THE RELATIONSHIP BETWEEN TEACHERS’ AUTONOMY SUPPORT AND
STUDENTS’ INTRINSIC MOTIVATION AND ACADEMIC ACHIEVEMENT
IN MIDDLES GRADES MATHEMATICS:
A SELF-DETERMINATION THEORY PERSPECTIVE

by

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DEDICATION

This work is dedicated to the people most responsible for its inception and completion.

My parents taught me the value of hard work and the importance of doing a job thoroughly and to the best of my ability. Thank you for introducing me to many different social contexts during my early formative years, which allowed me to express my capacities in a variety of settings (e.g., art class, Bible Drill, organized sports, piano lessons, and Tae Kwon Do) and begin to understand how one’s natural ability and one’s effort relate to self-actualization. Your belief in my abilities cultivated a deep and abiding sense of self-efficacy early in my life; thank you for that priceless gift. Thank you for consistently being models of hard work, pragmatism, and humility.

I once read a book in which the author dedicated the work to his wife and extolled her by exclaiming, “You have said ‘Yes’ to every dream.” When I read that nearly 15 years ago I thought, “One day, I would like to have a wife who says ‘Yes’ to every dream.” Wendy, thank you for your love, understanding, patience, and enduring grace over the last ten years, and especially the last three. Thanks for believing in me. I love you.

The prospect of being able to provide a richer array of opportunities for my two amazing, wonderful children contributed a great deal to my motivation and inspiration over the last three years. I could not ask for two more precious children. I look forward to seeing your lives continue to unfold and blossom.
Finally, this work is dedicated to all educators and those who influence the lives of children. May it provide some degree of insight into how we can interact with adolescents in ways that enrich their lives and facilitate a more benevolent society.
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Every teacher I have ever had, friends, family members, and many others have played an important role in getting me to where I am today. “No man is an island” unto himself (Donne, 1624); “I am a part of all that I have met” (Tennyson, 1842).

***

“It is the glory of God to conceal a matter; to search out a matter is the glory of kings.”
Proverbs 25:2 (NIV)

“Whatever you do, work at it with all your heart, as working for the Lord”
Colossians 3:23 (NIV)

“Perhaps no single phenomenon reflects the positive potential of human nature as much as intrinsic motivation.”
Ryan & Deci (2000b, p. 70)

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ABSTRACT

KENNETH A. WHALEY
THE RELATIONSHIP BETWEEN TEACHERS’ AUTONOMY SUPPORT AND
STUDENTS’ INTRINSIC MOTIVATION AND ACADEMIC ACHIEVEMENT IN
MIDDLE GRADES MATHEMATICS: A SELF-DETERMINATION THEORY
PERSPECTIVE
Under the direction of DR. SHERAH B. CARR

Research within self-determination theory (SDT) suggests that students benefit
when teachers support their autonomy. While a large body of research exists regarding
the relationship between SDT and positive educational outcomes, there is a paucity of
research concerning the relationship between autonomy-supportive instruction and
adolescent learning in a middle school mathematics setting. This study applied SDT to
investigate the relationship between seventh grade students’ (N = 362) perceptions of
their math teacher’s autonomy support and their intrinsic motivation and academic
achievement in prealgebra. Participants were drawn from an ethnically and
socioeconomically diverse suburban public middle school in the southeastern United
States and completed three self-report questionnaires to assess (a) their prealgebra
teacher’s autonomy support; (b) their interest/enjoyment, value/usefulness,
pressure/tension, and perceived competence in prealgebra; and (c) their self-determined
academic motivation.

Hierarchical multiple regression identified the most parsimonious model of
teacher autonomy support. Interest/enjoyment significantly predicted teacher autonomy

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support and explained the greatest amount of unique variance, followed by
value/usefulness and perceived competence. Pressure/tension, relative autonomy, and
academic achievement were unrelated to teacher autonomy support at every level of the
hierarchical regression, although pressure/tension and relative autonomy were
significantly related to teacher autonomy support outside of the regression model as
bivariate correlations. Academic achievement was unrelated to teacher autonomy
support, but it was significantly related to pressure tension and perceived competence as
bivariate correlations.

This study found evidence to support the SDT claim that motivation lies upon a
continuum of relative autonomy in which some forms of motivation are more
autonomous and self-determined than others. Students with a more autonomous
orientation for learning experienced less pressure and tension and greater
interest/enjoyment, value/usefulness, perceived competence, and academic achievement
than participants who had less self-determined academic motivation. Teacher autonomy
support was more closely related to intrinsic motivation and identified regulation than it
was to introjected regulation and external regulation. The finding that teacher autonomy
support accounted for the greatest amount of unique variance in the regression model and
was the most powerful predictor of middle school students’ intrinsic motivation in
mathematics holds important implications for theory and practice.
CHAPTER 1

Introduction to the Study

Background of the Study

Middle grades mathematics teachers face the challenge of creating meaningful learning experiences for students as they explore the field of mathematics (NCTM, 2000). Teachers can enhance students’ learning experiences by cultivating students’ motivational resources. Mathematics educators identify students’ motivation as an important construct related to the quality of their learning, academic achievement, and emotional well-being (Brahier & Speer, 2011; Middleton & Jansen, 2011; Middleton & Spanias, 1999). Many variables that affect students’ desire to learn mathematics are influenced by teachers (Brahier & Speer, 2011; Fiore, 1999; Frenzel, Pekrun, & Goetz, 2007; Middleton & Jansen, 2011; Middleton & Spanias, 1999). Math teachers can communicate with students and design lessons in ways that nurture students’ interests, curiosity, competence, self-efficacy, and goal-development (Brahier, 2011; Ford, 1992).

Middle grades mathematics teachers also face the challenge of working with young adolescents. Anderman and Maehr (1994) cited motivation as a problem among middle grade students, and research suggests that students’ motivation and interest in school tends to decrease between elementary and high school (Archambault, Eccles, & Vida, 2010; Eccles & Midgley, 1989; Eccles, Midgley, & Adler, 1984; Gottfried, Fleming, & Gottfried, 2001; Harter, 1982; Martinez, 2010, pp. 157-159; Middleton & Spanias, 1999). Contextual and intrapersonal factors contribute to students’ motivation
and achievement in school (Hardre & Reeve, 2003; Hidi & Harackiewicz, 2000). The classroom culture that math teachers foster is one contextual factor that influences students’ motivation and achievement. Although the sample of their study only included 24 math teachers, Matteson, Swarthout, and Zientek (2011) found that both novice and veteran mathematics teachers had difficulty “identifying motivational strategies related to pedagogy and curriculum” and concluded that “more professional development needs to be focused on educating teachers…on their role in affecting students’ motivation and methods they can utilize in the classroom” (p. 295). In view of research that suggests that contextual factors affect students’ motivation to learn mathematics, this study applied self-determination theory to investigate the relationship between teachers’ motivating styles and seventh grade students’ intrinsic motivation and academic achievement in a prealgebra course.

Theoretical Framework

Self-determination theory (SDT) espouses that people are dynamic organisms that require specific environmental nutriments in order to develop into integrated, healthy beings (Deci & Ryan, 1985, 2000, 2008a; Ryan & Deci, 2000a, 2000b, 2002, 2011). Though consisting of five minitheories, the SDT metatheory posits that humans have basic psychological needs for autonomy, competence, and relatedness. When these three needs are met, people develop their sense of self and identity. When these three needs are thwarted, people’s abilities and talents fail to fully develop, preventing self-actualization into one’s full potential. SDT has proven to be a useful theory in a variety of life domains including education, medicine, work, parenting, religious participation, sports therapy and psychology, environmentalism, close relationships, and organizational reform
Self-determination theory is a theory of motivation that focuses on social contexts that either nurture or undermine individuals' psychological development and well-being (Deci & Ryan, 2000, 2008a; Niemiec & Ryan, 2009; Ryan & Deci, 2000b, 2002). According to SDT, students are more likely to develop autonomous self-regulation and intrinsic motivation in autonomy-supportive environments. In educational settings, autonomy support involves a teacher taking students' perspective; acknowledging students' feelings and perceptions; providing students with information and opportunities for choice; minimizing the use of control, criticism, demands, and pressure; and praising mastery (Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Assor, Kaplan, & Roth, 2002; Black & Deci, 2000; Reeve, 2002, 2009; Reeve & Jang, 2006; Reeve, Ryan, Deci, & Jang, 2008).

**Teachers' Motivating Styles**

Teachers' motivating styles affect students' motivation (Reeve, 2009). Within the SDT framework, an autonomy-supportive motivating style is contrasted with a controlling motivating style (Assor et al., 2005; Assor et al., 2002; Deci & Ryan, 1987; Reeve, 1998, 2002, 2009; Reeve & Halusic, 2009; Reeve & Jang, 2006). Research suggests that autonomy-supportive instructional practices enhance students' motivation, engagement, development, learning, performance, and psychological well-being; in contrast, controlling motivating styles tend to have a diminishing effect on these important educational outcomes (Assor et al., 2005; Assor et al., 2002; Black & Deci, 2000; Boggiano, Flink, Shields, Seelbach, & Barrett, 1993; Deci, Nezlek, & Sheinman, 2011; Deci & Ryan, 2002, 2008b; Reeve, 2009; Ryan & Deci, 2000b, 2011; Su & Reeve, 2011).
1981; Grolnick & Ryan, 1987; Reeve, 2002, 2009; Reeve, Bolt, & Cai, 1999; Reeve & Halusic, 2009; Reeve & Jang, 2006; Reeve et al., 2008; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004; Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005). Despite this corpus of research, teachers often do not use autonomy-supportive instruction either because they do not understand how (Reeve, 2009; Reeve & Jang, 2006; Reeve & Halusic, 2009; Reeve et al., 2008), because they do not believe that it is a superior method to motivate students (Reeve, 1998, 2002, 2009), or because of various pressures teachers experience that conduce toward using a controlling motivating style (Pelletier, Séguin-Lévesque, & Legault, 2002; Reeve & Assor, 2011).

Developing interesting learning activities, helping students find personal value and meaning in tasks, teaching for mastery, and creating a classroom culture that reduces students’ anxiety each respectively foster students’ intrinsic motivation. Teachers facilitate students’ intrinsic motivation within the mathematics classroom by designing lessons that are interesting (Hidi & Renninger, 2006; Krapp, 2002, 2005; Middleton & Jansen, 2011; Schraw & Lehman, 2001), incorporating students’ interests into learning activities (Alexander, 2005; Brown, 2006; Brown, Mir, & Warner, 1996; Dewey, 1913; McCombs, 2001; Whaley, 2012), and providing cognitive autonomy support (Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008). Students often question the value of what they are asked to learn in mathematics. While curriculum with visible connections to the world enhances students’ motivation and conceptual understanding (Luke & Elkins, 2002), teachers can support students’ autonomy by providing a rationale during an uninteresting activity (Jang, 2008; Reeve & Halusic, 2009; Reeve, Jang, Hardre, & Omura, 2002). Perceived competence is a predictor of intrinsic motivation (Black &
Deci, 2000; Deci & Ryan, 2000; Deci et al., 1981; Ryan & Deci, 2000b, 2002); autonomy-supportive instruction involves teaching for mastery to enable students to feel competent (Niemiec & Ryan, 2009; Reeve, 2002; Skinner & Belmont, 1993). Teaching for mastery helps reduce students' math anxiety (Fiore, 1999; Geist, 2010; Hembree, 1990). Teachers can use noncontrolling language to help reduce pressure and anxiety within their classrooms as well (Assor et al., 2005; Reeve, 2009; Reeve & Assor, 2011; Reeve & Halusic, 2009; Reeve & Jang, 2006; Reeve et al., 2008).

Statement of the Problem

While there is a large body of research regarding the relationship between SDT and positive educational outcomes (Guay, Ratelle, & Chanal, 2008; Niemiec & Ryan, 2009; Reeve, 2002, 2009; Reeve & Assor, 2011; Su & Reeve, 2011), there is a need for more research on the relationship between autonomy-supportive instruction and adolescent learning in a middle school mathematics setting. Much of the research on SDT in educational settings has been done at the elementary (Assor et al., 2002; Deci, Nezlek et al., 1981; Grolnick & Ryan, 1987; Koestner, Ryan, Bernieri, & Holt, 1984), high school (Hardre & Reeve, 2003; Jang, Reeve, & Deci, 2010; Jang, Reeve, Ryan, & Kim, 2009; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Vallerand, Fortier, & Guay, 1997), or collegiate and graduate levels (Black & Deci, 2000; Reeve, 1998; Jang, 2008; Reeve et al., 2002; Vansteenkiste et al., 2004; Williams & Deci, 1996). Only four published SDT research studies have used seventh grade students as research participants (Assor et al., 2002; Tsai et al., 2008; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009; Whaley, 2012). Only one of these studies was conducted in a middle school setting (Whaley, 2012), only one used American students as a sample (Whaley, 2012), and only two were
conducted in mathematics classrooms (Tsai et al., 2008; Whaley, 2012). The lone math-based SDT study conducted with American middle school students had a sample of only 10 students (Whaley, 2012). In sum, very little SDT research conducted with seventh grade students has occurred in American middle schools, and very little has involved mathematics content (Ross & Bergin, 2011, p. 57).

Beginning in 2008, middle school students throughout the entire school district in which this research study took place completed the Student Engagement Instrument (SEI). Students completed the SEI twice, once at the beginning of the school year and again several months later. The SEI is a five-point Likert-scale questionnaire designed to measure students’ cognitive, psychological, and affective engagement (Appleton, Christenson, Kim, & Reschly, 2006; Betts, Appleton, Reschly, Christenson, & Huebner, 2010). The SEI consists of six subscales that measure students’ engagement; two of the subscales are Intrinsic Motivation and Control and Relevance of School Work. As students throughout the school district progressed from sixth through eighth grade, they reported decreases on the Intrinsic Motivation and Control and Relevance of School Work subscales of the SEI each successive school year, beginning in 2008. However, it is unclear why students reported decreases in intrinsic motivation and in their perceptions of control and relevance of schoolwork as they progressed through three years of middle school. At the time of this study, no empirical studies had investigated possible variables related to these students’ intrinsic motivation.

**Purpose of the Study**

The purpose of this study was to apply self-determination theory to investigate the relationship between students’ perceptions of teacher autonomy support and students’
intrinsic motivation and academic achievement in a seventh grade prealgebra mathematics course. This study used multiple regression to find the linear model most closely associated with teacher autonomy support and seventh grade students’ intrinsic motivation and academic achievement in mathematics. This study investigated the relationship between students’ perceptions of their teachers’ autonomy support and (a) students’ intrinsic motivation in learning mathematics as measured by the levels of interest/enjoyment, value/usefulness, pressure/tension, and perceived competence they experienced; (b) students’ autonomous self-regulation; and (c) students’ mathematical achievement.

Research Questions

The research questions addressed in this study are listed below.

1. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

2. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

3. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement?
4. Is there a statistically significant relationship between teacher autonomy support and seventh grade students' perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement?

5. Is there a statistically significant relationship between teacher autonomy support and seventh grade students' autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement?

6. Is there a statistically significant relationship between teacher autonomy support and seventh grade students' academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation?

**Significance and Rationale**

Teachers affect students' learning, motivation, and academic performance. As those involved in the cultivation of human potential, it is of great value for educators to understand the instructional practices and classroom milieu that either engender or undermine students' sense of identity, agency, purpose, and desire to achieve. According to SDT, instructional practices that satisfy students' basic psychological needs for autonomy, competence, and relatedness best facilitate the development of students' intrinsic motivation (Guay et al., 2008; Niemiec & Ryan, 2009; Reeve, 2009; Ryan & Deci, 2000b). The goal of this research was to contribute to the extant empirical literature on SDT that suggests that students benefit academically and developmentally when teachers support their autonomy. It is critical for educators to understand and utilize the
instructional practices that are the most liberating and intrinsically satisfying to students and those that enable students to achieve at their highest potential (Niemiec & Ryan, 2009; Ryan & Niemiec, 2009).

Limitations and Assumptions

This research was conducted at a public middle school located in a suburban metropolitan area of the southeastern United States. The middle school had a student population of 1,941 in grades six through eight. The sample of this study was 362 seventh grade students at this school. Although the population of the school was socioeconomically and ethnically diverse, it could be considered a limitation that the sample of this study only came from one middle school within the school district. Future research could include a sample of students from multiple middle schools with different socioeconomic, demographic, and Adequately Yearly Progress (AYP) achievement data than the middle school used in this study. However, the school in this study had a wide range of students along the socioeconomic spectrum. Forty-four percent of the school’s student population was enrolled in the free/reduced lunch program. Twenty-seven percent of the school’s student population qualified for the school district’s gifted education program. A more in-depth demographic description of the school’s student body and the sample used in this study is provided in Chapter 3.

The questionnaires used in this study were not administered by participants’ math teachers in order to help ensure honest, authentic responses from students. Students were encouraged to take their time in completing the questionnaires. Since students evaluated their teachers in some of the questionnaires, they were told that their responses would remain completely anonymous, that their teachers would not have access to their
responses, and that their course grade would not be affected by their responses. The questionnaires used in this study have been validated and used in multiple studies (e.g., Black & Deci, 2000; Deci, Eghrari, Patrick, & Leone, 1994; Hardre & Reeve, 2003; Jang, Reeve, Ryan, & Kim, 2009; McAuley, Duncan, & Tammen, 1989; Ryan & Connell, 1989; Ryan, Connell, & Plant, 1990; Williams & Deci, 1996). The researcher conducting this study was a seventh grade math teacher at the school where the study’s data was collected; the researcher did not know or teach any of the research participants.

The research was conducted during the first semester of the 2011-2012 school year. The first semester was 88 days, encompassing 18 weeks of the school calendar. While this was deemed an ample amount of time for teachers to influence students’ motivation and academic achievement in mathematics, future studies could utilize a longitudinal approach to examine the relationship between teacher autonomy support and student learning outcomes, as other studies have done (Jang et al., 2009, Study 4; Tsai et al., 2008; Vallerand et al., 1997; Williams & Deci, 1996).

The participants of this study were taught the same mathematics curriculum as predetermined by the public school district in which the study took place. The mathematics learning objectives and academic standards were the same for all seventh grade students, although it was contingent upon each individual classroom teacher to not deviate from teaching the prescribed mathematics content. All students were given two district-generated standardized multiple-choice tests based on the seventh grade mathematics curriculum. The test questions had been piloted in four previous school years and subsequently deemed valid and reliable by district-level administrators. However, no statistical data or empirical evidence was available to support the validity
and reliability of the standardized tests used to measure academic achievement in this study.

This study investigated the relationship between autonomy-supportive instruction and seventh grade students' intrinsic motivation and achievement in mathematics. It is assumed that autonomy-supportive instructional practices satisfy students' basic psychological needs and facilitate students' optimal performance more effectively than controlling instructional practices. However, there is a growing body of research suggesting that autonomy-supportive classroom conditions nurture students' autonomous motivation, facilitate optimal performance, and foster well-being (Deci & Ryan, 2000, 2008a, 2008b; Guay et al., 2008; Niemiec & Ryan, 2009; Reeve, 2009; Ryan & Deci, 2000b, 2002; 2011).

Summary

Teachers' motivating styles affect students' motivation, engagement, academic performance, psychological development and well-being, and capacity to internalize and self-regulate (Guay et al., 2008; Niemiec & Ryan, 2009; Reeve, 2009). Research suggests that students benefit when teachers support their autonomy; however, teachers often utilize controlling motivating styles (Reeve, 2009). Students' motivation and achievement in mathematics is a specific area of concern (Brahier & Speer, 2011; Middleton & Jansen, 2011; Middleton & Spanias, 1999). While there is a large body of research involving the relationship between autonomy-supportive instruction and positive educational outcomes, there is a dearth of research on the role that autonomy-supportive instruction plays within a middle school mathematics setting.
Definitions of Key Terms

The following terms will be used throughout this document.

*Academic achievement* – This refers to students’ academic performance. In this study, academic achievement was measured by students’ mean score from two standardized multiple-choice mathematics test. Students took the Interim I test nine weeks after the school year began and the Posttest I at the end of the semester (an 18-week time-period).

*Amotivation* – “The state of lacking the intention to act. When people are amotivated, either they do not act at all or they act passively...they go through the motions with no sense of intending to do what they are doing” (Ryan & Deci, 2002, p. 17).

*Autonomy* – “Autonomy refers to being the perceived origin or source of one’s own behavior. Autonomy concerns acting from interest and integrated values. When autonomous, individuals experience their behavior as an expression of the self” (Ryan & Deci, 2002, p. 8).

*Autonomy support* – “The interpersonal behavior one person provides to nurture another’s inner motivational resources and their true self-regulation of action” (Reeve et al., 2008, p. 230).

*Controlled regulation* – Engaging in behaviors “under interpersonal pressures or directly controlled by forces outside the self. When such forces regulate a person’s behavior, their behavior is considered *controlled* rather than autonomous” (Reeve et al., 2008, p. 224). Accordingly, “this does not constitute true self-regulation because the
person is regulated by the coercive or seductive forces rather than self-initiated, volitional, or self-endorsed regulation” (Reeve et al., 2008, p. 224).

Competition – “Competence refers to feeling effective in one’s ongoing interaction with the social environment and experiencing opportunities to exercise and express one’s capacities” (Ryan & Deci, 2002, p. 7).

External regulation – “External regulation is the least autonomous form of extrinsic motivation and includes the classic instance of being motivated to obtain rewards or avoid punishments” (Ryan & Deci, 2002, p. 17). “External regulation is in evidence when one’s reason for doing a behavior is to satisfy an external demand or a socially constructed contingency” (Ryan & Deci, 2002, p. 17).

Extrinsic motivation – Behaviors that are “focused toward and dependent on contingent outcomes that are separable from the action per se…With extrinsic motivation…people perceive the locus of initiation and regulation of their behavior to be external to themselves” (Ryan & Deci, 2002, p. 10).

Identified regulation – This “is a more self-determined form of extrinsic motivation, for it involves a conscious valuing of a behavioral goal or regulation, an acceptance of the behavior as personally important” (Ryan & Deci, 2002, p. 17). Additionally, “identification represents an important aspect of the process of transforming external regulation into true self-regulation” (Ryan & Deci, 2002, p. 17).

Intrinsic motivation – Behaviors “whose motivation is based in the inherent satisfactions of the behaviors per se, rather than in contingencies or reinforcements that are operationally separable from those activities” (Ryan & Deci, 2002, p. 10). Furthermore, “Intrinsic motivation represents a prototype of self-determined activity, in
that, when intrinsically motivated, people engage in activities freely, being sustained by the experience of interest and enjoyment” (Ryan & Deci, 2002, p. 10).

*Introjected regulation* – “Introjected regulation involves an external regulation having been internalized but not...truly accepted as one’s own. Introjection-based behaviors are performed to avoid guilt and shame or to attain ego enhancements and feelings of self-worth” (Ryan & Deci, 2002, p. 17).

*Integrated regulation* – “Integrated regulation provides the basis for the most autonomous form of extrinsically motivated behavior,” and “it results when identifications have been evaluated and brought into congruence with the personally endorsed values, goals, and needs that are already part of the self” (Ryan & Deci, 2002, p. 18).

*Relatedness* – “Relatedness refers to feeling connected to others, to caring for and being cared for by those others, to having a sense of belongingness both with other individuals and with one’s community” (Ryan & Deci, 2002, p. 7).

*Self-determination* – Individuals are self-determined when they are intrinsically, or autonomously, motivated (Ryan & Deci, 2002). When self-determined, individuals decide (or determine) for themselves their own goals, values, and behavior.

