
</tr>
<tr>
<td>Asian American – Latino</td>
<td>0.74</td>
<td>0.86</td>
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Table 11
Parameter Estimates and Variance Explained of Tested SEM Without Accounting for Prior Achievement in Total and Subgroup Samples

<table>
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<tr>
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<th></th>
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<th>AM→AchT2</th>
<th>AM R^2</th>
<th>AchT2 R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A→AM</td>
<td>C→AM</td>
<td>R→AM</td>
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</tr>
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<td>0.10</td>
<td>0.07*</td>
<td>0.30</td>
<td>0.01</td>
</tr>
<tr>
<td>Female</td>
<td>0.07</td>
<td>0.48*</td>
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<td>0.09*</td>
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<td>0.02</td>
</tr>
<tr>
<td>Male</td>
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<td>0.51*</td>
<td>0.15*</td>
<td>0.03</td>
<td>0.30</td>
<td>0.00</td>
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<td>0.01</td>
</tr>
<tr>
<td>European American</td>
<td>0.04</td>
<td>0.55*</td>
<td>0.12</td>
<td>0.11*</td>
<td>0.33</td>
<td>0.07</td>
</tr>
<tr>
<td>Latino</td>
<td>0.01</td>
<td>0.54*</td>
<td>0.14</td>
<td>0.14</td>
<td>0.38</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*p < .01

AchT1 = 2010 GPA, AchT2 = 2011 GPA, A = Autonomy, C = Competence, R = Relatedness, AM = Autonomous Motivation
<table>
<thead>
<tr>
<th>Language</th>
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<th>Female</th>
<th>Total Sample</th>
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<td></td>
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<tr>
<td>Spanish</td>
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<td></td>
</tr>
<tr>
<td>African American</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>European American</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latino</td>
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<td></td>
<td></td>
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</table>

Table 1: Indices of Fit for Confirmatory Factor Analysis of Needs-Satisfaction and Achievement.
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<th>C</th>
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<th>Reliability</th>
<th>Achievement</th>
<th>Autonomy</th>
<th>C</th>
<th>Connectedness</th>
<th>Reliability</th>
<th>Achievement</th>
<th>Autonomy</th>
<th>C</th>
<th>Connectedness</th>
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<td>0.22</td>
<td>0.24</td>
<td>0.02</td>
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<td>0.02</td>
<td>0.07</td>
<td>0.02</td>
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<td>0.01</td>
<td>0.01</td>
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<td>0.01</td>
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<td>0.01</td>
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<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Total Sample</td>
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<td>0.07</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
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</tr>
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Table 13: Parameter Estimates and Variance Explained of Measured Achievement for Total and Subgroup Samples
Table 14
Fit Indices of Tested SEM Accounting for Prior Achievement in Total and Subgroup Samples

<table>
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<tr>
<th>Goodness of Fit Indices</th>
<th>NNFI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>SRMR</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
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<td>0.21</td>
<td>656.20</td>
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<td>&lt;.01</td>
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<td>0.32</td>
<td>0.20</td>
<td>323.06</td>
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<td>&lt;.01</td>
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<td>Males</td>
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<td>0.22</td>
<td>352.62</td>
<td>7</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>African Americans</td>
<td>0.27</td>
<td>0.66</td>
<td>0.31</td>
<td>0.19</td>
<td>145.94</td>
<td>7</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Asian Americans</td>
<td>0.12</td>
<td>0.59</td>
<td>0.39</td>
<td>0.23</td>
<td>116.84</td>
<td>7</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>European Americans</td>
<td>0.30</td>
<td>0.67</td>
<td>0.34</td>
<td>0.21</td>
<td>312.62</td>
<td>7</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Latinos</td>
<td>0.22</td>
<td>0.64</td>
<td>0.35</td>
<td>0.22</td>
<td>135.14</td>
<td>7</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>
Figure 1. Proposed process model of students’ perceptions of basic needs, autonomous motivation, and achievement.
Figure 2. The SDT Components of Qualities of Motivation and Corresponding Subtypes as Adapted from Ryan & Deci (2009)

NEEDS-SATISFACTION AND ACHIEVEMENT

- Accomplishment
- Knowledge
- Skill
- Identified
- Integrate
- External
- Amotivated

- Autonomous Motivation
- Controlled Motivation
Figure 3. Hardre & Reeve (2003) Motivational Process Model.
Figure 4. Fortier, Vallerand, & Guay's (1995) Motivational Process Model.
Figure 3. Guay and Valente's (1996) Motivational Process Model.
NEEDS-SATISFACTION AND ACHIEVEMENT

Figure 6: Vallerand, Fontaine, and Guay’s (1997) Motivational Model.
Figure 7. Lavigne, Vallerand, & Miquelon's (2007) Motivational Model.
Note: A = Autonomy, C = Competence, R = Relatedness, E = Extrinsic-Identified, IK = Intrinsic-Knowledge, IS = Intrinsic-Stimulation, IA = Intrinsic-Accomplishment

Figure 8. Proposed model showing both latent constructs and contributing items
### Basic Psychological Needs Scale (BNS)

When I Am At High School...