*Self-regulation* – “The regulation of behavior when people’s interests and values are the reason for acting....From the perspective of self-determination theory, this constitutes self-regulation” (Reeve et al., 2008, p. 224). “When autonomous in their self-regulation, students are self-initiating and persistent because the tasks they undertake are perceived as interesting or personally important to them” (Reeve et al., 2008, p. 225). The SDT conceptualization of self-regulation refers to behavioral self-regulation more than
cognitive self-regulation (e.g., metacognition), although being self-determined represents the highest level of self-reflection and awareness.
CHAPTER 2
Review of Related Literature

Introduction

Teachers’ motivating styles affect students’ motivation (Black & Deci, 2000; Benware & Deci, 1984; Grolnick & Ryan, 1987; Reeve, 1998, 2002, 2009; Reeve & Halusic, 2009; Reeve et al., 2002; Reeve et al., 2008; Vansteenkiste, Timmermans, Lens, Soenens, & Van den Broeck, 2008). Within self-determination theory (SDT), autonomy-supportive motivating styles are contrasted with controlling motivating styles (Assor et al., 2005; Assor et al., 2002; Deci, Nezlek, et al., 1981; Reeve, 1998, 2002, 2009; Reeve et al., 1999; Reeve et al., 2008; Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005). Research suggests that autonomy-supportive instructional practices enhance students’ motivation, engagement, development, learning, performance, and psychological well-being while controlling motivating styles have a diminishing effect on these important educational outcomes (Reeve, 2009). Despite this corpus of research, teachers often do not use autonomy-supportive instruction (Reeve, 2009; Reeve & Assor, 2011; Reeve & Halusic, 2009; Reeve et al., 2008). While research suggests that students benefit when teachers support their autonomy, there is a lack of research concerning the relationship between autonomy-supportive instruction and adolescent learning in a middle school mathematics setting.
Purpose

The purpose of this study was to apply self-determination theory to investigate the relationship between students' perceptions of teacher autonomy support and students’ intrinsic motivation and academic achievement in a seventh grade prealgebra course. This study used multiple regression to find the linear model most closely associated with teacher autonomy support and seventh grade students’ intrinsic motivation and academic achievement in mathematics. This study investigated the relationship between students’ perceptions of their teachers’ autonomy support and (a) students’ intrinsic motivation in studying mathematics as measured by the levels of interest/enjoyment, value/usefulness, pressure/tension, and perceived competence they experienced; (b) students’ autonomous self-regulation (i.e., students’ relative autonomy); and (c) students’ mathematical achievement.

Research Questions

The research questions addressed in this study are listed below.

1. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

2. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement?
3. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ perceived pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement?

4. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement?

5. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement?

6. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation?

*Search Strategy and Inclusion Criteria*

This chapter provides a detailed analysis of self-determination theory; describes the classroom conditions conducive to satisfying students’ psychological needs for autonomy, competence, and relatedness; highlights the educational benefits of autonomy-supportive instruction; and examines the nature of effective mathematics instruction among middle school learners. This review of literature analyzes the results of SDT research over three decades. Woven throughout this chapter are the findings of a meta-
analysis on autonomy-supportive interventions (Su & Reeve, 2011) and the findings of empirical literature reviews on SDT research within education (Guay et al., 2008; Reeve, 2009).

Well-established peer-reviewed journals, scholarly books, and reports published by reputable educational programs provided the basis for the research referenced in this chapter. Prominent authors within the fields of self-determination theory, mathematics education, and adolescent development were identified through extensive reading of the research literature within these respective fields. Many of the sources cited in this chapter were referenced, often frequently, in the extant research literature.

Self-determination theory has proven to be a useful theory in a variety of life domains including education, medicine, parenting, religious participation, sports therapy and psychology, close relationships, and organizational reform (Chirkov et al., 2011; Deci & Ryan, 2002, 2008b; Reeve, 2009; Ryan & Deci, 2000b; Su & Reeve, 2011). There have been hundreds of studies involving SDT within these domains over the last three decades. The research studies reviewed in this chapter only involve the application of SDT within the field of education.

Not all tenets of SDT are universally accepted. Namely, SDT’s assertion that humans have an innate psychological need for autonomy (Chirkov et al., 2011; Deci & Ryan, 2000; Reeve et al., 2008, pp. 227-228; Ryan & Deci, 2002, 2006; Ryan & Niemiec, 2009) has been opposed by some researchers, including behaviorists (e.g., Cameron & Pierce, 1994; Eisenberger & Cameron, 1996), cultural relativists (e.g., Cross & Markus, 1999; Iyengar & DeVoe, 2003; Markus & Kitayama, 2003), and post-modernists (e.g., Gergen, 1991; see Chirkov, 2009, and Ryan & Deci, 2006, for a
review). Empirical findings that counter these claims and offer support for the SDT position are included in this chapter.

Multiple contemporary theories concerning human motivation and achievement exist. This review of literature explores motivation through the lens of SDT, specifically. This chapter does not supply an in-depth analysis of other contemporary theories of motivation.

*Self-Determination Theory Overview*

Self-determination theory provides a framework for understanding human motivation. Drawing from humanistic theories of personality within the field of positive psychology (Angyal, 1941, 1965; Maslow, 1955, 1968, 1970, 1971; Martinez, 2010, pp. 165-167; Rogers, 1961, 1963, 1969; Schunk, 2011, pp. 351-356; Seligman & Csikszentmihalyi, 2000; Sheldon & Ryan, 2011) and cognitive theories of development (Piaget, 1971; Werner, 1948), SDT posits that people have an innate propensity toward growth, integration, and psychological well-being (Deci & Ryan, 2000, 2008a; Ryan & Deci, 2000a, 2000b, 2002). According to SDT, individuals are active and curious by nature. The exploratory behavior of infants offers evidence of an innate tendency to proactively engage one's environment and to actively integrate information. However, only when certain psychological needs are satisfied will natural tendencies toward healthy development, optimal functioning, and self-actualization be sustained.

Self-determination theory asserts that individuals' psychological well-being is contingent upon the quality of their social environment. Within this framework, people are seen as dynamic organisms that must be sustained by specific psychological nutriments in order to function at their highest level. Just as a tadpole requires particular
environmental resources in order to mature and develop, SDT theorizes that humans need to experience autonomy, competence, and relatedness in order to reach their fullest potential. The various social contexts (e.g., home, school) individuals encounter throughout life’s epochs provide the avenue through which these needs are either nourished or thwarted. Social contexts that fulfill individuals’ psychological needs for autonomy, competence, and relatedness provide the necessary environment for growth and development to occur, whereas social contexts that do not satisfy these needs undermine and forestall growth and development.

**Autonomy**

Autonomy refers to being the perceived source, or origin, of one’s own actions (Ryan & Deci, 2002). Autonomous behaviors, because they align with one’s interests and integrated values, emanate from the self and are endorsed by the self (Ryan & Deci, 2002). Accordingly, they involve an internal perceived locus of causality (deCharms, 1968) and are accompanied by a sense of volition (Niemiec & Ryan, 2009; Reeve, Nix, & Hamm, 2003). Autonomy can also be thought of as regulation by the self (Reeve et al., 2008; Ryan & Deci, 2006). Autonomous self-regulation of one’s own behavior embodies true self-regulation (Reeve et al., 2008).

The opposite of autonomy is heteronomy, or controlled regulation. Heteronomy refers to action that occurs without self-endorsement and involves an external force regulating one’s behavior (Ryan & Deci, 2002, 2006). When controlled, individuals attribute their actions to an external perceived locus of causality (deCharms, 1968).

Notions of independence, individualism, detachment, separateness, and selfishness are not synonymous with autonomy (Deci & Ryan, 2008a; Ryan & Deci,
One can be dependent and cooperative with others and still act out of interests and self-endorsed behavior (Ryan & Deci, 2000b, 2002, 2006). Autonomy refers to the experience of an internal perceived locus of causality and a sense of volition (Reeve et al., 2003; Ryan & Deci, 2000b); such feelings may occur independently or while carrying out behaviors requested by others, provided one fully endorses those behaviors (Ryan & Deci, 2000b, 2002). For example, a student could comply with a teacher’s request to complete an assignment because she sees the value that completing the assignment holds or because she enjoys working on the assignment.

**Competence**

Many motivational theories cite a relationship between perceived competence and motivation. In addition to SDT, drive (White, 1959), achievement goal (Nicholls, 1989), control (Skinner, 1995), expectancy-value (Eccles & Wigfield, 2002), and self-efficacy (Bandura, 1977, 1989, 1997) theories view perceived competence as one of the chief predictors of motivation, psychological well-being, and performance. According to these theories, humans feel motivated to engage in tasks when they feel efficacious with respect to those tasks.

Self-determination theory defines competence as the need to feel effective at a given task (Ryan & Deci, 2002). Competence also involves individuals’ desire to express and exercise their capacities (Ryan & Deci, 2002). According to Ryan and Deci (2002), the “need for competence leads people to seek challenges that are optimal for their capacities and to persistently attempt to maintain and enhance those skills and capacities through activity” (p. 7). Competence, therefore, is not conceived as a set of skills or
repertoire of knowledge per se, but instead refers to the feelings of effectiveness and success one experiences during task involvement (Ryan & Deci, 2002).

Relatedness

Relatedness as defined within SDT involves a sense of belonging and connectedness with others and refers to the quality of the interpersonal relationships within a given social setting (Deci & Ryan, 2000; Ryan & Deci, 2000b, 2002). Relatedness concerns the need to care for others and to be cared for by others, to feel accepted by others, and to be included within a community (Ryan & Deci, 2002). Relatedness does not refer to a desire for augmented social status or powerful titles, but rather the innate psychological need for belongingness and companionship (Ryan & Deci, 2002). In addition to SDT, other theories cite the importance of relatedness as it pertains to motivation and well-being (Baumeister & Leary, 1995; Guisinger & Blatt, 1994).

Summary

According to self-determination theory, humans’ natural developmental trajectory trends toward integration, growth, and self-actualization facilitated through active engagement with the surrounding environment. However, individuals’ immediate social contexts either support or hinder the degree to which their psychological needs for autonomy, competence, and relatedness are fulfilled. People’s motivation, development, and psychological well-being are nurtured insofar as these innate needs are satisfied (Chirkov et al., 2011; Deci & Ryan, 2000, 2002, 2008a, 2008b; Niemiec & Ryan, 2009; Reeve, 2009; Ryan & Deci, 2000a, 2000b, 2002, 2011).
Historical Background of the Concept of Needs

Self-determination theory draws from several epistemological approaches within motivation research in specifying a definitive set of innate psychological needs. Some motivation researchers have contended that needs are innate (Hull, 1943; Kohut, 1977; Maslow, 1943; Spence, 1956). Others have maintained that needs are influenced by culture, context, and individual differences and are therefore learned, acquired, and developed (McClelland, 1965, 1985; Murray, 1938). Motivation theorists have specified needs at the physiological level (Hull, 1943; Spence, 1956), the psychological level (Murray, 1938), or both the physiological and psychological level (Maslow, 1943, 1968). SDT draws from the tradition of Hull (1943), conceptualizing needs as innate rather than learned and from the tradition of Murray (1938), identifying needs at the psychological level rather than the physiological level. Self-determination theory is therefore unique with its empirical focus on innate psychological needs. SDT does not deny the existence of physiological needs, and it recognizes that certain cultures, contexts, or circumstances could cause some needs to become more salient than others (Deci & Ryan, 2000).

During the twentieth century, debate concerning the nature of needs extended beyond the field of psychology. From 1933 through 1941, the Eight-Year Study, a large-scale educational reform effort, aimed to make high school curriculum more responsive to the needs of adolescents and less controlled by college admission requirements. The Progressive Education Association (PEA) Commission on the Secondary School Curriculum (CSSC) served as the curriculum arm of the Eight-Year Study. Within the CSSC, developmental psychologists worked with social efficiency educators (Schiro, 2008) to determine how high schools could serve youth more effectively (Aikin, 1942).
Disagreement ensued regarding how to identify adolescent needs. Some felt that adult perspectives and the needs of society should inform the curriculum while others thought that adolescents' developmental needs should be considered when designing curriculum. Some, such as Boyd Bode, a leader of the progressive education movement, were concerned that a progressive education based entirely on the needs of the student would become anti-intellectual and not academically rigorous. Disagreement over the importance of social needs versus individual needs eventually split the PEA in 1942. Tyler (1949) later aimed to combine societal needs, individual needs, and subject area needs into a rationale for curriculum work. Tyler's work guided curriculum development for several decades (Alexander, 2005; Kliebard, 1975), although his rationale was not always utilized for curriculum planning in the way he intended (Schubert, 2008, pp. 407-408). Tyler's rationale, with its emphasis on developing measurable learning objectives, served as an antecedent for the standards movement, which began in full thrust after the publication of *A Nation at Risk* (1983).

The way needs were defined in the Eight-Year Study, and later by Tyler (1949, pp. 1-16), differs from the way SDT defines needs. The CSSC concluded that needs are developed, learned, and unique to each individual; derived from one's interaction with the social environment; and influenced by the needs of society. This definition contrasts with the SDT position that identifies needs as innate rather than learned and specifies needs for autonomy, competence, and relatedness for all students.

Bullough and Kridel (2003) argued that within the current standards-based curriculum era of American education, the phrase "student needs" is now thought of in terms of "student lacks." Students' curricular needs are thought of almost exclusively in
terms of the knowledge and skills they need to possess in order to be successful in a
capitalistic society. In this way, Bullough and Kridel (2003) argued that the current
standards-based curriculum does not sufficiently account for adolescent needs. Bullough
and Kridel (2003) maintained that a parallel exists between the curricular crisis that led to
the Eight-Year Study and the current standards-based curriculum movement. As in 1930,
educational reform is needed to design curricula in a way that is more responsive to the
needs of adolescents and that better serves the purposes of democracy (Bullough &
Kridel, 2003).

**Historical Influences and Theoretical Underpinnings of SDT**

The notion that humans have an inherent psychological need for autonomy is
based on the work of several theorists. Building upon the ideas of Heider (1958),
deCharms (1968) claimed that people have a motivational desire to perceive themselves
as the source, or origin, of their behavior. He argued that individuals want to feel like
causal agents with respect to their own actions. He referred to this motivational
propensity as a perceived locus of causality. According to deCharms, people experience
an internal perceived locus of causality when they feel free to follow their interests and
when they behave naturally and spontaneously. An internal perceived locus of causality
contrasts with an external perceived locus of causality. When behavior is controlled by a
source outside the self, people experience an external locus of causality and are less
likely to perceive themselves as the origin of their behavior. Autonomy, as defined within
SDT, involves experiencing a sense of volition, willingness, and inner endorsement; this
relates to deCharms’ (1968) concept of an internal perceived locus of causality.
Autonomy also entails experiencing freedom and integration (Ryan & Deci, 2011).
Possessing an integrated sense of self relates to the way autonomy is defined by modern philosophers (Angyal, 1965; Brown & Ryan, 2003; Dworkin, 1988; Ricouer, 1966).

The work of White (1959) underlies the SDT claim that humans have a fundamental need for competence. White (1959) maintained that people have a propensity for competence, that is, people have an innate desire to feel effective within their environment. Feelings of accomplishment and success promote growth. The propensity for competence relates in part to the notion of intrinsic motivation in that people naturally want to feel effective and successfully engage with their environment. For example, a person might pick up a basketball and begin taking shots on the goal simply in order to experience feelings of success rather than to earn a reward or to avoid a punishment. Or, a person might decide to read a book in order to learn more about a given topic. Both of these cases exemplify behavior driven by a desire to experience feelings of competence. White’s work, which helped explain behaviors not induced by reinforcements, was unique at the time because of the prevalence of operant psychology (Skinner, 1953). Operant psychology, or behaviorism, also could not explain curiosity and exploratory behavior based on one’s interest. Such behavior gave rise to the concept of intrinsic motivation.

Self-determination theory’s assertion of relatedness as an innate psychological need stems from the work of attachment theorists and other empirically-based theories that cite a need to feel connected to others. The need for relatedness is implicit in the work of attachment theorists (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1958, 1979). The attachment framework explores the importance of the bond established between infants and their primary caregivers and the impact that this bond has on the
relationships established later in one's life. Attachment theorists argue that secure attachments with caregivers are essential for establishing productive relationships later in life and that the quality of the infant-caregiver relationship influences the quality of future relationships. Other theorists have cited a need to experience a sense of acceptance, to be loved and cared for, and to love and care for others (Baumeister & Leary, 1995; Guisinger & Blatt, 1994; Harlow, 1958; McAdams, 1989). SDT deviates from the attachment framework, and contends that proximal support of the need for relatedness has a greater influence than the infant-caregiver bond on one's psychological well-being (Deci & Ryan, 2000).

Self-determination theory is unique with its empirical focus on innate psychological needs and on its specification of needs for autonomy, competence, and relatedness as these relate to optimal performance and psychological health and development. While other theories focus on the importance of competence and relatedness, “SDT is unique in its emphasis on and empirical exploration of the need for autonomy” (Reeve & Assor, 2011, p. 111). In various empirical studies in educational settings, support for autonomy has causally increased students’ motivation, engagement, development, learning, performance, and psychological well-being (Reeve, 2009; Reeve & Assor, 2011). Supporting students’ autonomy seems to play an important role within educational settings. This study explored the variable of autonomy support and its relationship to students’ intrinsic motivation and academic achievement in mathematics. This study focused on the need for autonomy support and its relation to positive learning outcomes in the mathematics classroom.
Human Agency

An underlying foundational tenet of self-determination theory is that humans possess agency. Little, Hawley, Henrich, and Marsland (2002) describe individuals as "inherently active and self-regulating, and their actions are both purposive and self-initiated" (p. 390). According to this view, humans are naturally and predominantly self-directed, self-guided organisms, rather than passive creatures. Because they possess agency, individuals make choices based on self-interest; seek to process and integrate information; actively make sense of their surrounding environment; modify their behavior based on feedback received through the environment; and actively self-monitor themselves in relation to their environment (Little et al., 2002; Niemiec & Ryan, 2009).

Although individuals’ propensity is toward integration and optimal development, as organisms, they are influenced by the surrounding environment. Despite a natural tendency toward active, exploratory, and self-guided behavior, the quality of the surrounding environment affects individuals’ developmental path. The surrounding environment either encourages, nurtures, and fosters or undermines, diminishes, and subdues each individual’s personal sense of agency. While humans’ natural tendency is toward an integrated, well-adapted self, the surrounding environment affects the degree to which individuals maintain a sense of agency.

Individuals who have a strong sense of agency maintain high expectations and aspirations for themselves, view themselves as causal, and most importantly, have a greater sense of well-being (Little et al., 2002). Such individuals are more likely to persevere in the face of adversity, overcome obstacles, and achieve their goals. These individuals’ ability to successfully navigating through their environment produces an
even greater sense of agency and well-being (Bandura, 1997; Chirkov et al., 2011; deCharms, 1968; Little et al., 2002; Ryan & Deci, 2000b).

Individuals with a low sense of agency are more likely to feel helpless, be less self-directed, view themselves as victims of external events, and navigate and cope with obstacles less effectively (Little et al., 2002). Such individuals are not likely to initiate goal pursuits, and when they do, failures often create distrust in their own capabilities. As a result, these individuals have a greater sense of ill-being (Bandura, 1997; deCharms, 1968; Little et al., 2002; Ryan & Deci, 2000b). Repeated failure can lead to passivity and deep discouragement, creating a state of learned helplessness (Garber & Seligman, 1980; Martinez, 2010, pp. 168-169; Peterson, Maier, & Seligman, 1995; Seligman, 2006).

Using the concepts of origins and pawns, deCharms (1976) likened the concept of agency to a game of chess. Highly agentic individuals initiate their own behavior and perceive themselves as the origin of their actions. Individuals experience considerably less agency when they feel helpless and pushed around by others as pawns. This line of reasoning underlies SDT’s conceptualization of interpersonal contexts (e.g., the teacher-student relationship) as being either controlling or autonomy-supportive. In education, controlling learning environments make students feel pushed around like pawns, whereas autonomy-supportive contexts allow learners to experience a sense of volition, freedom, control, and self-expression.

McCombs (2001) analyzed the importance of agency as a moderator to self-regulation and experiences of autonomy and self-determination. According to this overview, when students perceive themselves as the origin of their behavior, they are more likely to be engaged, motivated, and perform at a high academic level. For instance,
Mills, Dunham, and Alpert (1988) found that when students developed a sense of agency
and personal control, they experienced more positive self-beliefs, facilitated by greater
self-efficacy and more positive learning experiences. Acknowledging the agentic nature
of students engenders their capacity to self-regulate and perform as active, self-directed
learners (McCombs, 2001).

Staunch beliefs in human agency have influenced the ideology of some curricular
theorists. Alexander (2005) argued that curriculum should bolster students’ sense of
agency and self-determination. Curriculum that allows students to exercise their agency
fosters independence, maturity, moral intelligence, and the capacity to contribute to and
live meaningfully within a liberal democratic society (Alexander, 2001, 2005; Hansen,

Agency, then, refers to humans’ propensity toward growth and development. This
includes a natural tendency to actively assimilate information, make sense of the
surrounding environment, and modify behavior based on feedback from the environment
(Little et al., 2002). As humans develop, their sense of agency is either supported or
diminished based on the extent to which their immediate environment cultivates a sense
of agency (Little et al., 2002; McCombs, 2001). Highly agentic individuals tend to have a
greater sense of control over their lives, achieve their goals more readily, and live
happier, healthier lives than individuals who do not have a strong sense of agency
(Bandura, 1997; Chirkov et al., 2011; deCharms, 1968; Little et al., 2002; Ryan & Deci,
2000b). Within the classroom, students who possess a greater sense of agency tend to
accomplish their goals, persist in the face of adversity, and demonstrate more control
over their learning than students who do not have a strong sense of agency (Little et al.,
2002; McCombs, 2001; Mills et al., 1988). Essentially, a heightened sense of agency facilitates greater self-efficacy (Bandura, 1997; McCombs, 2001) and greater self-determination (Chirkov et al., 2011; deCharms, 1968, 1976; McCombs, 2001; Ryan & Deci, 2000b). Curricula, therefore, should foster students’ sense of personal agency and self-determination (Alexander, 2005).

_Intrinsic Motivation_

Because people possess agency, they seek to actively engage in activities that interest them. The natural tendency to exercise one’s capacities, seek challenges, explore, assimilate knowledge, and develop mastery characterizes intrinsic motivation (Ryan & Deci, 2000b). While people are naturally curious with respect to activities that involve their interests, activities that involve novelty and provide optimal challenge also foster intrinsic motivation (Deci & Ryan, 2000; Niemiec & Ryan, 2009; Ryan & Deci, 2000b; Shapira, 1976). Izard (1977, 2004) suggested that interest is the primary emotion in intrinsically motivated activity and that enjoyment is the secondary emotion.

Intrinsic motivation leads to active engagement and exploratory behavior. These natural, exploratory behaviors are performed in the absence of any extrinsic rewards (Ryan & Deci, 2000b). This natural curiosity results from a deeply evolved tendency toward active involvement with the surrounding environment that, in turn, leads to information processing and facilitates growth and development (Deci & Ryan, 2000; Niemiec & Ryan, 2009).

Intrinsically motivated behaviors are engaged in solely for the inherent interest and enjoyment in the activity itself, are not catalyzed by any contingency or external force, have an internal perceived locus of causality, and engender feelings of competence.
(Deci & Ryan, 2000; deCharms, 1968; Niemiec & Ryan, 2009; Ryan & Deci, 2000a, 2000b, 2002). Deci (1975) posited that people have an innate desire to feel competent and self-determined with respect to their behavior; he identified behaviors that one fully endorses and that cultivate feelings of competence as *self-determined behaviors*. Since intrinsically motivated behaviors foster people’s need to feel self-determined, intrinsic motivation constitutes the prototype of self-determined behavior (Deci, 1975; Deci & Ryan, 2000, Ryan & Deci, 2000a, 2000b, 2002). Self-determination represents the highest level of self-reflection because, when self-determined, individuals have brought their actions, plans, and goals into alignment and harmony with their self-endorsed values; this reflexive process leads to greater self-actualization and cultivates a strong sense of individual identity. Self-determined behaviors lead to growth and are associated with optimal performance and well-being (Deci & Ryan, 2008a).

Intrinsically motivated behaviors differ distinctly from behaviors stimulated by extrinsic rewards. Extrinsic motivation is characterized by behaviors that are “focused toward and dependent on contingent outcomes that are separable from action” (Ryan & Deci, 2002, p. 10), whereas intrinsically motivated behaviors are characterized by experiences of interest and enjoyment in the behaviors themselves. Extrinsically motivated behaviors are initiated through a source outside, or external to, the self (deCharms, 1968; Ryan & Deci, 2002).

*Early Research on Intrinsic Motivation*

The study of intrinsic motivation emerged during a time when operant behaviorist theories held a strong presence in empirical psychology. Early research that found tangible rewards undermined intrinsic motivation proved to be controversial. Initial
studies found that tangible rewards decreased intrinsic motivation when participants expected rewards as a result of their participation during the activity (Deci, 1971, 1972a, 1972b; Kruglanski, Friedman, & Zeevi, 1971; Lepper, Greene, & Nisbett, 1973). The tangible rewards were thought to be controlling, affecting participants in a way that shifted the perceived locus of causality from internal to external (see Deci, Koestner, & Ryan, 2001a, 2001b, for a discussion). Later studies found that surveillance (Enzle & Anderson, 1993; Lepper & Greene, 1975; Plant & Ryan, 1985), evaluation (Harackiewicz, Manderlink, & Sansone, 1984; Ryan, 1982), imposed goals (Mossholder, 1980), deadlines (Amabile, DeJong, & Lepper, 1976), and testing (Benware & Deci, 1984; Grolnick & Ryan, 1987) also decreased intrinsic motivation, presumably because they also induced a shift in perceived locus of causality. On the contrary, early studies found that offering choices enhanced intrinsic motivation (Swann & Pittman, 1977; Zuckerman, Porac, Lathin, Smith, & Deci, 1978), presumably because doing so supported an internal locus of causality and a sense of autonomy. Parenthetically, a recent meta-analysis indicated that providing meaningful choice fosters intrinsic motivation, perceived competence, effort, and performance (Patall, Cooper, & Robinson, 2008). Initial studies also found that showing empathy and explaining things in a noncontrolling way (e.g., avoiding using the word “should” in an authoritarian, pressure-inducing manner) sustained intrinsic motivation (Koestner et al., 1984).

Collectively, this early corpus of research suggested that a shift toward a more external perceived locus of causality supplanted a sense of autonomy and volition, which were considered essential characteristics of intrinsic motivation. Competence, as initially suggested by White (1959) and later adopted into the SDT framework, was also
considered to play a crucial role in maintaining intrinsic motivation. This original body of
research provided the foundation for SDT’s assertion that people must experience
competence and a sense of autonomy in order to sustain intrinsic motivation with respect
to an activity (Deci, 1975; Fisher, 1978; Ryan, 1982). A brief historical overview of the
empirical exploration and theoretical development of intrinsic motivation within the SDT
framework is offered by Vansteenkiste, Lens, and Deci (2006).

Recent reviews of the literature aimed to elucidate the effects of extrinsic rewards
on intrinsic motivation. For example, Deci, Koestner, and Ryan (1999a) conducted a
meta-analysis of 128 studies highlighting the effects of extrinsic rewards on intrinsic
motivation and found that contingent tangible rewards significantly undermined intrinsic
motivation toward a target activity, although verbal rewards tended to enhance intrinsic
motivation. Although there has been intense scholarly debate over the interplay between
extrinsic rewards and intrinsic motivation (see Cameron, 2001; Cameron & Pierce, 1994;
Deci et al., 1999a, 1999b, 2001a, 2001b; Eisenberger & Cameron, 1996; Eisenberger,
Pierce, & Cameron, 1999; Lepper, Henderlong, & Gingras, 1999, for discussions),
research seems to support the notion that extrinsic rewards can be used in a controlling
manner that undermines students’ intrinsic motivation, especially in young children (Deci
et al., 2001b). Tangible rewards can be used in an informational, autonomy-supportive
way but are often used in a controlling, autonomy-suppressive manner (Deci et al.,
1999a, 1999b, 2001a, 2001b).

**Facilitating Intrinsic Motivation**

Environmental conditions either sustain or undermine humans’ natural tendency
toward intrinsically motivated behavior (Ryan & Deci, 2000b). While curious by nature,
individuals remain committed to tasks only when needs for competence and autonomy are satisfied (Deci & Ryan, 2000; Niemiec & Ryan, 2009; Ryan & Deci, 2000b). Needs for competence are satisfied as people adequately respond to challenges and experience task-related success (Deci & Ryan, 2000; Niemiec & Ryan, 2009; Ryan & Deci, 2000b). However, individuals can feel quite efficacious toward a task and still not be intrinsically motivated with respect to that activity; competence alone is not enough to maintain task-commitment (Deci & Ryan, 2000; Niemiec & Ryan, 2009; Ryan & Deci, 2000b). Self-determination theorists argue that a sense of autonomy and volition must accompany feelings of competence in order for intrinsically motivated behaviors to be sustained (Deci & Ryan, 2000; Niemiec & Ryan, 2009; Reeve et al., 2003; Ryan & Deci, 2000b). For example, employees who are highly efficacious within their job, or students who are highly competent within a certain content area, may experience less overall satisfaction, and less motivation, if feelings of interest and volition do not accompany their task-involvement (Ryan & Deci, 2000b).

In addition to autonomy and competence, relatedness plays a role in maintaining intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000b, 2002). Bowlby (1979) maintained that intrinsic motivation, expressed through exploratory behavior, was greater in infants who were more securely attached to a parent. Likewise, Frodi, Bridges, and Grolnick (1985) cited a positive relationship between secure maternal attachment and infants’ exploratory behaviors. Anderson, Manoogian, and Reznick (1976) found that students’ intrinsic motivation decreased when a supervising adult ignored their attempts to interact. Other researchers concluded that students were more intrinsically motivated by teachers whom they experienced as warm and caring (Ryan & Grolnick, 1986; Ryan,
Stiller, & Lynch, 1994). Wentzel (1998) found that sixth-grade students’ \( N = 167 \) interest in school was predicted by how caring, helpful, and supportive they perceived their teachers to be. Although research shows an association between relatedness and intrinsic motivation, it is clear that many intrinsically motivated behaviors can be done in solitude, such as hiking, gardening, leisure reading, and so on (Deci & Ryan, 2000; Ryan & Deci, 2000b, 2002). Whereas relatedness is deemed necessary for healthy development, growth, and well-being, it is considered to have a more distal relationship, relative to autonomy and competence, in nurturing intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000b, 2002).

**The Self-Determination Continuum**

Intrinsic motivation plays an important role in learning, but it is not the only type of motivation. Many theories conceive motivation as a dichotomous construct (i.e., only intrinsic and extrinsic motivation). In contrast, SDT maintains that four different types of extrinsic motivation exist, some of which are more autonomous and self-determined than others (Deci & Ryan, 2000, 2008a; Niemiec & Ryan, 2009; Ryan & Deci, 2000a, 2000b, 2002). Although all extrinsically motivated activities are performed in order to attain a separable outcome beyond sheer enjoyment in the activity itself, some types of extrinsic motivation have an external perceived locus of causality and are controlling. In contrast, other types of extrinsic motivation allow students to experience a more internal perceived locus of causality, feel like the origin of their behavior, and experience greater inner endorsement, or autonomy.

Many educational activities are not intrinsically interesting; they are not performed for the inherent satisfaction in the activity itself. Consequently, students often
require incentives or reasons to engage in activities that are not immediately intrinsically satisfying (Reeve et al., 2002; Ryan & Deci, 2000a, 2000b). As Ryan and Deci (2000) posit, "The real question concerning nonintrinsically motivated practices is how individuals acquire the motivation to carry them out and how this motivation affects ongoing persistence, behavioral quality, and well-being" (p. 71). According to SDT, students' willingness to engage in extrinsically motivated behaviors and the quality of their engagement depends on the degree to which the regulation of their behavior is internalized and integrated into their sense of self.

The process of taking in a value outside the self and integrating it into one's own sense of values and identity is referred to as the internalization of extrinsic motivation. Internalization refers to how autonomously self-regulating students are with respect to behaviors that others require of them. The internalization of extrinsic motivation is important because intrinsic motivation appears to decrease across the school years (Archambault et al., 2010; Eccles & Midgley, 1989; Eccles et al., 1984; Gottfried et al., 2001; Harter, 1982; Martinez, 2010, pp. 157-159; Middleton & Spanias, 1999; Ryan & Deci, 2000b).

Self-determination theory views the degree to which behavior can be experienced as self-determined on a continuum. On one end of the continuum is amotivation. Amotivation is characterized by lacking an intention to act. Students experience amotivation (i.e., the attitude of, "I don't want to do this, so I'm not going to do it") if they do not value an activity, do not feel competent or have low self-efficacy with respect to an activity (Bandura, 1986), or if they do not expect that their action will produce a desired outcome (Ryan & Deci, 2000b). On the other end of the continuum is intrinsic
motivation, the prototype of self-determined behavior. Intrinsic motivation is considered highly autonomous and results from one’s interest, enjoyment, and inherent satisfaction with an activity. Between amotivation and intrinsic motivation lie four different forms of extrinsic motivation, each of which varies in their relative autonomy. Figure 1 offers an illustration of the self-determination continuum as conceived within SDT. Permission to reproduce Figure 1, originally cited in Ryan and Deci (2000), is provided in Appendix A.


The least autonomous and self-determined form of extrinsic motivation is external regulation. Students perform externally regulated behaviors in order to earn a reward or avoid a punishment. This type of behavioral regulation is controlling and is associated with an external perceived locus of causality. Operant theorists, or behaviorists (Skinner,
recognize external regulation as the only type of motivation (Deci & Ryan, 2000a, 2000b). Operant theorists assert that all human behavior results from reinforcements and contingencies (i.e., external rewards and punishments; Eisenberger & Cameron, 1996; Ryan & Deci, 2006; Skinner, 1971). Although contingencies can be powerful motivators, externally regulated behaviors are not likely to be maintained once the salient contingencies have been removed (Vansteenkiste, Ryan, & Deci, 2008). Accordingly, externally regulated behaviors undermine the internalization process by failing to promote the transfer of a target behavior (Niemiec & Ryan, 2009; Ryan & Deci, 2006). Externally regulated behaviors are also “often associated with lower well-being, engagement, and satisfaction” (Ryan & Deci, 2006, p. 1570) because actions performed solely to earn a reward or avoid a punishment do not align with one’s integrated sense of self. Examples of external regulations would be a student who works on his classwork only in order to avoid being yelled at by his teacher or ridiculed by his peers for not working hard enough, to avoid detention, to earn a good grade, or to earn a prize at the end of the school day.

*Introjected regulation* is a second type of extrinsic motivation. The concept of *introjection* has been analyzed within the field of psychology for several decades (Freud, 1924; Meissner, 1981; Perls, 1973); a concise synopsis of the concept can be found in Deci et al. (1994, pp. 120-121). Introjected regulated behaviors are performed with the feeling of pressure in order to avoid guilt, shame, or anxiety; in order to feel worthy; or in order to attain an ego enhancement such as pride (Ryan & Deci, 2000a, 2000b; Niemiec, Ryan, & Brown, 2008). Introjected regulated behaviors are *internally* controlling and still have an external perceived locus of causality. Ego involvements (Nicholls, 1984; Ryan,
1982) are a common form of introjected regulations. When ego is involved, one's self-esteem is contingent on his or her performance. Ego involvements lead people to behave in a certain way "in order to enhance or maintain self-esteem and the feeling of worth" (Ryan & Deci, 2000a, p. 62). Because introjected regulations are internally controlling, they are not experienced as part of the self; introjected regulated behaviors do not align with one's true sense of identity and self-endorsed values. Whereas external regulations aim to satisfy external contingencies, introjected regulations aim to satisfy internal contingencies, or internal rewards and punishments. External regulations can be thought of as interpersonally controlling, and introjected regulations can be thought of as intrapersonally controlling (Ryan & Deci, 2000b). Examples of introjected regulations would be a student who works on her classwork in order to avoid feeling guilty for not staying on task, because she wants the teacher to think she is a good student, because she would be ashamed of herself if she did not complete the assignment, or because she would feel proud of herself for finishing before other students.

Identified regulation is a third and more autonomous, self-determined form of extrinsic motivation. Identified regulation represents an individual beginning to consciously value a behavior and view the behavior as personally important; with identification, people begin to personally endorse the value a given behavior expresses and accept it as their own. When people identify with the underlying value of an action, that behavior becomes more a part of their identity. Identification is the process through which people more fully internalize a behavior's value, and "identification represents an important aspect of the process of transforming external regulation into true self-regulation" (Ryan & Deci, 2002, p. 17). Identified regulations have a more internal
perceived locus of causality and a higher degree of perceived autonomy than external and introjected regulations. SDT posits that regulations stemming from identifications will be better maintained, associated with greater task-commitment, and related to better performance because these behaviors have been endorsed by the self. Examples of identified regulations would be a student who works on his classwork because he wants to learn new things, because he personally values hard work, or because he recognizes the value of his classwork at it relates to his future educational goals and career aspirations.

*Integrated regulation* is the most internalized, autonomous, and self-determined form of extrinsic motivation. It shares many characteristics of intrinsic motivation, but integrated regulation is still a form of extrinsic motivation because integrated behaviors are performed for some instrumental value other than solely for the inherent enjoyment and satisfaction with the activity itself. Like identified regulations, integrated regulations also have an internal perceived locus of causality. Regulations become integrated as individuals fully accept the reasons for an action and assimilate them in congruence and harmony with one's abiding interests, values, goals, and needs; fully assimilating a regulation into accord with one's identity occurs through evaluation, reflection, and self-examination. Integrated regulation is the most self-determined form of extrinsic motivation because it describes the process through which an external regulation is transformed into self-regulation. Examples of integrated regulation would be a student who works passionately on a sea turtle project for science class because she deeply cares about sea turtles and aquatic environmental conservation or a student who works diligently writing a short story for her language arts class because she is interested in her writing topic and wants to become a better writer. Behaviors characterized by integrated
regulation are associated with greater task-commitment, persistence, engagement, high-quality behavior, satisfaction, and well-being (Chirkov et al., 2011; Deci & Ryan, 2002; Niemiec & Ryan, 2009; Reeve, 2009; Ryan & Deci, 2000b, 2006).

Self-determination theory does not contend that the continuum of self-determined motivation represents a sequential order through which people gradually progress or that people necessarily move through the continuum developmentally (Ryan & Deci, 2000a, 2000b, 2002). Any given behavioral regulation of the internalization process may be experienced depending on the context and situation in which the regulation occurs (Ryan, 1995). For instance, within the same school day, a student might experience a high level of identified regulation in one teacher’s class but experience a high level of introjected regulation in another teacher’s class. A student might experience a high level of external regulation for one particular learning activity but experience integrated regulation for a different activity the next day. Although context and situation affect behavioral regulations, people increasingly develop the capacity to internalize regulations over time due to enhanced cognitive ability and ego development (Chandler & Connell, 1987; Loevinger & Blasi, 1991; Piaget, 1971). As the prefrontal cerebral cortex increases its executive functioning capacity to self-regulate and evaluate stimulus on a complex level, individuals are able to engage in more logical reasoning (Martinez, 2010; Ross, 2010). As people mature in their thinking due to the brain’s natural growth and development, they tend to develop a greater capacity to internalize regulations. The natural developmental trend toward more internalized self-regulation aligns with the SDT position that people are agentic and actively “integrate their ongoing experiences” (Ryan & Deci, 2002, p.
15); however, internalization will be expedited as nourishment for ambient psychological needs is available.

In what has proven to be a seminal study, Ryan and Connell (1989) found empirical evidence to support the concept of self-determined behavior lying on a continuum of relative autonomy. This study was the initial validation study for the Academic Self-Regulation Questionnaire (ASRQ), a questionnaire used in many subsequent studies. Drawing from a sample of over 2,000 students from four diverse school populations, this research used the ASRQ to assess elementary school children’s reasons for trying to do well in school. Differences in students’ attitudes were related to four different types of motivation: external, introjected, identified, and intrinsic. The ASRQ used an intrinsic motivation subscale instead of an integrated regulation subscale; the ASRQ did not include integrated motivation because it was believed that elementary school children were too young to have fully integrated an external regulation at such an early age. This study found that students who were more externally regulated showed less interest, effort, and value in their school work, and they were more likely to abdicate responsibility for negative learning outcomes and blame their teacher instead. Introjected regulation was positively correlated to trying to do well in school but was also related to experiencing greater anxiety and weaker ability to cope with failure. Identified regulation was related to a higher level of enjoyment with school, better coping skills, and expending more effort. Intrinsic motivation was related to interest and enjoyment with school activities, more positive coping, and perceived competence.

Many studies have extended this research and found that autonomous forms of extrinsic motivation were associated with more positive learning outcomes (e.g.,
increased engagement, deeper conceptual understanding, less high school dropout) relative to less autonomous forms extrinsic motivation (see Guay et al., 2008, Ryan & Deci, 2000a, p. 63, and Reeve, 2009, for a review). Several studies replicated and extended the results of Ryan and Connell (1989) across cultures. Hayamizu (1997), using a sample of 483 Japanese junior high school students, Yamauchi and Tanaka (1998), using a sample of 356 Japanese elementary school students in grades 5 and 6, and Yamauchi, Kumagai, and Kawasaki (1999), using a sample of 228 Japanese junior high students in grades 7 and 8 and 306 high school students in grades 11 and 12, also found empirical evidence to support the concept of self-determined behavior lying on a continuum of relative autonomy. In these studies, autonomous forms of motivation (i.e., identified regulation and intrinsic motivation) were associated with students’ ability to effectively cope with failures and use self-regulated learning strategies. Controlling forms of motivation (i.e., external regulation and introjected regulation) were associated with poor coping and less effective use of self-regulated learning strategies. Chirkov, Ryan, and Willness (2005) found that greater relative autonomy and satisfaction of psychological needs for autonomy, competence, and relatedness among students in Canada and Brazil led to greater internalization of cultural values and well-being.

Facilitating the Internalization of Extrinsic Motivation

Self-determination theory espouses that satisfaction of the basic psychological needs facilitates the internalization of extrinsic motivation. To the extent that students’ needs for autonomy, competence, and relatedness are satisfied, they begin to regulate their behavior internally (i.e., autonomously) and become more likely to comply with requests others ask of them. Students begin to internalize new values, goals, and interests
in the absence of controlling pressures (i.e., external controls such as contingent rewards or punishment and internal controls such as guilt, shame, or pride), as such pressures tend to undermine the fulfillment of students’ psychological needs (Ryan & Deci, 2002).

Perceived competence influences one’s readiness to internalize extrinsic motivation. As Niemiec and Ryan (2009) stated so succinctly, “students will only engage and personally value activities they can actually understand and master” (p. 139). Without perceived competence, not only will students fail to internalize and value an activity as personally important, they often become amotivated toward a task and do not engage at all (Ryan & Deci, 2002). Teachers support students’ needs for competence by creating learning activities that provide optimal challenge; if tasks are too hard, students might get frustrated and quit, and if activities are too easy, they will likely become bored and disengage (Ross & Bergin, 2011, pp. 59-61). Students maintain and enhance their skills in classrooms that provide optimally challenging lessons, which helps sustain the internalization process. Assessment is also tied into perceived competence. Teachers support students’ needs for competence by using noncontrolling language (e.g., avoiding use of the word “should”) to correct students’ mistakes and by providing students with information-rich feedback.

Relatedness also plays a key role in facilitating the internalization of extrinsic motivation. Promoting relatedness is thought to be an essential first step in nurturing students’ willingness to internalize and integrate extrinsic motivation (Ryan & Deci, 2000a, 2000b. 2002). For instance, Ryan et al. (1994) found that children who felt securely attached to their parents and accepted by their teachers demonstrated greater internalization of various school-related behaviors, including academic engagement,
positive coping skills, and self-esteem. Furrer and Skinner (2003) found that elementary students in grades three through six reported greater academic and emotional engagement when they felt a sense of relatedness to their parents, teachers, and peers, concluding that "a sense of belonging or relatedness plays an integral role in children’s motivational development" (p. 160). Students who feel physically, emotionally, and psychologically safe, respected, and cared for by their teachers and peers are more likely to adopt ambient social values and comply with teachers’ behavioral request. Cecilia Stamper, recently recognized as an outstanding teacher by the Professional Association of Georgia Educators, captured the idea that a sense of relatedness catalyzes the internalization of extrinsic motivation in stating, “By nature, children want to please if they know you have their best interest at heart” (Raudonis, 2012, p. 12). Although relatedness appears less important than autonomy and competence for maintaining intrinsic motivation, it appears quite central for fostering internalization (Ryan & Deci, 2002).

Although competence and relatedness facilitate the internalization process, students must have an experience of autonomy in order for extrinsic motivation to become truly self-regulating and self-determined. People may feel connected to others and competent with respect to a behavioral goal, yet regulations will likely remain only external or introjected without an accompanied sense of autonomy (Ryan & Deci, 2000b). In order for a regulation to become fully integrated and self-determined, people must inwardly “grasp its meaning and synthesize that meaning with respect to their other goals and values” (Ryan & Deci, 2000b, p. 74). According to SDT, such integration is most likely to occur in social contexts in which people experience a sense of choice, volition, and freedom from coercion to think or behave a certain way. Contexts that are
autonomy-supportive allow people to transform external regulations into self-regulation and extrinsic motivation into self-determined behavior.

*Autonomy Support*

Autonomy support provides the means through which the cultivation of intrinsic motivation and the internalization of extrinsic motivation occur. Autonomy support involves nurturing another person's inner motivational resources and recognizing their capacity for autonomous self-regulation (Reeve, 2002, 2009; Reeve & Jang, 2006; Reeve et al., 2008). In educational settings, teachers' motivating styles can be described as either autonomy-supportive or controlling, and these two styles can be thought of as opposite ends of a continuum (Reeve, 2002, 2009). Autonomy-supportive instructional practices have markedly different characteristics and related educational outcomes than the characteristics and educational outcomes associated with controlling instructional practices (Assor et al., 2005; Reeve, 2002, 2009; Reeve & Jang, 2006, Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005).

*Controlling Motivating Style*

Several characteristics define a controlling motivating style. Teachers who adopt a controlling motivating style pressure students to feel, think, or behave in a specific way; display impatience for students to generate the correct answer; use pressure-inducing language; demonstrate little tolerance for students' complaints and expressions of negative affect; use criticism to induce guilt; fail to offer explanatory rationales; and attempt to motivate students through contingencies (Reeve, 2009). Teachers who adopt a controlling motivating style interrupt students' natural responses to the learning environment by intruding into students' feelings, thoughts, or actions; overrunning
students’ perspectives with their own; or applying pressure until students’ change their thinking, beliefs, or actions (Reeve, 2009; Reeve & Assor, 2011).

Controlling motivating styles vary in their manifestation. Very few teachers employ an extremely controlling motivating style (Reeve, 2009). Teachers can attempt to control students either directly or indirectly (Assor et al., 2005; Reeve, 2009; Vansteenkiste, Simons, et al., 2005). Teachers directly control students by using deadlines, verbal commands, and behavioral rewards and punishments; by interfering with students’ preferred pace of learning; and by prohibiting students from voicing critical and independent opinions (Assor et al., 2005; Reeve, 2009). Teachers indirectly control students by seeking to induce students’ feelings of guilt, shame, or anxiety; by providing conditional approval; and by fostering a sense of perfectionism (Assor, Roth, & Deci, 2004; Reeve, 2009; Soenens, Vansteenkiste, Luyten, Duriez, & Goossens, 2005). Accordingly, teachers can either externally (i.e., directly) or internally (i.e., indirectly) attempt to control students (Reeve, 2009; Vansteenkiste, Simons, et al., 2005, p. 488). Research suggests that a controlling motivating style undermines students’ internal perceived locus of causality, motivation, engagement, conceptual understanding, psychological well-being, and development (Reeve, 2009).

Assor et al. (2005) explored the relationship between directly controlling teacher behaviors (DCTB) and students’ emotional well-being and academic engagement. Three hundred nineteen Israeli fourth and fifth grade students participated in this study. The DCTB examined in this study included giving students frequent directives, not allowing students to work at their preferred pace of learning, and not allowing students to voice opinions that differed from their teacher’s. This study found a significant negative
correlation between DCTB and students’ academic engagement. Path analyses revealed that DCTB elicited students’ feelings of anger and anxiety, and, in turn, these feelings diminished students’ academic engagement.

Research has investigated why teachers behave in a controlling manner toward students (Pelletier et al., 2002; Reeve, 1998, 2009; Reeve & Assor, 2011). Teachers are more likely to adopt a controlling motivating style when they experience “pressures from above, pressures from below, and pressures from within” (Reeve & Assor, 2011, p. 113). Teachers can experience pressure from above from several sources, such as department chairs, school administrators, bureaucratic edicts, federal and state level educational policies, and demanding parents. Teachers experience pressures from below as they attempt to respond to their dissatisfaction with students’ effort, motivation, and academic achievement; teachers tend to adopt a controlling style if they believe students lack motivation. Teachers experience pressures from within as a result of their own disposition, values, and beliefs about motivation. Some teachers’ possess an authoritarian, controlling motivating style due to their personalities—regardless of any pressures from above or from below. Together, these three sources of pressure create a framework that helps predict the conditions that increase the likelihood of teachers adopting a controlling style (Reeve & Assor, 2011).