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. I feel like I can make a lot decisions on how my schoolwork gets done.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. I really like the people I go to school with.</td>
<td>O O O O O O O</td>
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<tr>
<td>3. I do not feel very competent when I am at school.</td>
<td>O O O O O O O</td>
<td></td>
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<tr>
<td>4. People at school tell me I am good at schoolwork.</td>
<td>O O O O O O O</td>
<td></td>
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<tr>
<td>5. I feel pressured at high school.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>6. I get along with people at high school.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
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<tr>
<td>7. I pretty much keep to myself when I am at work.</td>
<td>O O O O O O O</td>
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<tr>
<td>8. I am free to express my ideas and opinions at high school.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I consider the people I go to school with to be my friends.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10. I have been able to learn interesting new skills and knowledge at high school.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. When I am at high school, I have to do what I am told.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Most days I feel a sense of accomplishment from my schoolwork.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. My feelings are taken into consideration at high school.</td>
<td>O O O O O O O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. In my school, I do not get much of a chance to show how capable I am.</td>
<td>O O O O O O O</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
15. People at high school care about me.

16. There are not many people in high school that I am close to.

17. I feel like I can pretty much be myself at high school.

18. The people I go to school with do not seem to like me much.

19. When I am working at school I often do not feel very capable.

20. There is not much opportunity for me to decide for myself how to go about my schoolwork.

21. People in school are pretty friendly towards me.
Academic Motivation Scale (AMS)

WHY DO YOU GO TO SCHOOL?
Using the scale below, indicate to what extent each of the following items presently corresponds to one of the reasons why you go to school.

<table>
<thead>
<tr>
<th>Does not correspond at all</th>
<th>Corresponds a little</th>
<th>Corresponds moderately</th>
<th>Corresponds a lot</th>
<th>Corresponds exactly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

WHY DO YOU GO TO SCHOOL?

1. Because I need at least a high school degree in order to find a high-paying job later on.
   - O O O O O O O

2. Because I experience pleasure and satisfaction from learning new things.
   - O O O O O O O

3. Because I think a high-school degree will help me better prepare for the career I have chosen.
   - O O O O O O O

4. Because I really like going to school.
   - O O O O O O O

5. Honestly, I don't know; I really feel that I am wasting my time in school.
   - O O O O O O O

6. For the pleasure I feel while surpassing myself in my studies.
   - O O O O O O O

7. To prove to myself that I am capable of completing my high-school degree.
   - O O O O O O O

8. In order to obtain a more prestigious degree later on.
   - O O O O O O O

9. For the pleasure I experience when I discover new things.
   - O O O O O O O

10. Because eventually it will enable me to enter the job market in a field I like.
    - O O O O O O O

11. Because for me, school is fun.
    - O O O O O O O

12. I once had good reasons to go to school; however, now I wonder whether I should continue.
    - O O O O O O O
13. For the pleasure I experience while surpassing myself in one of my personal accomplishments.

14. Because of the fact that when I succeed in school, I feel important.

15. Because I want to have the "good life" later on.

16. For the pleasure I experience when I am broadening my knowledge in subjects that I like.

17. Because it will help me make a better choice regarding my career orientation.

18. For the pleasure I experience when I have discussions with interesting teachers.

19. I can't see why I go to school, and frankly, I couldn't care less.

20. For the satisfaction I feel when I am in the process of accomplishing difficult academic tasks.

21. To show myself that I am an intelligent person.

22. In order to have a better salary later on.

23. Because my studies allow me to continue to learn about many things that interest me.

24. Because I believe a high school education will improve my ability as an employee.

25. For the thrill I experience while reading about various interesting subjects.

26. I don't know; I can't understand what I am doing at school.

27. Because it provides me personal satisfaction in my quest for excellence in my studies.

28. Because I want to show myself that I can succeed in my studies.