**Autonomy-Supportive Motivating Style**

A growing body of empirical literature suggests that autonomy-supportive motivating styles satisfy students’ psychological needs for autonomy, competence and relatedness compared to controlling motivating styles (Guay et al., 2008; Reeve, 2009). Autonomy-supportive instruction nurtures students’ inner motivational resources and thus
fosters their self-determination. Teachers who adopt an autonomy-supportive motivating style are more likely to cultivate students’ behavioral, cognitive, and emotional engagement (i.e., students’ time on task, self-regulation, and interests, respectively) by incorporating students’ interests into learning activities, providing an optimal level of academic rigor, and creating a safe and respectful learning environment that fosters relatedness. In contrast, controlling motivating styles tend to focus solely on students’ behavioral engagement (i.e., students’ time on task; Reeve, 2009).

Because autonomy-supportive instruction is associated with many positive educational and developmental outcomes, it is useful for teachers to understand specific teaching techniques that manifest an autonomy-supportive style. To support students’ autonomy, teachers can take students’ perspectives, acknowledge students’ feelings, provide rationales for uninteresting lessons, allow and accept students’ expressions of negative affect (e.g., during uninteresting activities), provide open access to instructional materials, recognize students’ interests, provide hints instead of answers, allocate time for independent work, provide adequate amount of time for assignment completion, praise mastery, communicate with non-controlling language, avoid using criticisms and directives (e.g., “should,” “ought to,” “need to”), and provide students with information and opportunities for choice (Deci et al., 1994; Reeve, 2002, 2009; Reeve & Halusic, 2009; Reeve & Jang, 2006; Reeve et al., 2008). By accounting for students’ interests and ways of thinking, autonomy-supportive teacher behaviors allow students to experience an internal perceived locus of causality and a sense of choice and volition (Reeve, 2002, 2009; Reeve et al., 2003). In many aspects, autonomy-supportive teaching is tantamount to what the curriculum field conceptualizes as a
• child-centered (Pereira & Smith-Adcock, 2011),
• learner-centered (McCombs, 2001; McCombs & Miller, 2006; Schiro, 2008),
• student-centered (Black & Deci, 2000, pp. 740-742; Sierens, Vansteenkiste, Goossens, Soenens, & Dochy, 2009, p. 65; Zhou, Ma, & Deci, 2009, pp. 495-496), or
• student-sensitive (Hansen et al., 2008) approach to teaching, because autonomy support involves the educator taking the learner’s internal frame of reference.

Empirical Findings Related to Autonomy Support

Over the last three decades, investigators have conducted research to examine the interplay between teachers’ autonomy support and students’ self-determined motivation, academic performance, and well-being. The findings suggests that autonomy-supportive learning environments tend to satisfy students’ basic psychological needs, cultivate their self-determined motivation, and facilitate positive learning outcomes. Less autonomy-supportive contexts tend to undermine students’ basic psychological needs, motivation, engagement, development, conceptual learning, and well-being (Deci & Ryan, 1987, 2000, 2002, 2008a, 2008b; Niemiec & Ryan, 2009; Reeve, 2002, 2009; Reeve & Assor, 2011; Reeve & Halusic, 2009; Ryan & Deci, 2000a, 2000b, 2002, 2011).

Deci, Nezlek, and Sheinman (1981) examined the relationship between elementary school teachers’ motivating styles and their students’ intrinsic motivation and self-esteem. Data was collected from 610 students in grades 4 through 6 at four different middle-to-lower-middle-class suburban elementary schools throughout New York. Intrinsic motivation was measured by students’ preference for challenging work versus easy work, a desire to learn in order to satisfy their curiosity rather than to please their
teacher, and independent attempts at mastery rather than relying on their teacher’s help to complete assignments. Self-esteem was measured by students’ perceived competence. Perceived competence was anticipated to facilitate students’ feelings of self-worth and intrinsic motivation. Teachers’ motivating styles were significantly related to students’ intrinsic motivation and self-esteem in this study. Students of autonomy-supportive teachers reported more personal responsibility and internal control than students of controlling teachers. Controlling teachers used more abrasive directives when communicating with students compared to autonomy-supportive teachers. Autonomy-supportive teachers provided more information to their students than controlling teachers did, and this appeared to increase students’ intrinsic motivation and self-esteem. A related research study also found that students whose teachers used informational language to communicate reported greater intrinsic motivation and perceived competence than students whose teachers communicated in a controlling manner (Deci, Schwartz, Sheinman, & Ryan, 1981).

Benware and Deci (1984) explored how learning science material in order to teach it to another student versus learning it in order to be tested effected college students’ intrinsic motivation and conceptual learning. Forty students in an introductory psychology course at the University of Rochester were given an article on brain functioning and told to read it. Nineteen students participated in the experimental group and were told they needed to learn the material in order to teach it to another student. Twenty-one students participated in the control group and were told they would be tested on the material. It was hypothesized that learning material in order to teach it to another student would produce more active learning, and as a result, would facilitate greater
intrinsic motivation and deeper conceptual understanding than learning in order to take a test. The researchers expected that testing—because it represented a form of evaluation—would induce an external locus of causality and undermine students’ intrinsic motivation. Data analyses confirmed that students in the experimental group experienced higher levels of interest in the learned material and significantly greater conceptual understanding of the material than students in the control group. Learning in order to take a test resulted in more passive learning and less intrinsic motivation than learning in order to teach the material to another student. This study’s findings suggest that activities that promote active learning facilitate students’ intrinsic motivation and produce greater conceptual understanding. The study’s small sample size limits the generalizability of the findings, however.

Research conducted with 43 first and second grade students in a suburban elementary school in New York investigated if limits could be set in a way that did not decrease students’ intrinsic motivation and creativity (Koestner et al., 1984). Participants were randomly placed in either an informational-limits group, a controlling-limits group, or a no-limits group and were given instructions prior to a 10-minute painting activity. During the instructions, limits were set for students in the informational-limits condition by an adult who used informational language and offered rationales to explain why the limits were in place (e.g., “I know that sometimes it’s really fun to just slop the paint around, but here the materials and room need to be kept nice for the other children who will use them,” and “I know that some kids don’t like to be neat all the time, but now is a time for being neat;” Koestner et al., 1984, p. 239). Limits were set for students in the controlling-limits group by an adult who used controlling language, including phrases
such as “you have to” and “you must.” No limits or additional instructions were given to students in the no-limits group, as they were for students in the other two groups.

There was no significant difference in intrinsic motivation for students in the informational-limits group and the no-limits group, suggesting that limits can be set in a way that does not diminish students’ intrinsic motivation. Intrinsic motivation was significantly greater for students in the informational-limits group compared to students in the controlling-limits group, and paintings of students in the informational-limits group tended to be more creative than paintings of students in the controlling-limits group. Setting limits in an informational manner that supported students’ autonomy appeared to augment students’ intrinsic motivation and creativity relative to setting limits through the use of controlling language. The researchers in this study followed the guidelines set forth by the play therapist Ginott (1959, 1977) to determine how limits might be set in an autonomy-supportive way that did not thwart students’ motivation and creative expression.

Grolnick and Ryan (1987) tested the effects of an autonomy-supportive versus a controlling learning environment on students’ rote recall, conceptual understanding, and emotional experiences while reading grade-level material. Ninety-one fifth grade students from three elementary schools in Rochester, New York were randomly and equally divided into one of three experimental conditions: a controlling-directed (CD) group \((n = 31)\), a noncontrolling-directed (NCD) group \((n = 31)\), or a nondirected (ND) group \((n = 29)\). Students in the CD group were told that after they finished reading they would be tested and graded on how well they understood the reading material. Students in the NCD group were told that they would be asked questions about the reading passage but that
there would be no test or grade and that they could read the passage in whatever way was best for them. Students in the ND group were told only that they would be asked questions after they finished reading the passage. The evaluative presence of testing and grades was hypothesized to produce an external perceived locus of causality for students in the CD group that, in turn, would engender a greater sense of pressure, less interest, and less conceptual understanding compared to students in the other two groups. Students in the NCD and ND groups were hypothesized to experience greater autonomy and thus more enjoyment, less pressure, and a higher level of engagement that, in turn, would facilitate deeper conceptual understanding of the reading material.

Analysis of variance (ANOVA) revealed that students in the NCD and ND learning groups experienced greater interest in the reading material, felt less pressure and tension, and demonstrated greater conceptual understanding of the reading content than students in the CD group. Students in the CD group displayed greater rote recall than students in the other two groups, but not significantly greater recall than students in the NCD group. As expected, students in the ND learning group demonstrated the least amount of rote recall of the three conditions.

This study also found that regardless of what experimental group they were placed in, students with a more self-determined orientation for learning experienced less task-related pressure, greater interest, and more conceptual learning than students with a less self-determined orientation for learning. This study's findings suggest that learning environments that focus students' attention on a learning goal (i.e., directed leaning), reduce a sense of evaluation, and provide directions in an autonomy-supportive way facilitate deeper conceptual processing, greater task-related interest, and less task-related
tension than learning environments perceived to be highly evaluative in nature and controlling. This study also found that students who had a greater reservoir of inner motivational resources, as evidenced by a more autonomous learning orientation, appeared able to rebuff harmful controlling influences within the learning environment (i.e., evaluative pressures).

Flink, Boggiano, and Barrett (1990) investigated how teachers’ use of controlling strategies that resulted from pressure to maximize student achievement affected their students’ performance. Fifteen fourth grade teachers and 267 of their students from seven different elementary schools in a Colorado school district participated in this study. Two experimental groups were created among participating teachers and their students: a nonpressure condition ($n = 7$ teachers and their students) and a pressure condition ($n = 8$ teachers and their students).

Students were assessed on their performance on three different activities: tactile storytelling, sequencing, and spatial reasoning, respectively. A researcher leading the study told the teachers in the nonpressure condition that it was their role to facilitate students’ learning and to simply “help the students learn how to solve the problems” (Flink et al., 1990, p. 918). Teachers in the pressure group were told that it was their “responsibility to make sure that students perform up to standards” and that their students “should” be able to do well if they were tested on the material (Flink et al., 1990, p. 918).

Multiple analysis of variance (MANOVA) revealed that students taught by nonpressured teachers performed significantly better on each of the three tasks than students taught by pressured teachers. To determine the extent to which teachers used controlling teaching strategies, raters blind to the experimental conditions observed
teachers' interactions with their students and recorded how often teachers used controlling strategies. Pressured teachers were found to be significantly more controlling in their interactions with students than nonpressured teachers. Controlling teachers offered students' less choice, provided more evaluative feedback (i.e., criticism and praise), exerted more control, and created more pressure and tension than noncontrolling teachers. In sum, teachers who felt pressured to maximize student performance were significantly more likely to use controlling strategies, and teachers' use of controlling strategies significantly diminished students' task performance. This research proved to be a harbinger of future studies that found controlling teacher behaviors undermined students' academic engagement (Assor et al., 2005) and conceptual understanding (Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005), and that teachers who felt pressured to maximize student performance were more likely to adopt a controlling motivating style that, in turn, diminished students' performance and self-determined motivation (Pelletier et al., 2002).

Boggiano et al. (1993) examined how teachers' use of controlling language and limiting opportunities for choice affected students' performance on analytic reasoning problems. Eighty-three college students in an introductory psychology course at the University of Colorado, Boulder were divided into two groups: a controlling-directives (CD) group \((n = 40)\) and a noncontrolling-directives (NCD) group \((n = 43)\). Participants in the CD group were told that they "should" use the strategy modeled by the teacher to solve a set of analytical problems. Participants in the NCD group were taught the same problem solving strategy but were "encouraged to use any strategy they chose" to solve the problems (Boggiano et al., 1993, p. 319). Students in the NCD group were also given
five minutes to independently practice problems using whatever strategy they thought was best prior to beginning the analytical tasks, whereas students in the CD group practiced problems with the teacher using the prescribed strategies and were not allotted independent practice time. Data analyses indicated that students in the CD group performed significantly worse on the analytical problems than students in the NCD condition, as expected. However, there was no significant difference between the two groups for rote learning (i.e., students’ performance on 3-digit multiplication facts). A separate, related study conducted by the same researchers found that students in a NCD group who were given choice on how to solve analytic reasoning problems reported significantly higher feelings of freedom and self-determination while working on the problems compared to students in a CD group (Boggiano et al., 1993).

This study’s findings hold important implications for mathematics instruction. Boggiano et al. (1993) found that when teachers required students to solve problems a specific way, students’ feelings of self-determination and performance on complex conceptual problems diminished. The best problem solvers use the quickest, most efficient method possible to find a solution (Schoenfeld, 1987, 1992); helping students to understand the best way to solve a problem represents one of math teachers’ most central responsibilities (NCTM, 2000; Schoenfeld, 1987). However, it appears critical that teachers communicate effective problem-solving methods in an autonomy-supportive way instead of simply telling students, “This is the best way to solve this problem, so you should always solve it using this method.” Teachers can demonstrate the best approach to solving a problem in an autonomy-supportive way by refraining from using the word “should,” since use of the word “should” is internally-controlling to students, and by
explaining why a given method constitutes the best strategy. Teachers will cultivate students’ number sense and self-determination as they explain why certain problem solving strategies are more efficient than others. Teachers can also foster students’ self-determination and conceptual understanding by allowing students to make choices during the problem solving process—even after they’ve explained the best way(s) to solve a problem (Boggiano et al., 1993).

Deci et al. (1994) investigated the depth and quality of 192 college students’ internalization while participating in an uninteresting activity. This study examined the effects that three specific treatments (i.e., offering a meaningful rationale, acknowledging students’ feelings and perspective, and providing choices rather than pressure) had on students’ internalization. Students who received either two or three of the conditions reported greater overall internalization than students who received only one or no conditions. Data analyses also showed that students who were given two or three conditions reported higher levels of integrated regulation, whereas students who were given only one or no conditions had higher levels of introjection.

Two related field experiments extended the findings of Deci et al. (1994). An explanatory rationale communicated in an autonomy-supportive way during an uninteresting activity increased college students’ engagement (Reeve et al., 2002) and conceptual understanding (Jang, 2008). Importantly, Reeve et al. (2002) and Jang (2008), like Deci et al. (1994), found that a rationale alone was not enough to facilitate internalization of curricular content; rather, a rationale communicated in an autonomy-supportive way fostered greater internalization. Autonomy support was provided through use of noncontrolling language (e.g., use of the phrase “we ask you to” instead of “you
should”) and acknowledging participants’ negative affect. An example of showing empathy and acknowledging participants’ negative affect from Reeve et al. (2002) was, “The information...has been difficult and at times frustrating. Still, we ask you to concentrate, persevere, and try hard” (p. 189), and an example from Jang (2008) was “Learning about correlations may not be fun for some of you. So it is understandable that you might not find it very interesting” (p. 802). Greater details on how the experimental conditions were manipulated through the provision of an autonomy-supportive rationale are included in Reeve et al. (2002, pp. 188-189) and Jang (2008, p. 802).

Williams and Deci (1996) found that medical school students who perceived their instructors as autonomy-supportive reported greater perceived competence and internalization of their instructors’ values regarding conducting medical interviews. The longitudinal nature of this study revealed that students transferred an autonomy-supportive communication style into their own medical settings involving interviews with patients, suggesting the depth at which the internalization occurred. In a similar study, Black and Deci (2000) found that college-level organic chemistry students who perceived their instructors as autonomy-supportive experienced more autonomous self-regulation, interest and enjoyment, and perceived competence; performed better academically; and experienced less anxiety over the semester.

Vallerand et al. (1997) used a sample of 4,537 students in grades 9 and 10 from seven public Canadian high schools to investigate the relationship between teachers’, parents’, and school administrators’ autonomy support and students’ perceived competence and autonomy. Low perceived autonomy support predicted low self-determined academic motivation, and high perceived autonomy support predicted self-
determined academic motivation. The quality of students' academic motivation (i.e., how autonomous, or self-determined, it was) influenced their intentions to stay in versus drop out of high school—intentions that they enacted one year later. Structural equation modeling (SEM) revealed that autonomy support positively predicted students' perceived competence and self-determined academic motivation that, in turn, predicted students’ decision to stay in school. Hardre and Reeve (2003) extended the findings of Vallerand et al. (1997) with a sample of 483 high school students drawn from four rural, public high schools in Iowa. SEM indicated that teachers’ autonomy support predicted students’ perceived competence and self-determined academic motivation that, in turn, predicted their intentions to persist in, versus drop out of, high school.

Ryan et al. (1999) investigated the relationship between university students’ life goals and their well-being. One hundred eighty-three Russian college students and 116 American college students from similar universities participated in this study ($N = 299$). Intrinsic life goals such as personal growth, meaningful interpersonal relationships, and community involvement were contrasted with extrinsic life goals such as fame, wealth, and image. Multiple-group mean and covariance structures (MACS) analyses found that attainment of intrinsic goals was associated with greater well-being, and attainment of extrinsic goals was not associated with well-being. These findings held true for American and Russian men and women. American men and women and Russian men who placed a high value on the importance of extrinsic life goals produced scores that were negatively related to well-being, but this relationship was not significant for the Russian women in this study. This study’s findings suggest that psychological well-being and happiness generate from attaining intrinsic goals associated with autonomous motives rather than
from attaining extrinsic goals associated with controlling motives such as fame, material possessions, and power. Educators can help students develop intrinsic goals and understand how the pursuit of these goals might facilitate feelings of contentment and satisfaction relative to the sole pursuit of extrinsic goals related to learning, such as grades, image, and pleasing authoritative figures.

The findings of Ryan et al. (1999) also have implications for curriculum development. Apple (2006, 2008) claimed that public school curriculum has been commodified to serve the purposes of capitalistic interests and aims almost exclusively to prepare students for the workforce. This is a criticism similar to Bullough and Kridel’s (2003) who, echoing the call of many others (e.g., Alexander, 2005; Apple & Beane, 2007; Beane, 2005; Brown, 2006; Dewey, 1916; Eisner, 2003; Hansen et al., 2008; Kliebard, 2004; Schutz, 2001), argued that curriculum could do more to prepare citizens for active participation in a democratic society than just prepare them for the workforce. The research findings of Ryan et al. (1999) seem to support a curriculum that emphasizes community involvement, raises students’ awareness of societal problems, and enables students to actively engage and connect with the world around them. Curricular aims such as these appear to have inherent intrinsic value to students and more adequately fulfill their basic psychological needs compared to a curriculum that—although it prepares them for the workforce—is perhaps more closely associated with extrinsic aspirations such as the accumulation of wealth. Regarding mathematics curriculum and instruction, Boaler (2011), Duncan-Andrade and Morrell (2008, pp. 157-170), Gutstein (2006), and Gutstein and Peterson (2005) illustrated how math can be taught in ways that
are conducive to community involvement and democratic participation (see Schiro, 2008, pp. 137-143, for a discussion).

Chirkov and Ryan (2001) investigated the relationship between parent and teacher autonomy-support and students’ academic self-motivation and well-being. One hundred sixteen high school students from the United States and 120 high school students from Russia participated in this study ($N = 236$). This study used the ASRQ to assess students’ academic self-motivation. MACS analyses indicated that parental and teacher autonomy-support were significantly related to students’ internalization of school-related goals. Only parental autonomy-support was related to students’ well-being, and only teacher autonomy-support was related to students’ intrinsic motivation in school. These findings suggest that parental autonomy-support has a greater influence upon students’ overall well-being, and teacher autonomy-support is more closely associated with students’ intrinsic motivation in school. The authors of this study concluded that, compared to parents, teachers “appear to more greatly affect students’ experiences of interest and challenge in the academic domain” (Chirkov & Ryan, 2001, p. 631).

Pelletier, Fortier, Vallerand, and Brière (2001) examined the relationship between coaches’ autonomy support and competitive swimmers’ self-determined motivation and persistence over a two-year period. Three hundred sixty-nine competitive swimmers from 23 different teams from the Province of Quebec, Canada participated in this study. SEM revealed that coaches’ autonomy support was more closely associated with swimmers’ self-determined forms of motivation (i.e., intrinsic motivation and integrated regulation) than with controlling forms of motivation (i.e., introjected regulation, external regulation, and amotivation), and a controlling coaching style was negatively associated with
swimmers’ self-determined forms of motivation and positively associated with
controlling forms of motivation. This study found that coaches’ autonomy support
positively predicted participants’ self-determined motivation; in turn, swimmers’ self-
determined motivation predicted whether or not they quit competitive swimming two
years later. This research thus extended the findings of a similar prospective study that
found autonomy support positively predicted self-determined motivation that, in turn,
predicted students’ decision to not drop out of high school (Vallerand et al., 1997).

Research conducted with 862 Israeli-Jewish students in grades 3 through 8 from
three different middle-class elementary schools in Israel sought to determine (a) if
children and adolescents could distinguish between three autonomy-supportive teacher
behaviors (i.e., fostering relevance, providing choice, and allowing criticism and
encouraging independent thinking) and three autonomy-suppressive teacher behaviors
(i.e., suppressing criticism and independent opinions, intruding, forcing meaningless and
uninteresting activities) and (b) which of these six behaviors best predicted students’
feelings toward and engagement in schoolwork (Assor et al., 2002). Statistical analyses
were conducted separately for students in grades 3 through 5 (n = 498) and students in
grades 6-8 (n = 364). Smallest Space Analyses (Bloombaum, 1970; Guttman, 1968)
indicated that both children and adolescent students were able to distinguish between the
six types of teacher behaviors. Regression analyses indicated that fostering relevance and
suppressing criticism were the two strongest predictors of students’ positive feelings
toward schoolwork and of their cognitive and behavioral engagement. This study’s
findings underscore the importance of providing autonomy support for both children and
young adolescents as a means of nurturing their positive feelings toward and engagement in school.

Koestner and Losier (2002) used a longitudinal design to investigate how students' internalizations affected their adjustment from high school to college and from college to post graduation. Somewhat surprisingly, they found that identified regulation was a more important predictor than intrinsic motivation of students' satisfaction and continued enrollment in college. Students' identification with the importance of school was more closely related to their adaptation, adjustment, and psychological well-being through school transitions than their feelings of interest and enjoyment in school. As hypothesized, introjection was significantly related to higher levels of psychological distress throughout college.

Vansteenkiste, Simons, Lens, Sheldon, and Deci (2004) explored the effect that framing intrinsic learning goals in an autonomy-supportive way versus framing extrinsic learning goals in a controlling way had on high school and college students' cognitive processing, conceptual learning, and persistence. Three separate studies included 200 female college students studying to become preschool teachers, 377 college students in a marketing class, and 224 10th- and 11th-grade students learning the Asian sport of Tai-bo, respectively. All participants attended schools in Belgium. In each of the three studies, participants were in one of four experimental conditions: (a) an intrinsic goal communicated in an autonomy-supportive way, (b) an intrinsic goal communicated in a controlling way, (c) an extrinsic goal communicated in an autonomy-supportive way, and (d) an extrinsic goal communicated in a controlling way.
Participants in each group received a set of instructions for an assigned reading activity. Instructions for participants in the intrinsic-goal-autonomy-supportive learning condition emphasized intrinsic learning goals such as community (Study 1), personal growth (Study 2), and health (Study 3) and included autonomy-supportive phrases such as “you can,” “you might,” “if you choose,” and “we ask you to.” In contrast, instructions for participants in the extrinsic-goal-controlling learning condition highlighted extrinsic learning goals such as saving money (Study 1), attaining wealth (Study 2), and maintaining an attractive physical appearance (Study 3) and included controlling phrases such as “you should,” “you have to,” “you’d better,” and “you must.” For example, the instructions for participants in the intrinsic-goals-autonomy-supportive condition of Study 2 stated, “Carefully reading the text about communication styles can contribute to your personal development” (i.e., an intrinsic goal) and “You might decide to try to learn more about communication styles” (i.e., use of autonomy-supportive language; Vansteenkiste et al., 2004, p. 252). In contrast, instructions for participants in the extrinsic-goals-controlling learning condition of Study 2 stated, “Carefully reading the text about communication styles can help your chances of getting a well-paid job in the future” (i.e., an extrinsic goal) and “You should learn more about communication styles” (i.e., use of controlling language; Vansteenkiste et al., 2004, p. 252).

ANOVAs found that students in the intrinsic-goals-autonomy-supportive condition showed significantly greater cognitive processing, conceptual learning, and persistence than students in the extrinsic-goals-autonomy-suppressive condition. Results further indicated that intrinsic learning goals and autonomy support (although they were used together within the same experimental condition) both had unique main effects on
the dependent variables related to students’ learning. Autonomy support and intrinsic goal framing appeared to uniquely contribute to positive learning outcomes.

Two related studies conducted with fifth and sixth grade Belgian students replicated and extended the findings of Vansteenkiste et al. (2004). Framing intrinsic learning goals in an autonomy-supportive way produced significantly greater conceptual learning compared to students whose learning tasks were framed with extrinsic learning goals communicated in a controlling way (Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008). Notably, these two studies (i.e., Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008) also found that extrinsic goal framing and use of a controlling motivating style produced no significant difference upon students’ rote learning compared to intrinsic goal framing using autonomy-supportive communication. It thus appears that intrinsic goal framing and extrinsic goal framing, irrespective of how they are communicated to students, are similarly effective at producing learning involving memorization and recall. In fact, Vansteenkiste, Simons, et al. (2005) found that rote learning was often greater for students in the extrinsic-goals-controlling condition compared to students in the intrinsic-goals-autonomy-supportive condition, but not significantly greater. Likewise, Grolnick and Ryan (1987) found that rote learning was greater for students in a controlling learning condition (i.e., one that emphasized grades) compared to students in an autonomy-supportive condition, but not significantly greater. Boggiano et al. (1993) and Jang (2008) also found no significant differences in rote learning between participants in a controlling condition and an autonomy-supportive learning condition.
In sum, research suggests that controlling teacher practices undermine conceptual, but not rote, learning (Boggiano et al., 1993; Grolnick & Ryan, 1987; Jang, 2008; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008). Intrinsic learning goals explained in a way that nurtures students’ autonomy appear to best facilitate deep conceptual learning but do not appear to affect rote learning compared to controlling teaching strategies. The controlling strategies used in these studies included (a) use of controlling language such as “should” and “must” (Jang, 2008; Vansteenkiste et al., 2004; Vansteenkiste, Simons et al., 2005); (b) not allowing time for independent work (Boggiano et al., 1993), (c) insistence on using the teacher’s prescribed method for solving a problem (Boggiano et al., 1993), and (d) emphasizing extrinsic learning goals such as grades (Grolnick & Ryan, 1987), money, and image (Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008).

Reeve et al. (2004) investigated if teacher autonomy-support enhanced students’ engagement. Twenty veteran classroom teachers from two different high schools in the midwestern United States participated in this experimental study. Teachers who were trained to use autonomy-supportive instructional behaviors displayed significantly more autonomy-supportive instructional techniques than teachers who were not trained, and students’ engagement increased as teachers’ use of autonomy-supportive behaviors increased.

Soenens and Vansteenkiste (2005) conducted two separate studies to explore the relationship between teachers’ autonomy support and students’ self-determined academic motivation. Self-determined academic motivation was, in turn, expected to predict participants’ school competence, grade point average (GPA), and self-determined
motives for searching for a job after high school graduation. Participants' job search
behavior (e.g., writing an application letter, looking for jobs on the internet, and
contacting possible employers) was assessed only in Study 2. Three hundred twenty-eight
Belgian students in grades 10 through 12 participated in Study 1, and 285 Belgian
students in grades 12 through 13 from three different schools participated in Study 2.
Participants in Study 2 were enrolled in "lower educational disciplines, that is, the
technical and vocational training classes" (Soenens & Vansteenkiste, 2005, p. 597).

SEM revealed a significant relationship between teachers' autonomy support and
participants' self-determined academic motivation. Academic motivation, in turn,
predicted students' school competence, GPA (but only in Study 2), and proactive, self-
determined job-searching behaviors. Teacher autonomy support was unrelated to
participants' GPA in Study 1 ($r = .02$, ns) and significantly related to GPA in Study 2,
although the effect size for this relationship was small ($r = .19$, $p < .01$). Participants self-
reported their GPA in this study. While this is a notable limitation, several studies have
found students' self-reported GPA correlates highly with their actual GPA, $r = .68$, $p <
.01$ (Battin-Pearson et al., 2000), and $r = .76$, $p < .01$ (Dornbusch, Ritter, Leiderman,
Roberts, & Fraleigh, 1987).

Reeve and Jang (2006) examined how autonomy-supportive and controlling
instructional practices were related to students' perceived autonomy. Listening to
students, allowing students to work in their own way on a problem, praising improvement
and mastery, allowing students to talk and think aloud, encouraging students' effort,
offering hints to students who seemed stuck, being responsive to student-generated
questions and comments, and making perspective-acknowledging statements were
significantly and positively related to perceived autonomy support. Limiting students' access to learning materials, providing answers to students without providing adequate time for them to work on the problems independently and discover it on their own, using directives and commands, making "should" statements during instruction, and asking controlling questions to direct students' work (e.g., "Would a good student do that?") were identified as controlling instructional behaviors and were significantly and negatively related to students' perceived autonomy.

Trouilloud, Sarrazin, Bressoux, and Bois (2006) used a 1-year longitudinal design to examine the relationship between teachers' early expectations (TEE) of their students and students' later perceived competence. Students often adopt behaviors based on their perceptions of TEEs of them; accordingly, TEEs often become a self-fulfilling prophecy (Brophy, 1983). For instance, if initial interactions with a teacher lead a student to believe that the teacher thinks he or she has low competence, then the student might act that way, or, even worse, come to believe that he or she actually has low competence. Notably, multiple studies have found that TEEs for their students' mathematical ability influence students' self-concepts of their mathematical ability (Jussim, 1989; Madon et al., 2001; Parsons, Kaczala, & Meece, 1982). In turn, students' academic self-concept can affect their academic achievement (Jussim, 1986, 1989), although Trouilloud (2002) found that teacher expectations had weak self-fulfilling effects and strongly predicted students' actual achievement.

French students \( N = 421 \) in grades 7 through 11 and their 22 physical education teachers from 10 different high schools in France participated in the study. Students' self-reported their perceived competence during the first and last month of the school year. To
assess TEEs, teachers completed a questionnaire during the first month of the school year to measure their expectations about students' performance and ability. Students completed the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996) in the middle of the school year to assess teacher autonomy support.

Hierarchical linear modeling (HLM), or multilevel modeling (Field, 2009; Raudenbush & Bryk, 2002), found that, as hypothesized, (a) positive TEEs were positively related to students' later perceived competence, (b) teacher autonomy support predicted students' perceived competence, and (c) teacher autonomy support appeared to moderate the impact of low TEEs on students' later perceived competence. The combination of low TEEs and low perceived teacher autonomy support appeared to have a detrimental impact on students' later perceived competence. Conversely, when teachers' early expectations of students' abilities were low yet students perceived their teacher as autonomy-supportive, students were less likely to have low perceived competence at the end of the school year. Students' perceived teacher autonomy support seemed to mitigate the impact of low TEEs upon students' later perceived competence.

Tsai et al. (2008) examined the extent to which teachers' autonomy support predicted students' interest in mathematics lessons. Seventh grade students ($N = 261$) from two public gymnasium schools in Berlin, Germany participated in this study. Gymnasium schools represent the highest academic track within the 3-tier secondary school system in Germany. HLM analyzed the relationship between teachers' autonomy support and participants' interest in math lessons over a 3-week period.

This study differentiated between an overall autonomy-supportive classroom environment (as measured by a 6-item version of the LCQ), teachers' use of controlling
behaviors (e.g., “Our teacher expected split-second answers,” “Our teacher’s instructions were so vague that nobody knew what to do,” “Our teacher covered so much material that we had difficulty keeping up,” and “Our teacher was mean to a student”), and teachers’ cognitive autonomy support. Cognitive autonomy support occurs “when teachers explain the purposes of the task at hand and its links to the learning concepts and scaffold students’ understanding by activating prior knowledge or increasing personal relevance” (Tsai et al., 2008, p. 462). Cognitive autonomy support allows students to “experience a sense of personal control at the cognitive level,” and students have evidenced greater involvement and positive attitudes in mathematics when teachers “scaffold learning and transfer responsibilities to students” (Tsai et al., 2008, p. 462). Using a 6-point scale that ranged from 1 (strongly disagree) to 6 (strongly agree), participants responded to the following four items that assessed perceived teacher cognitive autonomy support: “We worked through exercises that helped us understand the topic,” “Different students presented their solutions to the same task,” “Our teacher set tasks that required time to reflect,” and “Our teacher emphasized the relations between the topics discussed” (Tsai et al., 2008, p. 472).

HLM found that the effects of an autonomy-supportive climate, cognitive autonomy support, and controlling teacher behaviors on students’ interest in math lessons varied significantly according to each individual student. Controlling teacher behaviors were less likely to influence students with greater individual interest in the math lessons compared to students with lower individual interest in the math lessons; that is, students who enjoyed a math lesson were less likely to lose interest when the teacher used a controlling behavior (e.g., demanded a split-second answer), and students who
experienced less interest in a math lesson were likely to further lose interest in the lesson when the teacher used a controlling behavior. In contrast, all students’ interest experience, regardless of their individual interest in a lesson, was likely to be affected by the overall autonomy-supportiveness of the learning environment (as measured by the LCQ). Furthermore, cognitive autonomy support (e.g., activating prior knowledge, promoting conceptual understanding, and helping students clearly see the value in learning the specified mathematical tasks) contributed unique effects to students’ interest and engagement in math lessons, over and above the effects of the other two variables (i.e., an overall autonomy-supportive climate and controlling behaviors).

An important, unique contribution of this research was the finding that individual interest in mathematics made a student more or less vulnerable to a teacher’s motivating style. Stated differently, teachers’ motivating style—namely three different modes of autonomy support—affected some students’ interest experience differently than others. However, all students, regardless of individual differences in interest-levels during a math lesson, were relatively sensitive to an autonomy-supportive classroom. An additional unique, original finding of this research was that cognitive autonomy support was most closely associated with students’ interest in math lessons ($r = .66, p < .01$), followed by an autonomy-supportive climate ($r = .57, p < .01$) and then controlling teacher behaviors ($r = -.19, p < .05$).

Vansteenkiste et al. (2009) investigated the relationship between optimal learning outcomes and four different types of motivation espoused by SDT (i.e., external, introjected, and identified regulation and intrinsic motivation). Two hundred ninety-one students from two Belgian high schools and 484 college students from four Belgian
teacher training programs participated in this research. The ASRQ measured participants’ academic motivation. Optimal learning was measured by participants’

- **cognitive processing** (e.g., building connections and linking new knowledge to prior knowledge);
- **metacognition** (e.g., cognitive monitoring, cognitive control over one’s thoughts and thought processes, goal setting, self-testing, and giving self-feedback);
- **affective self-regulation** (e.g., handling test anxiety);
- **cognitive self-regulation** (e.g., effectively managing study time and choosing an appropriate, distraction-free location to study);
- **determination/persistence**;
- **procrastination**;
- **cheating attitude** and **cheating behavior**; and
- **academic performance** (e.g., grades on exams from the previous semester).

Self-report questionnaires were used to measure the outcome variables in this study, including students’ grades. Several studies have found self-reported GPA to be a reliable measure of actual GPA (Battin-Pearson et al., 2000; Dornbusch et al., 1987; Herman, Dornbusch, Herron, & Herting, 1997). The alphas for the questionnaires were above .70, providing evidence of good internal consistency.

In this study, autonomous motivation (i.e., intrinsic motivation and identified regulation) was significantly and positively associated with cognitive processing, metacognitive strategy use, time and environment use, persistence, and grades, and it was significantly and negatively associated with procrastination, cheating attitude, and cheating behavior. Notably, these correlations were moderately strong and significant at
the $p < .001$ level. Autonomous motivation was unrelated to test anxiety. Controlled motivation (i.e., external and introjected regulation) was significantly and negatively related to time and environment use, persistence, and grades; significantly and positively related to test anxiety, procrastination, cheating attitude, and cheating behavior; and unrelated to cognitive processing and metacognitive strategy use. Significant relationships between controlled motivation and the outcome variables were significant at the $p < .001$ level as well. Participants were more likely to display autonomous motivation and demonstrate optimal learning when teachers provided a high degree of autonomy support.

A case study conducted in a large, suburban public middle school located in the southeastern United States investigated how autonomy-supportive teaching influenced 10 seventh grade students' understanding of algebra (Whaley, 2012). Allowing students to design algebraic word problems on the basis of their interests (e.g., extracurricular activities and hobbies) enhanced their conceptual understanding of how equations are used to model real-world phenomena. Interviews with students indicated that they developed greater mathematical reasoning skills and algebraic habits of mind as a result of the assignment (i.e., modeling and representation; Driscoll, 1999; Cuoco & Curcio, 2001). Allowing students to make choices about the content of their word problems and incorporate their interests into the learning process stimulated their academic engagement and facilitated conceptual understanding.

*Teacher Autonomy Support in Nonwestern Cultures*

Recent SDT research has investigated the importance of autonomy for students in nonwestern collectivist-oriented societies. Some theorists have asserted that Eastern
students might “flourish when they are forced to meet pressuring internal or external expectations,” and that Asian children “don’t appear to suffer any obvious negative consequences of the enormous pressure that is placed on them to achieve” (Markus & Kitayama, 2003, p. 4). SDT maintains that such pressures thwart students’ social and emotional development and diminish their psychological well-being. Several studies investigated this hypothesis, namely, the extent to which Asian students’ in Eastern countries autonomy support was related to their learning and well-being.

Four separate research studies conducted with South Korean high school students explored the role that teacher autonomy support and basic psychological need satisfaction (i.e., autonomy, competence, and relatedness) played in predicting the quality of students’ learning experiences (Jang et al., 2009). Students’ perceived teacher autonomy support and psychological need satisfaction were significantly related to high levels of engagement, achievement (but only in 1 of the 3 studies), intrinsic motivation, and emotional well-being. Achievement was measured by students’ course grades from their school records. In this study, satisfaction of needs for autonomy and competence were more closely related to the outcome variables (i.e., high levels of engagement, achievement, intrinsic motivation, and emotional well-being) than the need for relatedness.

Vansteenkiste, Zhou, Lens, and Soenens (2005) investigated the relationship between participants’ self-determined academic motivation and a variety of learning outcomes among a sample of Chinese students learning the English language. One hundred thirty-two students from Shenyang, China participated in Study 1, and 79 Chinese students participated in Study 2. Participants ranged in age from 18 to 39 years.
In this study, Chinese students who had a more autonomous academic orientation for learning (as measured by the ASRQ) were significantly more likely to use self-regulated learning strategies effectively (e.g., time management, concentration, and deep information processing); hold positive attitudes toward learning course content (e.g., less procrastination, higher class attendance, greater interest in course material, and less performance anxiety); and have higher academic achievement than participants who had a less autonomous, self-determined academic motivation. Academic achievement was measured by participants' self-reported score on the International English Language Testing System. Participants who had a more controlled academic motivation were more likely to drop-out, apply self-regulation strategies less effectively, have poorer dispositions toward school, and have diminished psychological well-being (e.g., depression, mood, energy, and sense of vitality). This study found that autonomous motivation was significantly related to optimal learning among nonwestern students. Additionally, Zhou et al. (2009) found that teacher autonomy support positively predicted fourth and fifth grade rural Chinese students' \((N = 48)\) perceived competence and autonomous academic motivation (i.e., intrinsic motivation and identified regulation as measured by the ASRQ).

Kaplan and Madjar (2012) investigated the relationship between parent and teacher autonomy support and 102 Bedouin-Israeli students' motivation to use proenvironmental behaviors (PEB). Participants were in grades 8, 9, and 10 and situated within a hierarchical-collectivist oriented society. Participants completed questionnaires that assessed their teachers' and parents' autonomy support, their autonomous motivation (i.e., reasons) for engaging in PEB, their perceived competence and their sense of
relatedness as control variables, and their attitude toward practicing different types of PEB. Teachers provided lessons about the importance of PEB such as recycling, cleaning, conservation, and environmental activism. SEM found that teacher autonomy support had unique positive effects on students’ autonomous motivation and intention to practice PEB, controlling for perceived competence and relatedness. The results appeared to uphold the SDT claim that autonomy support expedites the internalization process by enabling students to identify with the importance and value a given behavior expresses.

The collective body of research conducted within authoritarian cultures (Chirkov & Ryan, 2001), hierarchically-structured, collectivist-oriented cultures (Kaplan & Madjar, 2012) and Eastern collectivist-oriented cultures (Jang et al., 2009; Vansteenkiste, Zhou, et al., 2005; Zhou et al., 2009) thus extended the findings of similar research among Western samples. Likewise, Chirkov’s (2009) review of literature found that autonomous motivation and autonomy support were linked to an array of educational benefits in a variety of cultures. The results of these studies further solidify the notion that autonomy is a fundamental human need and that, across cultures, “perceiving others as supporting one’s autonomy facilitates well-being and self-motivation” (Chirkov & Ryan, 2001, p. 632). Yet the satisfaction of the need for autonomy goes beyond mere self-absorption (Wayment & Bauer, 2008). As Reeve and Assor (2011) argued:

An autonomy-promoting school is a social asset. This is so because the satisfaction of the need for autonomy and offering of recurring classroom opportunities to experience autonomy enable students to become more fully and more wholeheartedly immersed in the learning process. This, in turn, promotes
optimal learning and personal growth, as well as the inclinations to internalize
cultural values, care for others, and contribute to important social causes. (p. 128)

It seems plausible that a more psychologically-satisfied, optimally functioning citizenry
would generate a more optimally functioning society.

*Autonomy Support and Structure*

Teachers do not have to choose between offering students autonomy support or
structure. Autonomy support does not mean permissiveness or laissez-faire classroom
management (Reeve, 2002, 2009; Reeve & Halusic, 2009). Research has found that
autonomy support and structure are neither orthogonal nor antithetical constructs.

Teachers support students’ psychological need for competence by providing
structure (Skinner & Belmont, 1993). Teachers create structure by setting clear guidelines
and expectations, maintaining an organized classroom, supplying timely feedback,
providing adequate help, and helping students establish goals (Jang et al., 2010; Koestner
& Losier, 2002, pp. 114-115; Reeve, 2002, 2009; Sierens et al., 2009; Vansteenkiste et
al., 2009). Teachers’ can vitalize their students’ inner motivational resources by
providing structure in an autonomy-supportive—rather than a controlling—way (Reeve,

Sierens et al. (2009) found that autonomy support and structure were positively
and significantly correlated ($r = .67, p < .01$). In this study, when teachers’ provided
moderate-to-high levels of both perceived autonomy-support and structure, Belgian high
school and first-year college students’ ($N = 526$) were significantly more likely to use
metacognitive, self-regulation, and cognitive processing strategies than when teachers
offered little autonomy-support. Participants assessed their teachers’ provision for
structure with an 8-item version of the Teacher as Social Context Questionnaire (Belmont, Skinner, Wellborn, & Connell, 1988) that included items such as, “If I can’t solve a problem, this teacher shows me different ways to try to.”

Vansteenkiste et al. (2009) also found that autonomy support and structure were positively correlated \( (r = .59, p < .001) \). Belgian high school and college students \( (N = 1,371) \) were significantly more likely to display intrinsic motivation and identified forms of extrinsic motivation when teachers provided both autonomy support and structure. In turn, students’ autonomous motivation was positively associated with cognitive processing, metacognitive self-regulation, and effort and negatively associated with test anxiety and procrastination.

A study conducted in nine public high schools throughout the midwestern United States with 1,584 students in grades nine through 11 found that students’ engagement was highest when teachers provided high levels of both autonomy support and structure (Jang et al., 2010). In this study, autonomy support and structure were positively and significantly correlated \( (r = .60, p < .01) \). Autonomy support and structure both uniquely predicted students’ observed behavioral engagement, but only autonomy support predicted students’ self-reported engagement. Trained observers blind to the purpose of the study used instruments validated in previous research to rate teachers’ autonomy supportiveness, teachers’ provision for structure, and six indices of students’ behavioral engagement (e.g., attention, effort, verbal participation, persistence, positive emotion, and voice). The student self-report measure of engagement was a questionnaire that included behavioral, cognitive, and emotional measures of engagement.
In three separate studies, autonomy support and structure were found to be significantly, positively, and strongly correlated (Jang et al., 2010; Sierens et al., 2009; Vansteenkiste et al., 2009). Furthermore, autonomy support and structure both uniquely predicted many positive learning outcomes (i.e., engagement, autonomous academic motivation, use of metacognitive strategies, and self-regulation) among college and high school students, although autonomy support explained more of the variance among the outcome variables in these studies. Earlier experimental research also found that autonomy support and structure appeared to both be fundamental ingredients to cultivating students' autonomous motivation and concomitant positive learning outcomes. Koestner et al. (1984) found that setting limits using autonomy-supportive, informational language sustained elementary school students' intrinsic motivation and creative expression compared to setting limits through use of controlling, authoritarian language. These studies seem to indicate that teachers' provisions for autonomy support and structure facilitate optimal learning.

Summary of the Research on Teacher Autonomy Support

Over the last three decades, researchers have applied self-determination theory to a variety of classroom settings across the globe (e.g., elementary schools, middle schools, junior high schools, high schools, and universities in Belgium, Brazil, Canada, China, France, Germany, Israel, Japan, Russia, South Korea, and the United States). The findings of these studies suggest that autonomy support is an important variable related to students' motivation, learning, performance, and well-being. This chapter reviewed 32 studies in which autonomy support was investigated within educational settings; 19 studies were nondirectional correlation studies, 12 were experimental studies in which a
teacher’s motivational style affected students’ motivation and learning, and one was a case study. Nondirectional correlational studies found significant relationships between teachers’ autonomy support and students’

- academic achievement (Black & Deci, 2000; Jang et al., 2009; Soenens & Vansteenkiste, 2005; Vansteenkiste, Zhou, et al., 2005);
- academic engagement (Assor et al., 2002; Assor et al., 2005; Jang et al., 2010; Jang et al., 2009);
- anxiety and pressure (Black & Deci, 2000; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005);
- autonomous, self-determined academic motivation (Black & Deci, 2000; Hardre & Reeve, 2003; Pelletier et al., 2001; Soenens & Vansteenkiste, 2005; Vallerand et al., 1997; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005; Zhou et al., 2009);
- cognitive processing (Sierens et al., 2009; Vansteenkiste et al., 2009);
- effort and persistence (Pelletier et al., 2001; Soenens & Vansteenkiste, 2005; Vansteenkiste, Zhou, et al., 2005; Vansteenkiste et al., 2009);
- decision (Vallerand et al., 1997), or intention (Hardre & Reeve, 2003), to not drop out of high school;
- internalized curricular content/values (Chirkov & Ryan, 2001; Kaplan & Madjar, 2012; Soenens & Vansteenkiste, 2005; Williams & Deci, 1996);
- intrinsic motivation (Assor et al., 2002; Black & Deci, 2000; Chirkov & Ryan, 2001; Deci, Nezlek, & Sheinman, 1981; Jang et al., 2009; Tsai et al., 2008; Vansteenkiste, Zhou, et al., 2005);
• perceived competence (Black & Deci, 2000; Deci, Nezlek, & Sheinman, 1981; Hardre & Reeve, 2003; Trouilloud et al., 2006; Vallerand et al., 1997; Williams & Deci, 1996; Zhou et al., 2009);
• use of metacognitive strategies (Sierens et al., 2009; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005); and
• use of self-regulation strategies (Sierens et al., 2009; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005).

Experimental studies found causal links between teachers’ autonomy support and students’
• academic engagement (Jang, 2008; Reeve et al., 2004; Whaley, 2012);
• academic task performance (Boggiano et al., 1993; Flink et al., 1990);
• anxiety and pressure (Flink et al., 1990; Grolnick & Ryan, 1987);
• autonomous, self-determined academic motivation (Jang, 2008; Reeve et al., 2002);
• conceptual understanding (Benware & Deci, 1984; Boggiano et al., 1993; Grolnick & Ryan, 1987; Jang, 2008; Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008; Whaley, 2012);
• cognitive processing (Vansteenkiste et al., 2004);
• creativity (Koestner et al., 1984);
• effort and persistence (Reeve et al., 2002; Vansteenkiste et al., 2004; Vansteenkiste, Timmermans, et al., 2008);
• internalized curricular content (Deci et al., 1994; Jang, 2008; Reeve et al., 2002; Vansteenkiste, Timmermans, et al., 2008);
• intrinsic motivation (Benware & Deci, 1984; Boggiano et al., 1993; Grolnick & Ryan, 1987; Koestner et al., 1984; Vansteenkiste, Timmermans, et al., 2008); and
• use of self-regulation strategies (Jang, 2008).

Table 1 provides a brief synopsis of the 32 empirical studies reviewed in this chapter in which autonomy support was investigated within educational settings. Table 1 includes the authors of the research, the year of publication, a brief description of the sample, and a synthesis of the research findings. The studies are listed in chronological order, based on their publication date. Figure 2 illustrates the educational benefits of teacher autonomy support according to the 32 empirical studies listed in Table 1.
### Table 1

**Summary of Empirical Findings on the Educational Benefits of Teacher Autonomy Support**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>N</th>
<th>Location of Study (Country)</th>
<th>Educational Benefits of Teacher Autonomy Support (TAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deci, Nezlek, &amp; Sheinman(^a)</td>
<td>1981</td>
<td>610 students in grades 4-6</td>
<td>Four suburban elementary schools in New York (US)</td>
<td>TAS significantly related to students’ intrinsic motivation, perceived competence, and self-esteem</td>
</tr>
<tr>
<td>Benware &amp; Deci(^b)</td>
<td>1984</td>
<td>40 college students in a psychology course</td>
<td>University of Rochester (US)</td>
<td>TAS enhanced students’ intrinsic motivation and conceptual understanding of course material</td>
</tr>
<tr>
<td>Koestner, Ryan, Bernieri, &amp; Holt(^b)</td>
<td>1984</td>
<td>43 students in grades 1-2</td>
<td>A suburban elementary school in New York (US)</td>
<td>TAS fostered greater intrinsic motivation and creativity</td>
</tr>
<tr>
<td>Grolnick &amp; Ryan(^b)</td>
<td>1987</td>
<td>91 students in grade 5</td>
<td>Three elementary schools in Rochester, New York (US)</td>
<td>TAS facilitated greater intrinsic motivation toward curricular content, greater conceptual understanding of reading material, and less pressure/tension</td>
</tr>
<tr>
<td>Flink, Boggiano, &amp; Barrett(^b)</td>
<td>1990</td>
<td>15 fourth grade teachers and 267 of their students</td>
<td>Seven elementary schools in a Colorado school district (US)</td>
<td>Teachers who felt pressured to maximize student performance were significantly more likely to use controlling strategies that, in turn, significantly diminished students’ task performance</td>
</tr>
</tbody>
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### Table 1 (continued)

<table>
<thead>
<tr>
<th>Authors</th>
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<th>N</th>
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<tr>
<td>Boggiano, Flink, Shields, Seelbach, &amp; Barrett b</td>
<td>1993</td>
<td>34 (Study 1) and 83 (Study 2) college students in a psychology course</td>
<td>University of Colorado, Boulder (US)</td>
<td>TAS enhanced students' feelings of self-determination while solving complex logic problems (Study 1) and facilitated significantly higher student performance on analytic reasoning problems (Study 2)</td>
</tr>
<tr>
<td>Deci, Eghrari, Patrick, &amp; Leone b</td>
<td>1994</td>
<td>192 college students in a psychology course</td>
<td>University of Rochester (US)</td>
<td>TAS facilitated greater internalization of the content presented in a laboratory experiment</td>
</tr>
<tr>
<td>Williams &amp; Deci a</td>
<td>1996</td>
<td>91 (Study 1) and 72 (Study 2) medical students</td>
<td>Two different universities (US)</td>
<td>TAS associated with greater perceived competence and with deeper internalization of an autonomy-supportive, psychosocial approach to interviewing patients</td>
</tr>
<tr>
<td>Vallerand, Fortier, &amp; Guay a</td>
<td>1997</td>
<td>4,537 students in grades 9-10</td>
<td>Seven public high schools in Montreal (Canada)</td>
<td>TAS associated with students' self-determined academic motivation and perceived competence that, in turn, predicted students' choice to stay in school rather than drop out</td>
</tr>
<tr>
<td>Black &amp; Deci a</td>
<td>2000</td>
<td>137 college students enrolled in an organic chemistry course</td>
<td>A small eastern university (US)</td>
<td>TAS significantly related to greater interest and enjoyment, perceived competence, and autonomous motivation for learning; higher end-of-course grades; and less anxiety</td>
</tr>
<tr>
<td>Authors</td>
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<tr>
<td>Chirkov &amp; Ryan</td>
<td>2001</td>
<td>116 US students and 120 Russian students</td>
<td>Two high schools (US and Russia, respectively)</td>
<td>TAS associated with students' internalization of school-related goals and intrinsic motivation in school</td>
</tr>
<tr>
<td>Pelletier, Fortier, Vallerand, &amp; Brière</td>
<td>2001</td>
<td>369 competitive swimmers from 23 different teams, (mean age = 15.6, age range = 13-22)</td>
<td>The Province of Quebec (Canada)</td>
<td>Coaches' autonomy-support associated with swimmers' self-determined motivation and persistence over a two-year period; controlling relationships fostered non-self-determined behavioral regulation and less persistence</td>
</tr>
<tr>
<td>Reeve, Jang, Hardre, &amp; Omura</td>
<td>2002</td>
<td>141 (Study 1) and 70 (Study 2) college students enrolled in a psychology course</td>
<td>A large midwestern university (US)</td>
<td>TAS facilitated greater internalization and self-determined motivation during an uninteresting activity that, in turn, facilitated greater effort</td>
</tr>
<tr>
<td>Assor, Kaplan, &amp; Roth</td>
<td>2002</td>
<td>862 Israeli-Jewish students in grades 3-8</td>
<td>Three middle-class elementary schools (Israel)</td>
<td>TAS significantly related to students' cognitive and behavioral engagement in school work and to students' positive feelings toward learning</td>
</tr>
<tr>
<td>Hardre &amp; Reeve</td>
<td>2003</td>
<td>483 students in grades 9-12</td>
<td>Four rural, public high schools from four Iowa school districts (US)</td>
<td>TAS predicted students' self-determined motivation, perceived competence, and intention to remain in, versus drop out of, high school</td>
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<tr>
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<tr>
<td>Vansteenkiste, Simons, Lens, Sheldon, &amp; Deci b</td>
<td>2004</td>
<td>200 female college students (Study 1); 377 college students (Study 2); 224 high school students (Study 3)</td>
<td>One university and one high school (Belgium)</td>
<td>TAS facilitated deeper cognitive processing, higher test performance (i.e., a written test assessing students' conceptual learning), and greater persistence</td>
</tr>
<tr>
<td>Reeve, Jang, Carrell, Jeon, &amp; Barch b</td>
<td>2004</td>
<td>20 high school teachers</td>
<td>Two midwestern high schools (US)</td>
<td>TAS facilitated greater student academic engagement</td>
</tr>
<tr>
<td>Soenens &amp; Vansteenkiste a</td>
<td>2005</td>
<td>328 students in grades 10-12 (Study 1); 285 students in grades 12-13 (Study 2)</td>
<td>Several secondary schools/high schools (Belgium)</td>
<td>TAS positively associated with students' academic motivation (i.e., their RAI), grade point average (Study 2), and self-determined job-search motivation (Study 2)</td>
</tr>
<tr>
<td>Vansteenkiste, Simons, Lens, Soenens, &amp; Matos b</td>
<td>2005</td>
<td>130 (Study 1), 113 (Study 2), and 80 (Study 3) Belgian students in grades 5-6</td>
<td>Over 40 elementary schools (Belgium)</td>
<td>TAS and intrinsic goal framing both uniquely enhanced conceptual (but not rote) learning of reading material</td>
</tr>
<tr>
<td>Assor, Kaplan, Kanat-Maymon, &amp; Roth a</td>
<td>2005</td>
<td>319 Israeli-Jewish students in grades 4-5</td>
<td>Four different schools (Israel)</td>
<td>Controlling teacher behaviors undermined students' academic engagement and induced student's feelings of anxiety and anger toward their teacher</td>
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<th>Author(s)</th>
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<tr>
<td>Vansteenkiste, Zhou, Lens, &amp; Soenens&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2005</td>
<td>132 (Study 1) and 79 (Study 2) Chinese students learning English</td>
<td>Shenyang, China (Study 1); Belgium (Study 2)</td>
<td>Parental autonomy support predicted students' autonomous motivation for studying; in turn, autonomous motivation was associated with a positive attitude toward learning, concentration, time management, reduced performance anxiety, higher test performance, and lower dropout</td>
</tr>
<tr>
<td>Trouilloud, Sarrazin, Bressoux, &amp; Bois&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2006</td>
<td>421 students in grades 7-11 and 22 of their teachers</td>
<td>10 high schools (France)</td>
<td>TAS predicted students' perceived competence in physical education classes and moderated the relationship between teachers' early low expectations of students and students' later perceived competence</td>
</tr>
<tr>
<td>Vansteenkiste, Timmermans, Lens, Soenens, &amp; Van den Broeck&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2008</td>
<td>138 students in grades 5-6</td>
<td>Schools in Tremeloo (Belgium)</td>
<td>Framing a learning activity in terms of an intrinsic (rather than an extrinsic) goal enhanced students' intrinsic motivation, internalization of curricular content, conceptual (but not rote) learning of reading material, and persistence</td>
</tr>
<tr>
<td>Jang&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2008</td>
<td>136 college students enrolled in an educational psychology course</td>
<td>A large midwestern university (US)</td>
<td>TAS facilitated greater self-determined motivation (i.e., identified regulation), interest-enhancing strategies, behavioral engagement, and conceptual learning during an uninteresting learning activity</td>
</tr>
<tr>
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<tr>
<td>Tsai, Kunter, Lüdtke, Trautwein, &amp; Ryan a</td>
<td>2008</td>
<td>261 German high school students in grade 7</td>
<td>Two public gymnasium schools in Berlin (Germany)</td>
<td>TAS, particularly cognitive autonomy support, predicted students’ interest in math lessons, after controlling for individual interests and other individual characteristics (i.e., grades and gender)</td>
</tr>
<tr>
<td>Vansteenkiste, Sierens, Soenens, Luyckx, &amp; Lens a</td>
<td>2009</td>
<td>887 students in grades 7-12 (Study 1); 484 college students (Study 2)</td>
<td>Two high schools (Study 1); four teacher training institutes (Study 2) (Belgium)</td>
<td>TAS associated with higher quality (i.e., more autonomous) motivation that, in turn, was positively related to students’ effective cognitive processing, use of meta-cognitive strategies, use of time and environment, and effort and was negatively associated with students’ test anxiety and procrastination</td>
</tr>
<tr>
<td>Sierens, Vansteenkiste, Goossens, Soenens, &amp; Dochy a</td>
<td>2009</td>
<td>586 students in grades 11-12</td>
<td>Two secondary schools (Belgium)</td>
<td>TAS, when coupled with teacher-provided structure, positively predicted students’ use of metacognitive, self-regulation, and cognitive processing strategies</td>
</tr>
<tr>
<td>Jang, Reeve, Ryan, &amp; Kim a</td>
<td>2009</td>
<td>837 Korean students in grades 9-10</td>
<td>Three urban, middle-class high schools in Seoul (South Korea)</td>
<td>TAS significantly related to students’ intrinsic motivation, engagement, achievement (in 1 of the 3 studies), and less negative affect</td>
</tr>
</tbody>
</table>
Table 1 (continued)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>N</th>
<th>Location of Study (Country)</th>
<th>Educational Benefits of Teacher Autonomy Support (TAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhou, Ma, &amp; Deci⁴</td>
<td>2009</td>
<td>195 (Study 1) and 48 (Study 2) Chinese students in grades 4-6</td>
<td>Rural, public elementary schools (Mainland China)</td>
<td>TAS positively associated with students' autonomous motivation for learning and with their perceived competence in math and English language classes</td>
</tr>
<tr>
<td>Jang, Reeve, &amp; Deci⁴</td>
<td>2010</td>
<td>1,584 students in grades 9-11 (84 different classes)</td>
<td>Nine public, midwestern high schools (US)</td>
<td>TAS predicted students’ observed behavioral engagement (from trained raters) and students’ self-report engagement</td>
</tr>
<tr>
<td>Whaley⁵</td>
<td>2012</td>
<td>10 students in grade 7</td>
<td>A large, public middle-class suburban middle school (US)</td>
<td>TAS cultivated deep conceptual understanding of algebraic equations, promoted real-world applications of algebraic concepts, and fostered algebraic habits of mind (namely modeling and representation)</td>
</tr>
<tr>
<td>Kaplan &amp; Madjar⁴</td>
<td>2012</td>
<td>102 Israeli Bedouin students in grades 8-10</td>
<td>A large-scale intervention program (Israel)</td>
<td>TAS had unique positive effects on students’ autonomous motivation to enact proenvironmental behaviors (i.e., recycling, conservation, activism, and cleaning behaviors)</td>
</tr>
</tbody>
</table>

Note. The 32 studies listed in Table 1 are described in greater detail throughout this chapter. TAS = teacher autonomy support; US = United States; RAI = Relative Autonomy Index.

⁴ Correlational research. ⁵ Experimental research. ⁶ Case study. Of the 32 of the studies in listed in Table 1, 19 = correlational research, 12 = experimental research, and one = a case study.
Figure 2. Empirical findings on the educational benefits of teacher autonomy support.
The preponderance of evidence included in Table 1 and Figure 2 might appear impressive and convincing. However, the research is not without limitations. Several findings of the empirical literature presented in this chapter need further elucidation.

Many studies produced similar findings. Correlational and experimental studies found strong relationships and clear links, respectively, between autonomy support, intrinsic motivation, and academic engagement (see Figure 3). Teacher autonomy support was often associated with autonomous forms of motivation (i.e., intrinsic motivation and identified regulation). Students’ autonomous motivation, in turn, was linked to a myriad of optimal learning outcomes including (a) academic achievement, (b) interest in course material, (c) internalization of curricular content, (d) perceived competence, (e) effort, (f) use of active learning strategies (i.e., metacognition and self-regulation), and (g) less pressure, anxiety, and dropout.

Seven correlational studies investigated the relationship between autonomy support and perceived competence and found significant, positive associations between these two variables. However, no study experimentally manipulated autonomy support as the independent variable and perceived competence as the dependent variable (see Figure 3). Accordingly, there appears to be a need to establish causal links between teachers’ autonomy support and students’ perceived competence.

Seven experimental studies found that autonomy support facilitated conceptual learning compared to controlling teaching strategies (see Figure 3). However, in five of these seven studies, there was no significant difference in rote learning between participants in the autonomy-supportive and controlling conditions (Boggiano et al., 1993; Grolnick & Ryan, 1987; Jang, 2008; Vansteenkiste, Simons, et al., 2005;
Vansteenkiste, Timmermans, et al., 2008). In two of the studies, rote learning was actually higher for participants in the controlling conditions than for participants in the autonomy-supportive conditions, but not significantly higher (Grolnick & Ryan, 1987; Vansteenkiste, Simons, et al., 2005). Autonomy-supportive teaching strategies appear to have no significant effect on students’ rote learning compared to controlling teaching strategies. Vansteenkiste, Simons, et al. (2005) offered the following explanation for this phenomenon:

Learning in the service of extrinsic goals prompts behavioral engagement in the activity because the learning is seen as an important route to obtain the extrinsic goal. However, individuals’ engagement and attention under these extrinsic goal circumstances are more likely to be more narrowly focused and rigid, which is detrimental for their conceptual learning, but yield some positive effects for the direct memorization of learning material. (p. 497)

In line with SDT, extrinsic goals are thought to induce a shift in students’ locus of causality and thus focus learners’ attention away from the inherent value in the learning task and toward the extrinsic reward. This shift in focus is thought to result in some “superficial engagement in the learning activity” (Vansteenkiste, Simons, et al., 2005, p. 487), but interferes with deep conceptual processing and engenders less retention of concepts than learning for more autonomous, self-determined reasons.

Research that investigated the relationship between teacher autonomy support and academic achievement produced somewhat inconsistent results. Teacher autonomy support was significantly related to students’ grades in only 1 of the 2 studies conducted by Soenens and Vansteenkiste (2005) and in only 1 of the 3 studies conducted by Jang et
al. (2009); furthermore, in these studies, the significant associations between teacher autonomy support and academic achievement were small ($r = .19, p < .01$, and $r = .17, p < .01$, respectively). Black and Deci (2000) found that significant associations between instructors’ autonomy support and college students’ course grades ($r = .25, p < .01$) and exam performance ($r = .29, p < .01$) were also small-to-moderate. Soenens and Vansteenkiste (2005) and Vansteenkiste, Zhou, et al. (2005) used self-report measures for students’ grades and test scores, respectively. Four of the ten studies that explored autonomy support and academic achievement utilized correlational research designs (see Figure 3). In sum, the studies that investigated autonomy support and academic achievement often found inconclusive data (Jang et al., 2009; Soenens & Vansteenkiste, 2005), relied on self-report measures of academic achievement (Soenens & Vansteenkiste, 2005; Vansteenkiste, Zhou, et al., 2005), utilized nondirectional correlation research methods (Black & Deci, 2000; Jang et al., 2009; Soenens & Vansteenkiste, 2005; Vansteenkiste, Zhou et al., 2005), and/or found only small-to-moderate effects even when results were significant (Black & Deci, 2000; Jang et al., 2009; Soenens & Vansteenkiste, 2005; Vansteenkiste, Zhou, et al., 2005). For instance, Soenens and Vansteenkiste (2005) utilized a non-directional correlational design, relied on a self-report measure to obtain students’ grades, found a significant relationship between teacher autonomy support and students’ grades in only one of their two studies, and the significant relationship between teacher autonomy support and students’ self-reported grades had a small effect size ($r = .19, p < .01$).

The findings related to teacher autonomy support and students’ academic performance are not necessarily obscure or convoluted. Seven experimental studies found
causal links between autonomy support and conceptual learning (see Figure 3), which is a crucial measure of students' academic achievement. It is also important to note that no studies found negative correlations between teacher autonomy support and student achievement.

Figure 3 illustrates that the nature of student motivation, learning, and achievement involves a highly complex and nuanced network of intrapersonal processes inextricably linked to and influenced by physical, social, and emotional stimuli within the student's interpersonal environment. The responses generated as a learner's internal processes interact with environmental influences either catalyze or diminish one's motivation, learning, and performance (Vygotsky, 1978). A teacher's use of an autonomy-supportive motivating style represents one environmental influence shown to nurture students' motivation, learning, and achievement. The research reviewed in this chapter suggests that students benefit in a variety of ways when teachers support their autonomy, as depicted in Figure 3.
Figure 3. Optimal learning outcomes related to teacher autonomy support and the interplay between those outcomes.
Note. The 32 studies listed in Figure 3 are discussed in greater detail in this chapter. Numbers in **bold** indicate experimental research. Numbers in plain font indicate correlational research. Study number 30 (Whaley, 2012) was a case study (i.e., neither correlational nor experimental research).

*a* Indicates a study conducted in a mathematics classroom setting. *b* Indicates a self-report measure of academic performance (e.g., grades or test performance).

Autonomy support was significantly correlated with grades in only 1 of the 3 studies in this research. Autonomy support was significantly correlated with grades in only 1 of the 2 studies in this research.

1. Assor et al. (2002)
2. Assor et al. (2005)
5. Boggiano et al. (1993)
6. Chirkov & Ryan (2001)
7. Deci et al. (1994)
9. Flink et al. (1990)
13. Jang et al. (2010)*
14. Jang et al. (2009)* **c**
17. Pelletier et al. (2001)
20. Sierens et al. (2009)*
21. Soenens & Vansteenkiste (2005)* **a**
22. Trouilloud et al. (2006)
23. Tsai et al. (2008)*
24. Vallerand et al. (1997)
25. Vansteenkiste et al. (2009)
29. Vansteenkiste, Zhou, et al. (2005)*
30. Whaley (2012)*
31. Williams & Deci (1996)
32. Zhou et al. (2009)*
Table 2 shows learning outcomes associated with a teacher’s use of an autonomy-supportive motivating style. The findings related to teacher autonomy support and some measures of academic achievement (e.g., grades) are not as lucid or as conclusive as the findings on the relationship between teacher autonomy support and other outcome variables often studied in SDT research (e.g., conceptual understanding, academic engagement, internalization, intrinsic motivation, and perceived competence). Studies have shown that teacher autonomy support fostered students’ conceptual understanding and their performance on authentic assessments—whether those authentic, performance-based assessments involved writing (Benware & Deci, 1984; Grolnick & Ryan, 1987; Jang, 2008; Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al. 2005; Vansteenkiste, Timmermans, et al., 2008; Whaley, 2012), solving analytic logic problems (Boggiano et al., 1993), pictorial storytelling (Flink et al., 1990), or practicing Tia-bo (Vansteenkiste et al., 2004).

The extant findings related to teacher autonomy support and academic achievement need to be interpreted and applied with caution. To suggest that teacher autonomy support unequivocally facilitates academic achievement would be overstating what the research has found. The findings demonstrate the need to further investigate and illuminate the relationship between teacher autonomy support and students’ academic achievement. Specifically, the literature would benefit from more experimental designs investigating the effects of teacher autonomy support on students’ grades and test performance. For example, Vansteenkiste et al. (2004) experimentally found that teacher autonomy support enhanced participants’ conceptual knowledge as measured by their
performance on a writing assessment (and there was a moderate-to-large effect size; see Vansteenkiste et al., 2004, pp. 250-257).
### Five Different Measures of Academic Performance Associated with Teacher Autonomy Support

<table>
<thead>
<tr>
<th>Measure of Achievement</th>
<th>Outcome</th>
<th>Supporting Empirical Studies</th>
</tr>
</thead>
</table>
| Conceptual understanding | Seven experimental studies and one case study found that TAS enhanced elementary school, middle school, high school, and college students’ conceptual understanding across content areas. | • Benware & Deci (1984)  
• Boggiano et al. (1993)  
• Grolnick & Ryan (1987)  
• Jang (2008)  
• Vansteenkiste et al. (2004)  
• Vansteenkiste, Simons, et al. (2005)  
• Vansteenkiste, Timmermans, et al. (2008)  
• Whaley, 2012 |
| Rote learning | In five experimental studies, TAS did not significantly affect rote learning, compared to controlling instructional practices. | • Boggiano et al. (1993)  
• Grolnick & Ryan (1987)  
• Jang (2008)  
• Vansteenkiste, Simons, et al. (2005)  
• Vansteenkiste, Timmermans, et al. (2008) |
| Test performance | In a correlational study, TAS was significantly related to college students’ test performance, although the effect size of the relationship was small ($r = .29, p < .01$).  
In three separate experimental studies, TAS was linked with higher test performance among Belgian college students, and produced higher test scores among Belgian fifth and sixth grade students. | • Black & Deci (2000)  
• Vansteenkiste et al. (2004)  
• Vansteenkiste, Simons, et al. (2005)  
• Vansteenkiste, Timmermans, et al. (2008) |
Table 2 (continued)

<table>
<thead>
<tr>
<th>Measure of Achievement</th>
<th>Outcome</th>
<th>Supporting Empirical Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic task performance&lt;br&gt;a</td>
<td>In five experimental studies, TAS produced greater academic task performance among American elementary school students, American college students, Belgian elementary school students, and Belgian high school students, respectively.</td>
<td>• Boggiano et al. (1993)&lt;br&gt;• Flink et al. (1990)&lt;br&gt;• Vansteenkiste et al. (2004)&lt;br&gt;• Vansteenkiste, Simons, et al. (2005)&lt;br&gt;• Vansteenkiste, Timmermans, et al. (2008)</td>
</tr>
</tbody>
</table>
| Grades | In three correlational studies, TAS was significantly, yet weakly, associated with students' grades. | • Black & Deci (2000)<br>• Jang et al. (2009)<br>• Soenens & Vansteenkiste (2005)<br>

*Note. TAS = teacher autonomy support.*

*a All tasks were authentic, performance-based assessments (e.g., writing, Tai-bo, and complex problem-solving). b Autonomy support was significantly correlated with grades in only 1 of the 3 studies in this research. c Autonomy support was significantly correlated with grades in only 1 of the 2 studies in this research.*
Self-Determination Theory and the Middle School Learner

Multiple studies have found that students’ academic motivation generally decreases between the late elementary school years and the early high school years; moreover, this trend is more evident in some subject areas than others and is particularly characteristic of students who have little academic success (Archambault et al., 2010; Eccles, Lord, & Midgley, 1991; Eccles & Midgley, 1989; Eccles et al., 1984; Eccles, Midgley, et al., 1993; Eccles, Wigfield, Harold, & Blumenfeld, 1993; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Otis, Grouzet, & Pelletier, 2005; Schunk, 2011, pp. 474-477; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991). Gottfried et al. (2001) found that, compared to other subject areas, students showed the greatest decline in academic intrinsic motivation in math. Wigfield et al. (1997) reported that, over the course of 3 years, elementary school students’ ($N = 615$) perceived competence and perceived usefulness and importance of math curricula decreased, but their interest in math did not decrease. Other studies found that American students’ intrinsic motivation in mathematics tends to peak in the elementary grades, decline, and then begin to crystallize after middle school (Middleton & Spanias, 1999). Many math teachers lack a theoretically-sound, empirically-supported, well-developed cohesive framework to guide them as they attempt to effectively motivate students, so this further exacerbates the problem of student motivation and achievement in middle school mathematics (Beyers, 2011; Matteson et al., 2011).

An expansive body of literature on motivational research has shed light on the antecedents and determinants of the decline in students’ motivation in mathematics across school years. A teacher’s influence is a primary variable found to affect young
adolescent students' motivation in mathematics. Feldlaufer, Midgley, and Eccles (1988) found that the student–teacher relationship appeared to wane after elementary school; longitudinal data generated from student self-report measures and independent classroom observations indicated that elementary school math teachers were more warm and friendly than junior high math teachers. A 2-year longitudinal study of 1,301 adolescent students found that their intrinsic motivation and perceived value of mathematics increased when they moved from a less supportive elementary school math teacher to a more supportive junior high school teacher (Midgley, Feldlaufer, & Eccles, 1989b). The opposite was also true: When students moved from a highly supportive elementary school math teacher to a less supportive junior high school teacher, students’ intrinsic motivation and perceived usefulness and importance of math sharply declined. The later was particularly true for lower-achieving students. A similar 2-year longitudinal study with 1,329 students found that students’ perceived competence in math diminished when transitioning from an elementary school math teacher with greater self-efficacy than their junior high math teacher, and having a less efficacious junior high math teacher was especially detrimental for lower-achieving students (Midgley, Feldlaufer, & Eccles, 1989a). These studies highlighted how teachers influence students’ motivational beliefs in mathematics (i.e., their perceived competence and perceived importance of math curricula). Results of a 2-year longitudinal study ($N = 1,850$) showed that students’ perceived competence and intrinsic motivation in math declined during the transition from elementary to junior high school (Wigfield et al., 1991). Eccles, Wigfield, Midgley, et al. (1993) found that middle grade math teachers controlled students more and offered students fewer decision-making opportunities compared to sixth-grade elementary school
math teachers. In this longitudinal study, controlling teacher practices were significantly related to a deterioration of students’ motivation in middle school. These studies were conducted nearly 20 years ago and served, in part, as an impetus for middle school reform and facilitated the transformation of departmentalized junior high schools (comprised of grades 7 through 9) into interdisciplinary-focused middle schools (comprised of grades 6 through 8).

The transition from elementary school to middle school poses challenges to many students (Jackson & Davis, 2000; Meece & Daniels, 2007; Schunk, 2011, pp. 463-465; Wigfield, Byrnes, & Eccles, 2006). The challenges young adolescent middle school students face as they transition from elementary school include

• physiological and interpersonal changes resulting from puberty,
• changes in identity (i.e., identity development),
• changes in their relationship with their parents,
• increased peer-influence,
• larger school buildings,
• larger class sizes,
• less individualized attention from teachers (compared to elementary school),
• decreased time with a primary teacher since students move from subject to subject throughout the school day,
• encounters with more authoritative teachers, which often undermine students’ initiative and self-determination,
• disrupted social networks resulting from attending classes with unfamiliar students that, in turn, produces greater social anxiety and less perceived social competence, and

• a systemic emphasis on achievement, grades, competition, and social comparison—each of which create pressure and inhibit self-determined motivation, especially for lower-achieving students.

In short, many salient environmental factors inherent in the transition from elementary to middle school tend to undermine adolescent students' psychological needs for autonomy, competence, and relatedness. Accordingly, teachers' provision for autonomy support might assuage many of the influences that subdue middle school students' self-determination and academic achievement. The middle school model is theoretically designed to ameliorate many of the challenges listed above and to support students as they transition from childhood to adolescence and from elementary school to high school (Jackson & Davis, 2000). It is therefore interesting that no published research to date has investigated the influence of an autonomy-supportive motivating style on middle school students' self-determined motivation and academic achievement.

Figure 4 illustrates the variety of educational settings in which teacher autonomy support has been investigated. Seventh grade students have participated in SDT research conducted in Israeli elementary schools (Assor et al., 2002), Belgian high schools (Vansteenkiste et al., 2009), French high schools (Trouilloud et al., 2006), German gymnasium schools (i.e., high schools; Tsai et al., 2008), and one American middle school (Whaley, 2012). Other than one case study that included a sample of 10 seventh grade students (Whaley, 2012), no published studies have researched the relationship
between teachers' autonomy support and the intrinsic motivation and academic achievement of seventh grade students in an American middle school setting. Two studies conducted in Japanese junior high schools examined the optimal learning outcomes associated with autonomous forms of students' motivation (i.e., intrinsic motivation and identified regulation) compared to controlling forms of motivation (i.e., external regulation and introjected regulation) but did not include teacher autonomy support as a variable (Hayamizu, 1997; Yamauchi, Kumagai, & Kawasaki, 1999). The aggregate data in Figure 4 is based on the research studies reviewed in this chapter.
Figure 4. A comparison of the educational settings in which self-determination theory has been applied to investigate autonomy support and optimal learning.
Psychoanalytic theories of development cite an innate need for autonomy among young adolescent students (Blos, 1979; Erikson, 1963, 1964, 1968; Schunk, 2011, p. 453). Unlike SDT however, many of these theories equate autonomy with notions of individualism, detachment, and separation, namely from parents and authoritative figures (Frank, Pirsch, & Wright, 1990; Hill & Holmbeck, 1986). This conceptualization of autonomy differs from the SDT concept, which defines autonomy as inner endorsement and congruency with one’s inner values, self-reflection, a sense of freedom, and the realization of one’s personal goals and interests (Assor et al., 2002; Ryan & Deci, 2011). Others have echoed this conceptualization of autonomy, and do not conceive autonomy and relatedness as antithetical constructs (Grotevant & Cooper, 1986). Indeed, research suggests that autonomy support enhances a sense of relatedness in close interpersonal relationships (Deci, La Guardia, Moller, Scheiner, & Ryan, 2006; La Guardia, Ryan, Couchman, & Deci, 2000) and that people tend to experience a high degree of autonomy when helping their partners (Gaine & La Guardia, 2009). These findings underscore that autonomy, as defined within SDT, clearly does not mean selfishness, independence, or showing a lack of concern for others and that autonomy and relatedness are both essential for happiness and well-being.

Freud (1958) considered autonomy to be important primarily during the adolescence years. This perspective also contrasts with the SDT view, which maintains that autonomy is vital for development and well-being across life’s epochs (Grolnick, Gurland, Jacob, Decourcey, 2002). According to SDT, adolescent students do not have a
greater need for autonomy than children or adult learners; satisfaction of the need for autonomy is important for students of all ages (Assor et al., 2002; Grolnick et al., 2002).

During the latter half of the twentieth century, the growing belief that autonomy was a crucial developmental need especially unique to emerging adolescents coupled with the conceptualization of autonomy as a need for independence facilitated misguided educational policy decisions. The belief that children’s need for independence increased as they transitioned into adolescence led, in part, to the open classroom movement in American public education (Barth, 1972; Dennison, 1999; Graubard, 1972). In reference to the idea that adults should become less involved in children’s lives as they transition into adolescence, Assor et al. (2002) acknowledged that an erroneous, yet widely-held, view suggests that autonomy support essentially “involves minimization of guidance and consultation by educators, so as to leave sufficient space for the emergence of the child’s true self” (p. 273). Assor et al. (2002) concluded that “this somewhat simplistic view” of autonomy-support might be corrected by acknowledging that “the essence of autonomy enhancement is not minimisation of the educator’s presence, but making the educator’s presence useful for the student who strives to formulate and realise personal goals and interests” (p. 273). Teachers enable students to develop and realize their personal goals and interests by explaining how learning tasks might help them reach their goals; attempting to understand their feelings and ideas about assignments; making lessons as relevant and interesting as possible; allowing them to choose tasks that align with their goals and interests; and permitting them to voice criticisms, independent opinions, and express negative affect (Assor et al., 2002; Heron, 2009, pp. 144-145; Reeve & Assor,
These autonomy-supportive teacher behaviors cultivate a more democratic, humane classroom culture and foster students' self-determination.

Self-Determination Theory and Mathematics Pedagogy

Very few studies have applied self-determination theory to investigate the learning outcomes associated with perceived teacher autonomy support in mathematics. As Ross and Bergin (2011) astutely noted, “Although much SDT research has occurred in classrooms, little has been specific to mathematics classrooms” (p. 57). Seven of the 32 studies reviewed in this chapter, about 22%, explored autonomy-supportive instruction in mathematics classrooms.

Jang (2008) investigated how autonomy supportive teaching might nurture the internalization process during an uninteresting (but potentially useful) learning activity involving statistics. The research examined the effect that offering college students (N = 136) an explanatory rationale in an autonomy-supportive way while teaching a lesson about correlations had on participants’ perceived value of correlations. Offering a rationale in an autonomy-supportive way significantly enhanced participants’ engagement with curricular content, perceived importance of correlational research, and conceptual understanding compared to the group of students who did not receive a rationale explained in an autonomy-supportive way.

Tsai et al. (2008) investigated the relationship between three unique types of teacher autonomy support and 261 seventh grade German students’ interest in mathematics. Cognitive autonomy support was most closely associated with students’ interest in their math class (r = .66, p < .01), followed by an autonomy-supportive climate (r = .57, p < .01) and then controlling teacher behaviors (r = -.19, p < .05). HLM found
that the extent to which the three different types of autonomy-support related to students' interest experience during math lessons varied according to each individual. For example, controlling teacher behaviors were more likely to adversely influence students who did not like math compared to students who did like math. An overall autonomy-supportive climate was related to all students' interest experience during their math class, irrespective of (i.e., controlling for) their individual interest in math. A teachers' provision for cognitive autonomy support contributed unique effects to students' interest experience during math lessons, in addition to the unique effects contributed by an autonomy-supportive climate and controlling behaviors. Thus, these findings highlighted the value of (a) supporting students' cognitive processes in an autonomy-supportive way (e.g., providing clear examples and explanations of concepts to ensure student comprehension; granting students the cognitive flexibility and freedom to employ a variety of problem-solving methods; offering students time to reflect, synthesize information, and make connections between their newly acquired knowledge and their prior knowledge; and showing the relationships between the topics discussed); (b) providing an autonomy-supportive classroom climate; and (c) avoiding the use of controlling behaviors during mathematics instruction.

The Learning Climate Questionnaire (LCQ), which assesses students' perceived teacher autonomy support, was administered to students in either their math or language class in the research conducted by Jang et al. (2009) and Zhou et al. (2009). In a series of three separate studies, Jang et al. (2009) found that perceived teacher autonomy support was positively associated with South Korean high school students' engagement (Study 1, $r = .28, p < .01$; Study 2, $r = .18, p < .01$; Study 3, $r = .19, p < .01$) and intrinsic
motivation (Study 1, $r = .33, p < .01$; Study 2, $r = .29, p < .01$; Study 3, $r = .24, p < .01$) and negatively related to students' feelings of frustration, anger, anxiety, depression, and unhappiness (Study 1, $r = -.45, p < .01$; Study 2, $r = -.31, p < .01$; Study 3, $r = -.26, p < .01$). Autonomy support was positively related to participants’ end-of-course grades in one of the three studies (Study 1, $r = .17, p < .05$; Study 2, $r = .00, ns$; Study 3, $r = .01, ns$). Zhou et al. (2009) found that teacher autonomy support was positively associated with fourth and fifth graders ($N=48$) autonomous motivation ($r = .51, p < .01$) and perceived competence ($r = .58, p < .01$) in mathematics but unrelated to participants’ interest ($r = .21, ns$) and perceived choice ($r = .02, ns$).

Jang et al. (2010) found that teacher autonomy support was related to students’ observed behavioral engagement ($r = .70, p < .01$) and to their self-reported engagement ($r = .36, p < .01$). However, data was not generated exclusively from participants’ math classes. Some students were observed in English, science, or social studies classes. Likewise, less than half of the students in the research conducted by Sierens et al. (2009) rated their mathematics teacher.

Whaley (2012) found that autonomy-supportive instruction augmented seventh grade students’ conceptual understanding of algebraic modeling. In this study, students created word problems, or number stories, that could be modeled by a linear equation. Students were encouraged to incorporate their interests into the content of their word problems in order to progress from a concrete to an abstract understanding of algebra. Ten students participated in interviews and were observed as they worked on their projects. Qualitative data analysis indicated that students developed algebraic habits of
mind as they made connections between abstract algebraic representations (i.e., equations) and real-world phenomena that occurred in their personal lives.

To review, the SDT research conducted within mathematics classrooms has been limited to college students enrolled in an introductory educational psychology class at a midwestern American university (Jang, 2008), academically-advanced seventh grade high school students in Germany (Tsai et al., 2008), students from three different high schools in South Korea (Jang et al., 2009), a small sample of fourth and fifth grade students attending a summer school enrichment camp in rural China (Zhou et al., 2009), students from nine public high schools in the midwestern United States (Jang et al., 2010), high school and first-year college students in Belgium (Sierens et al., 2009), and 10 seventh grade participants of a case study conducted at a suburban middle school in the southeastern United States (Whaley, 2012). The findings of these studies are generalizable primarily to the population from which the research participants were drawn, so it remains unclear how teacher autonomy support might be related to American middle school students' motivation and achievement in mathematics.

The results of these studies found that teacher autonomy support was related to greater academic engagement (Jang, 2008; Jang et al., 2009; Jang et al., 2010; Whaley, 2012), intrinsic motivation (Jang et al., 2009; Tsai et al., 2008), perceived competence (Zhou et al., 2009), conceptual learning (Jang, 2008; Whaley, 2012), and use of optimal, self-regulated learning strategies (Jang, 2008; Sierens et al., 2009). Only three of these seven studies examined achievement in mathematics. Of these, Jang (2008) found that a rationale explained in an autonomy-supportive way enhanced conceptual learning but not factual, or rote, learning. Jang et al. (2009) found that perceived teacher autonomy
support was related to participants’ end-of-course grade in one of three separate studies, and this correlation was small ($r = .17, p < .05$). Whaley (2012) found that teacher autonomy support fostered conceptual learning in algebra, but the sample of this study was only 10 students.

Beyond these seven studies, relatively little scholarly literature exists that fuses SDT with mathematics pedagogy. However, several authors recently highlighted how SDT can be used to teach math effectively. In 2011, the 73rd yearbook of The National Council of Teachers of Mathematics addressed the topic of student motivation and achievement in mathematics (Brahier & Speer, 2011). Two of the 21 chapters in this volume illustrated how SDT can be applied to mathematics curriculum and instruction. In Chapter 4, Ross and Bergin (2011) described how the *Principals and Standards for School Mathematics* (NCTM, 2000) can be implemented by applying SDT to mathematics instruction. They explained how teachers can create instructional activities for students in ways that satisfy their needs for autonomy, competence, and relatedness and how autonomy-supportive teaching can enhance students’ mathematical learning. They included two examples of learning activities that applied SDT to the mathematics classroom; in both examples, students are allowed to make choices while still engaging in rigorous mathematical content. The authors concluded that applying SDT to the mathematics classroom is an effective way to support teaching the *Principals and Standards for School Mathematics* (NCTM, 2000). In Chapter 15, Jones, Uribe-Flórez, and Wilkins (2011) illustrated how SDT can be used to effectively teach math with manipulatives. The authors described two different ways base-ten blocks can be used to teach subtraction of multi-digit numbers and argued that one way was much more likely
than the other to enhance students’ intrinsic motivation and self-determination because students “created their representations, chose to work in groups or individually…,
represented the situation in a way that made sense to them, and presented their solution to
the class in their own way” (Jones et al., 2011, p. 221). The clear intention of the article
was to provide classroom teachers with specific ways to apply SDT to practice.

Math Anxiety

A considerable amount of empirical literature exists on the phenomena referred to as
math anxiety. Definitions of math anxiety include

- “the panic, helplessness, paralysis, and mental disorganization that arises among
  some people when they are required to solve a mathematical problem” (Tobias &
  Weissbrod, 1980, p. 65);
- “feelings of tension and anxiety that interfere with the manipulation of numbers
  and the solving of mathematical problems” (Richardson & Suinn, 1972, p. 551);
- “an emotion that blocks a person’s reasoning ability when confronted with a
  mathematical situation” (Spicer, n.d.); and
- “an emotional reaction to mathematics based on a past unpleasant experience
  which harms future learning” (Freedman, n.d.).

Many less-than-optimal learning outcomes have been associated with high math anxiety,
including poor test performance (Hembree, 1990; Richardson & Suinn, 1972), low grades
in high school and college math courses (Ashcraft & Kirk, 2001; Wigfield & Meece,
1988), diminished working memory and executive functioning processes (Ashcraft &
Kirk, 2001), low perceived competence (Hembree, 1990; Wigfield & Meece, 1988), and
avoidance behaviors of mathematics (Ashcraft & Kirk, 2001; Hembree, 1990; Wigfield
Math anxiety tends to increase from elementary to high school (Brush, 1980; Wigfield & Meece, 1988), and females tend to display higher levels of math anxiety than males (Fiore, 1999; Hembree, 1990; Wigfield & Meece, 1988).

Environmental factors affect students' math anxiety. Fiore (1999) claimed "most math anxiety has its roots in the teachers and teaching of mathematics" (p. 403). Specific teacher behaviors that engender students' feelings of anxiety in math include the use of comments intended to shame, intimidate, or belittle students; poorly explained concepts; a lack of enthusiasm; and displaying impatience with students (Fiore, 1999; Hembree, 1990); notably, each of these constitute controlling teacher behaviors, according to the SDT perspective (Patrick, Hisley, & Kempler, 2000; Reeve, 2009; Tsai et al., 2008).

Just as teachers are often the origin of students' math anxiety, teachers can help reduce math anxiety. Teachers bolster students' motivation in math, and reduce their anxiety, by helping them (a) make deep conceptual—and often interdisciplinary—curricular connections, (b) understand relationships between concepts, and (c) realize how math might help them reach their personal goals (Assor et al., 2002; Boaler, 2011; Fiore, 1999; Matteson et al., 2011; NCTM, 2000; Tsai et al., 2008). Fostering conceptual connections supports students' need for competence. Offering personally meaningful rationales that enable students to align the value a given learning activity expresses with their personal goals nurtures their need for autonomy. Motivating students through meaningful curricular connections and supporting their internal perceived locus of causality by providing explanatory rationales holds intrinsic value to students, and intrinsically-framed learning goals promote conceptual understanding (Vansteenkiste et
For example, teachers might tell students:

Learning this math concept will help you understand the world better. The more you understand something, the more you appreciate it and the more you respect it, so the better you understand mathematics, the better you will understand, appreciate, and respect the world in which you live.

Enabling students to find personal value in learning mathematics represents a key component of alleviating math anxiety.

Norwood (1994) found that math-anxious students were more comfortable in classes when teachers afforded a high degree of class structure. Jang et al. (2010) found that students’ academic engagement was greatest when teachers provided autonomy support and structure. Sierens et al. (2009) and Vansteenkiste et al. (2009) found that students were more likely to utilize metacognitive and self-regulated learning strategies when teachers provided autonomy support and structure.

Correlational and experimental research found that students experienced less anxiety and pressure when their teachers provided autonomy support (Black & Deci, 2000; Flink et al., 1990; Grolnick & Ryan, 1987; Vansteenkiste, Zhou, et al., 2005; Vansteenkiste et al., 2009). However, no published empirical studies have investigated the relationship between a teachers’ autonomy support and students’ math anxiety. According to SDT, autonomy support reduces students’ sense of pressure whereas controlling practices have the opposite effect. It seems that teacher autonomy support would help reduce students’ math anxiety, and, in turn, improve their learning.
Summary

Self-determination theory has been applied to a variety of educational settings over the last three decades. The results of these studies suggest that a teacher’s use of an autonomy-supportive motivating style is related to many positive educational outcomes, including students’ academic engagement, creative expression, effort and persistence, intrinsic motivation, perceived competence, valuing of curricular content, intentions to stay in school, absence of anxiety and pressure, task performance, conceptual learning, use of active learning strategies (i.e., metacognition and cognitive and affective self-regulation), and cognitive processing (i.e., building connections and linking new knowledge to prior knowledge). Controlling teacher practices tend to be negatively associated with these important learning outcomes, although five different studies found that an autonomy-supportive motivating style showed no benefit compared to a controlling motivating style on students’ factual learning, or memorization and recall (i.e., rote learning).

Many studies also found that an autonomy-supportive motivating style was associated with autonomous academic motivation, or students’ self-determined reasons for learning. When students’ academic orientation is self-determined, they possess an awareness of how learning tasks align with their goals, values, and interests. Furthermore, they have an ability to bring the value a given learning task expresses into harmony and congruence with their goals, values, and interests, synthesizing it within a well-established, integrated, and coherent self-system (McCombs, 2001). For example, when a teacher gives an assignment, less self-determined students might be inclined to complain or fail to see the importance of the assignment. In contrast, self-determined learners
understand and recognize the value the assignment holds, because they are aware of how it will help them grow, develop, and extend their potential as learners (and as human beings). The capacity to find personal value in learning tasks illuminates the essence of the relation between self-determination and (a) a sense of agency, (b) a sense of identity, and (c) a readiness to self-actualize. Self-determined learners have greater control within their learning environment; being self-determined is a source of power, satisfaction, and personal happiness and facilitates the self-actualization of one’s potential (Chirkov, 2011, p. 69).

Some teachers are willing to become more autonomy-supportive, but they are unsure how (Deci & Ryan, 1987; Reeve, 2002, 2009; Reeve & Halusic, 2009). It is instructive to understand the autonomy-supportive instructional strategies identified by empirical research. Table 3 displays autonomy-supportive teacher behaviors, and Table 4 displays controlling teacher behaviors, according to the studies reviewed in this chapter.
Table 3

*Autonomy-Supportive Instructional Practices Based on Empirical Findings*

<table>
<thead>
<tr>
<th>Autonomy-Supportive Strategy</th>
<th>Characteristics and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Show empathy</td>
<td>• allow criticism&lt;br&gt;• listen to students&lt;br&gt;• take students’ perspectives&lt;br&gt;• acknowledge students’ feelings&lt;br&gt;• make perspective-acknowledging statements&lt;br&gt;• show responsiveness to student-generated questions and comments&lt;br&gt;• accept students’ expressions of negative affect (e.g., during uninteresting activities)</td>
</tr>
<tr>
<td>Foster relevance</td>
<td>• help students find personal value and meaning in tasks&lt;br&gt;• provide personally meaningful rationales for uninteresting lessons</td>
</tr>
<tr>
<td>Teach for mastery</td>
<td>• encourage students’ effort&lt;br&gt;• praise improvement and mastery&lt;br&gt;• provide information-rich feedback as assessment&lt;br&gt;• create learning activities that provide an optimal sense of challenge</td>
</tr>
<tr>
<td>Frame intrinsic learning goals</td>
<td>• guide students to develop intrinsic learning goals&lt;br&gt;• communicate intrinsic learning goals in an autonomy-supportive way</td>
</tr>
<tr>
<td>Reduce students’ math anxiety</td>
<td>• help students (a) make deep conceptual connections, (b) understand the relationship between concepts, and (c) realize how math might help them reach their personal goals</td>
</tr>
<tr>
<td>Autonomy-Supportive Strategy</td>
<td>Characteristics and Description</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Provide cognitive autonomy support</td>
<td>• provide hints instead of answers</td>
</tr>
<tr>
<td></td>
<td>• allocate time for independent work</td>
</tr>
<tr>
<td></td>
<td>• transfer responsibilities to students</td>
</tr>
<tr>
<td></td>
<td>• set tasks that require time to reflect</td>
</tr>
<tr>
<td></td>
<td>• allow students to talk and think aloud</td>
</tr>
<tr>
<td></td>
<td>• offer hints to students who seem stuck</td>
</tr>
<tr>
<td></td>
<td>• emphasize the relations between the topics discussed</td>
</tr>
<tr>
<td></td>
<td>• allow students to work in their own way on a problem</td>
</tr>
<tr>
<td></td>
<td>• enable students to make real-world curricular connections</td>
</tr>
<tr>
<td></td>
<td>• provide adequate amount of time for assignment completion</td>
</tr>
<tr>
<td></td>
<td>• work through exercises that help students understand the topic</td>
</tr>
<tr>
<td></td>
<td>• allow different students to present their solutions to the same task</td>
</tr>
<tr>
<td></td>
<td>• explain the purposes of the task at hand and its links to the learning concepts</td>
</tr>
<tr>
<td></td>
<td>• allow students to choose from a variety of strategies when solving complex problems</td>
</tr>
<tr>
<td></td>
<td>• scaffold students’ understanding by activating prior knowledge and increasing personal relevance</td>
</tr>
<tr>
<td>Create interesting learning activities</td>
<td>• recognize students’ interests</td>
</tr>
<tr>
<td></td>
<td>• incorporate students’ interests into learning activities</td>
</tr>
<tr>
<td></td>
<td>• draw upon educational research and learning theory to develop interesting and meaningful lessons that foster students’ needs for competence</td>
</tr>
</tbody>
</table>
Table 3 (continued)

<table>
<thead>
<tr>
<th>Autonomy-Supportive Strategy</th>
<th>Characteristics and Description</th>
</tr>
</thead>
</table>
| Provide structure in an autonomy-supportive way | • provide adequate help  
• supply timely feedback  
• help students establish goals  
• maintain an organized classroom  
• set clear guidelines and expectations |
| Minimize the use of control, criticism, demands, and pressure | • provide choices rather than pressure  
• provide open access to instructional materials  
• avoid using directives (e.g., “should,” “ought to,” “need to”)  
• provide students with information and opportunities for choice  
• communicate with non-controlling, autonomy-supportive language  
  - use autonomy-supportive phrases such as “you can,” “you might,” “if you chose,” and “I ask you to”  
  - avoid using controlling phrases such as “you should,” “you have to,” “you’d better,” and “you must” |
Table 4

*Controlling Instructional Practices Based on Empirical Findings*

<table>
<thead>
<tr>
<th>Controlling Strategy</th>
<th>Characteristics and Description</th>
</tr>
</thead>
</table>
| Foster math anxiety                   | • show a lack of enthusiasm for subject matter  
• display impatience or frustration with students  
• offer unclear explanations of mathematical concepts  
• use comments intended to shame, intimidate, or belittle students |
| Show a lack of empathy                | • limit students' access to learning materials  
• treat a student disrespectfully or in a mean manner  
• demonstrate little tolerance for students' complaints and expressions of negative affect  
• prohibit students from voicing critical and independent opinions that differ from the teacher's |
| Seek to directly control students     | • use deadlines to motivate students  
• give students frequent directives and verbal commands  
• attempt to motivate students through external controls such as contingent rewards or punishment |
| Seek to indirectly control students   | • provide conditional approval  
• foster a sense of perfectionism  
• seek to induce students' feelings of guilt, shame, or anxiety  
• ask controlling questions to direct students' work  
  (e.g., "Would a good student do that?") |
| Forestall the internalization process| • fail to offer explanatory rationales  
• force meaningless and uninteresting activities |
<table>
<thead>
<tr>
<th>Controlling Strategy</th>
<th>Characteristics and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilize cognitively controlling</td>
<td>• expect split-second answers</td>
</tr>
<tr>
<td>instructional behaviors</td>
<td>• interfere with students’ preferred pace of learning</td>
</tr>
<tr>
<td></td>
<td>• provide instructions that are vague and confusing to students</td>
</tr>
<tr>
<td></td>
<td>• display impatience for students to generate the correct answer</td>
</tr>
<tr>
<td></td>
<td>• cover too much material such that students have difficulty maintaining pace</td>
</tr>
<tr>
<td></td>
<td>• provide answers to students without providing adequate time for them to work on the problems</td>
</tr>
<tr>
<td></td>
<td>independently and to discover it on their own</td>
</tr>
<tr>
<td>Pressure students to feel, think, or</td>
<td>• use pressure-inducing language</td>
</tr>
<tr>
<td>behave in a specific way</td>
<td>• overrun students’ perspectives with their own</td>
</tr>
<tr>
<td></td>
<td>• intrude into students’ feelings, thoughts, or actions</td>
</tr>
<tr>
<td></td>
<td>• apply pressure until students’ change their thinking, beliefs, or actions</td>
</tr>
<tr>
<td></td>
<td>• use controlling phrases such as “you should,” “you have to,” “you’d better,” and “you must”</td>
</tr>
<tr>
<td></td>
<td>during instruction</td>
</tr>
</tbody>
</table>
Tables 3 and 4 illuminate the stark contrast between an autonomy-supportive and a controlling motivating style and highlight the vast differences in the two epistemological approaches to teaching and the ontological approaches to motivating students. An autonomy-supportive instructional style is congruent with a cognitivist approach (Ertmer & Newby, 1993) to teaching and learning, couched within the field of positive psychology. An autonomy-supportive instructional style conduces toward what Ramsden (2003) identified as a deep approach to learning and to what Fink (2003) described as significant learning experiences. In contrast, a controlling motivating style is more congruent with a behavioristic approach to teaching and beliefs about the nature of learning and motivation and draws from the field of operant psychology (Mace, Belfiore & Hutchinson, 2001).

Relatively little research has examined the influence of an autonomy-supportive motivating style on students learning mathematics or on young adolescent students situated within a middle school setting. Research has shown that middle school students face a litany of challenges inherent in the transition from elementary to high school. Motivating students to learn mathematics requires skillful expertise (Brahier & Speer, 2011; Middleton & Jansen, 2011; Schoenfeld, 1992). In view of the corpus of research that suggests (a) students benefit in a variety of ways when teachers support their autonomy, (b) students' academic intrinsic motivation tends to decrease during early adolescence, and (c) math teachers influence students’ motivation and learning, it seems important to investigate the relationship between a teacher’s motivating style and middle school students’ motivation and achievement in mathematics. The purpose of this study was to identify the variables most closely related to an autonomy-supportive motivating
style and the importance of these variables as they related to seventh grade students’ motivation and academic achievement in prealgebra.

Chapter 3 describes the methods used to collect and analyze the data for this study. Chapter 4 includes the empirical results of the data analyses. Chapter 5 provides interpretations of the data analyses and highlights the significance of the findings for theory and practice.
CHAPTER 3

Methodology

Introduction

Education involves the cultivation of human potential. Accordingly, it is important for educators to understand the instructional practices and classroom milieu that either facilitate or undermine students' motivation and desire to achieve. The ability to identify specific predictors of intrinsic motivation is vitally important for those directly involved in human development.

Research on self-determination theory (SDT) suggests that students benefit academically and developmentally when teachers support their autonomy (Reeve, 2009). Within SDT, autonomy-supportive teaching styles are contrasted with controlling instructional styles, and autonomy-supportive styles are associated with positive educational outcomes relative to controlling styles (Deci & Ryan, 1987; Reeve, 2009; Reeve et al., 2008). While there is a large body of research regarding the relationship between SDT and positive educational outcomes (Deci, Vallerand, Pelletier, & Ryan, 1991; Niemiec & Ryan, 2009; Reeve, 2002; Reeve, 2009), there is a lack of empirical research concerning the relationship between autonomy-supportive instruction and adolescent learning in a middle school mathematics setting.

Purpose of the Study

The purpose of this study was to apply self-determination theory to investigate the relationship between students' perceptions of teacher autonomy support and students'
intrinsic motivation and academic achievement in a seventh grade mathematics course. This study used multiple regression to find the linear model most closely associated with teacher autonomy support and seventh grade students’ intrinsic motivation and academic achievement in mathematics. This study investigated the relationship between students’ perceptions of their teachers’ autonomy support and (a) students’ intrinsic motivation in studying mathematics as measured by the levels of interest/enjoyment, value/usefulness, pressure/tension, and perceived competence they experience; (b) students’ autonomous self-regulation; and (c) students’ mathematical achievement.

Research Questions

The research questions addressed in this study are listed below.

1. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

2. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

3. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement?
4. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement?

5. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement?

6. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation?

Research Hypotheses

The research hypotheses of this study are listed below.

1. There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

2. There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement.
3. There will be a statistically significant relationship between teacher autonomy support and seventh grade students' pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement.

4. There will be a statistically significant relationship between teacher autonomy support and seventh grade students' perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement.

5. There will be a statistically significant relationship between teacher autonomy support and seventh grade students' autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement.

6. There will be a statistically significant relationship between teacher autonomy support and seventh grade students' academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation.

Null Hypotheses

The null hypotheses of this study are listed below.

1. There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement.
2. There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

3. There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement.

4. There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement.

5. There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement.

6. There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation.

Sample

This research was conducted at a public middle school located in a suburban metropolitan area of the southeastern United States during the first semester of the 2011-
2012 school year. The middle school had a student population of 1,941 in grades six through eight, and the seventh grade had a population of 637 students. Seventh grade students (n = 483) enrolled in the district's standard math course were invited to participate in this study, and 362 students assented to participate. Only students enrolled in regular education math classes were invited to participate in order to have the largest yet most cognitively homogenous sample possible. Seventh grade students (n = 154) enrolled in the district's accelerated math course were not invited to participate in this study.

The sample included students from 18 separate math classes and five different seventh grade math teachers. In order to maintain confidentiality, the five teachers mentioned in this study are referred to using letters A through E, respectively. Tables 5 through 10 include demographic information from the school where the research study took place.

Table 5

*School Demographics – Gender*

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Population</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>6</td>
<td>344</td>
<td>293</td>
</tr>
<tr>
<td>7</td>
<td>361</td>
<td>276</td>
</tr>
<tr>
<td>8</td>
<td>355</td>
<td>312</td>
</tr>
<tr>
<td>Total</td>
<td>1060</td>
<td>881</td>
</tr>
</tbody>
</table>

Total % of School Population 55 45

Total % of Sample 54 46
Table 6

*School Population – Race/Ethnicity*

<table>
<thead>
<tr>
<th>Grade</th>
<th>African American</th>
<th>Asian</th>
<th>Caucasian</th>
<th>Hispanic</th>
<th>Multiracial</th>
<th>Other</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>130</td>
<td>130</td>
<td>234</td>
<td>108</td>
<td>31</td>
<td>4</td>
<td>637</td>
</tr>
<tr>
<td>7</td>
<td>135</td>
<td>129</td>
<td>259</td>
<td>82</td>
<td>27</td>
<td>5</td>
<td>637</td>
</tr>
<tr>
<td>8</td>
<td>166</td>
<td>125</td>
<td>240</td>
<td>105</td>
<td>29</td>
<td>2</td>
<td>667</td>
</tr>
<tr>
<td>Total</td>
<td>431</td>
<td>384</td>
<td>733</td>
<td>295</td>
<td>87</td>
<td>11</td>
<td>1941</td>
</tr>
</tbody>
</table>

Total % of School Population

|                           | 22 | 20 | 38 | 15 | 4 | 1 |

Table 7

*Student Sample – Race/Ethnicity*

<table>
<thead>
<tr>
<th>Grade</th>
<th>African American</th>
<th>Asian</th>
<th>Caucasian</th>
<th>Hispanic</th>
<th>Multiracial</th>
<th>Other</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>88</td>
<td>65</td>
<td>137</td>
<td>55</td>
<td>14</td>
<td>3</td>
<td>362</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>18</td>
<td>38</td>
<td>15</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Total % of Sample

|                           | 24 | 18 | 38 | 15 | 4 | 1 |
Table 8

*School Population – Free/Reduced Lunch*

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Free</th>
<th>Reduced</th>
<th>Paid</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>230</td>
<td>58</td>
<td>349</td>
<td>637</td>
</tr>
<tr>
<td>7</td>
<td>225</td>
<td>50</td>
<td>362</td>
<td>637</td>
</tr>
<tr>
<td>8</td>
<td>243</td>
<td>57</td>
<td>367</td>
<td>667</td>
</tr>
<tr>
<td>Total</td>
<td>698</td>
<td>165</td>
<td>1078</td>
<td>1941</td>
</tr>
</tbody>
</table>

Total % of School Population

<table>
<thead>
<tr>
<th></th>
<th>Free</th>
<th>Reduced</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total % of Sample</td>
<td>36</td>
<td>8.5</td>
<td>55.5</td>
</tr>
</tbody>
</table>

Table 9

*Student Sample – Free/Reduced Lunch*

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Free</th>
<th>Reduced</th>
<th>Paid</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>138</td>
<td>33</td>
<td>191</td>
<td>362</td>
</tr>
<tr>
<td>Total % of Sample</td>
<td>38</td>
<td>9</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>
Table 10

*Teacher Sample – Seventh Grade Mathematics*

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Gender</th>
<th>Ethnicity</th>
<th>Years of Teaching Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>F</td>
<td>PI</td>
<td>9</td>
</tr>
<tr>
<td>B</td>
<td>F</td>
<td>W</td>
<td>9</td>
</tr>
<tr>
<td>C</td>
<td>F</td>
<td>W</td>
<td>28</td>
</tr>
<tr>
<td>D</td>
<td>F</td>
<td>W</td>
<td>18</td>
</tr>
<tr>
<td>E</td>
<td>F</td>
<td>W</td>
<td>13</td>
</tr>
<tr>
<td>M</td>
<td></td>
<td></td>
<td>15.40</td>
</tr>
</tbody>
</table>

*Note. N = 5. F = female; PI = Pacific Islander; W = White/Caucasian.*

This study had six variables predicted to be significantly related to teacher autonomy support. Field (2009) suggested that a regression study using six predictors have a sample size over 300 in order to have sufficient power to detect a small effect (pp. 222-223). Fink (2002) recommended that there be between 40 and 50 participants for each predictor variable. The sample size of this study met these criteria and thus provided sufficient power to detect a small effect.

*Data Collection and Instrumentation*

The degree to which students find enjoyment and value in academic lessons and activities, experience reduced anxiety, and feel competent each affect their intrinsic motivation (Anderman & Anderman, 2009; Brophy, 2010; Perry, Turner, & Meyer, 2006; Reeve, 2009; Wentzel & Wigfield, 2009). Each of these measures related to intrinsic motivation are relevant constructs within the middle grades mathematics classroom. The research questions in this study were addressed using the following instruments.
Learning Climate Questionnaire

The Learning Climate Questionnaire (LCQ) contained questions that allowed participants to assess the extent to which their teacher supported their autonomy. Many studies have used the LCQ for this purpose (e.g., Black & Deci, 2000; Hardre & Reeve, 2003; Jang et al., 2009; Soenens & Vansteenkiste, 2005; Trouilloud et al., 2006; Tsai et al., 2008; Williams & Deci, 1996; Zhou et al., 2009). The LCQ used in this study had nine items (see Appendix B). Students responded to each of the nine items on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree); scores with a higher average represented greater perceived autonomy support. Williams and Deci (1996) and Black and Deci (2000) found the alpha reliability of the LCQ scale to be .96 and .94, respectively. The LCQ measured all six research questions in this study. Appendix C includes a figure illustrating the relationship between the three basic psychological needs espoused by SDT and the items assessed on the LCQ related to perceived teacher autonomy support.

Intrinsic Motivation Inventory

The Intrinsic Motivation Inventory (IMI) has been used in several studies related to intrinsic motivation and self-regulation (Deci et al., 1994; McAuley et al., 1989; Ryan et al., 1990; Zhou et al., 2009). The IMI used in this study consisted of the four subscales (a) Interest/Enjoyment, (b) Value/Usefulness, (b) Pressure/Tension, and (d) Perceived Competence (see Appendix D). The Interest/Enjoyment subscale has been used to measure intrinsic motivation (Black & Deci, 2000; Zhou et al., 2009). The Value/Usefulness subscale has been used in internalization studies (Deci et al., 1994). Pressure, tension, and anxiety are theorized to undermine intrinsic motivation and are
thought to be a quite controlling form of behavioral regulation (Black & Deci, 2000; McAuley et al., 1989). Perceived competence is considered a predictor of intrinsic motivation (Ryan & Deci, 2002).

The IMI used in this study had 20 items. Students responded to each of the 20 items on a 7-point Likert scale (1 = not at all true, 4 = somewhat true, and 7 = very true). Scores were calculated for each of the four subscales, and scores with a higher average represented greater interest/enjoyment, value/usefulness, perceived competence, and pressure/tension, respectively. The IMI used by McAuley et al. (1989) had an alpha reliability of .85. The IMI measured Research Questions 1 through 4 in this study.

**Interest/enjoyment subscale.** The Interest/Enjoyment (IE) subscale used in this study assessed students' intrinsic motivation in their prealgebra class (see Appendix D). Izard (1977, 2004) suggested that interest is the primary emotion in intrinsically motivated activity and that enjoyment is the secondary emotion. Various studies have found psychometric evidence supporting this claim (e.g., Harackiewicz, 1979). SDT defines intrinsic motivation as behaviors engaged in solely for their inherent interest and enjoyment (Ryan & Deci, 2002). Such behaviors are endorsed by the self and are not influenced by any external force. Intrinsically motivated behaviors are not influenced by external pressures or contingencies and represent actions fully aligned with the self. The IE subscale used by Black and Deci (2000) had an alpha reliability of .90. The IE subscale measured Research Question 1 in this study.

**Value/usefulness subscale.** The Value/Usefulness (VU) subscale measured the degree to which participants felt that what they were asked to learn in their prealgebra class was valuable and useful (see Appendix D). Teachers can help students recognize the
value in learning mathematics by supporting their autonomy. Learning environments that support students’ autonomy are more likely to facilitate students’ internalization of uninteresting yet important activities (Deci et al., 1994; Jang, 2008; Reeve et al., 2002). To foster students’ internalizations, teachers can offer evidence that curricular content is useful, provide meaningful rationales, acknowledge students’ negative affect, take students’ perspective, rely on noncontrolling language, and provide opportunities for choice (Assor et al., 2002; Deci et al., 1994; Reeve, 2002, 2009; Reeve & Assor, 2011; Reeve & Halusic, 2009; Reeve & Jang, 2006; Reeve et al., 2008). As teachers do this, students become more likely to endorse curricular content and integrate it within their value system. Deci et al. (1994) found the alpha reliability for this scale to be greater than .60 (p. 129). The VU subscale measured Research Question 2 in this study.

**Pressure/tension subscale.** The Pressure/Tension (PT) subscale has been used in studies to measure how much pressure, tension, and anxiety participants feel in a given environment or while engaged in a given task (see Appendix D). The questions on the PT subscale assessed how much anxiety students experienced in their mathematics classes. Pressure and tension create anxiety and are therefore considered to be a quite controlling form of motivation. Pressure and tension are antithetical to intrinsic motivation (i.e., behaviors engaged in solely for their enjoyment) and undermine autonomous motivation. Autonomy-supportive teachers reduce the amount of pressure, tension, and anxiety students experience through use of autonomy-supportive instructional practices, such as allowing students to express negative emotional affect and by minimizing the use of pressure and demands (Black & Deci, 2000; Deci et al., 1994; Flink et al., 1990; Reeve, 2009; Reeve & Halusic, 2009; Reeve et al., 2008; Vansteenkiste, Simons, et al., 2005).
McAuley et al. (1989) found the alpha reliability of the PT subscale to be .68, and Ryan et al. (1990) found it to be greater than .70. The PT subscale measured Research Question 3 in this study.

*Perceived competence subscale.* The Perceived Competence (PC) subscale has been used to measure how competent, or efficacious, individuals feel at a given task (see Appendix D). In this study, the PC subscale measured how competent students perceived themselves to be in mathematics. Perceived competence is considered a predictor of intrinsic motivation since feelings of competence facilitate intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000b, 2002). Black and Deci (2000) found the alpha reliability for this scale to be .90. The PC subscale measured Research Question 4 in this study.

*Academic Self-Regulation Questionnaire*

The Academic Self-Regulation Questionnaire (ASRQ) measured students’ self-determined academic motivation, that is, their autonomous self-regulation. Previous studies have used the ASRQ to measure students’ self-determined academic motivation (Chirkov & Ryan, 2001; Grolnick & Ryan, 1987; Ryan & Connell, 1989; Vallerand et al., 1997; Vansteenkiste, et al., 2009; Zhou et al., 2009; see Appendix E). Items on the ASRQ represented one of four subscales. Two of the subscales, *external* and *introjected* regulation, were associated with controlled regulation. The other two subscales, *identified* regulation and *intrinsic* motivation, were associated with autonomous self-regulation and self-determined behavior. Scores from these subscales were used to find a student’s Relative Autonomy Index (RAI). The RAI is a measure of the degree to which an individual autonomously self-regulates his or her behavior. External and introjected
regulation are more controlled forms of regulation and are not considered very autonomous forms of behavioral regulation. Identified regulation and intrinsic motivation are more autonomous forms of behavioral regulation and therefore represent more self-determined behavior. Intrinsic motivation is considered the prototype of autonomous self-regulation and self-determined behavior (Ryan & Deci, 2002). The ASRQ used by Ryan and Connell (1989) had an alpha reliability of .79. A more recent study used only the intrinsic motivation subscale of the ASRQ and found its alpha reliability to be .96 (Jang et al., 2009). The ASRQ measured Research Question 5 in this study.

Benchmark Tests

The relationship between teacher autonomy support and academic achievement was assessed using the average of students' scores on two district-generated standardized multiple-choice math tests. Students completed the first test (Interim I) nine weeks into the school year. Students completed the second test (Posttest I) at the end of the first semester on December 12, 2011. The test questions had been piloted multiple times and subsequently deemed valid and reliable by district-level administrators within the school system. Participants' mean score on the Interim I and Posttest I was used to measured Research Question 6 in this study.

Including the variable of academic achievement was deemed theoretically important because of its relation to other variables in this study. Research has shown that students perform well academically when they find class interesting, value what they are asked to learn, feel relaxed instead of pressured, feel competent, and exhibit self-determined academic motivation (Anderman & Anderman, 2009; Brophy, 2010; Perry, Turner, & Meyer, 2006; Reeve, 2009; Wentzel & Wigfield, 2009). Teacher autonomy
support has been shown to facilitate increased test performance (Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008), and, in correlational studies, it has been significantly and positively related to test performance (Black & Deci, 2000). The tests used in these studies were open-ended tests that assessed participants' conceptual understanding.

Conversely, the tests used in the current study were multiple-choice, standardized tests designed to measure students' rote knowledge and conceptual understanding. According to data released by district-level administrators responsible for producing the test, the benchmark tests assessed more rote learning than conceptual learning. The school district used Webb's (2002a, 2002b, 2007) depth of knowledge (DOK) design to develop the math tests, and most of the benchmark test questions assessed lower-level knowledge (i.e., Level 1 and Level 2 of Webb's DOK design). There were more Level 1 questions on the tests than Level 2 and Level 3 questions combined.

This study investigated if there was a significant relationship between students' perceived teacher autonomy support and their performance on two standardized math tests. No SDT research has investigated the relationship between perceived teacher autonomy support and adolescents' achievement on standardized math tests. This study drew upon past research (Black & Deci, 2000) that found a significant association between students' perceived teacher autonomy support and their test performance to predict that a significant relationship would exist between students' perceived teacher autonomy support and their academic achievement in mathematics, as measured by their mean score on two standardized multiple-choice tests.
General Information

The researcher gathered general information about the participants in this study. Students recorded their student number. The researcher then used the student number to identify participants' gender, ethnicity, and socioeconomic status. Multivariate analysis of variance (MANOVA) was used to determine if statistically significant relationships existed between these categorical variables (i.e., gender, ethnicity, and socioeconomic status) and the continuous variables under examination in this study related to motivation, achievement, and teacher autonomy support. Although participants' student number enabled the researcher to gather demographic information, students' names were not identified and participants remained anonymous. Table 11 shows the alignment between the six research questions of the current study and the instruments used to measure them.

Table 11

Instruments Used to Measure the Research Questions of the Multiple Regression Analysis

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Instrument Used to Measure the Predictor Variables (x)</th>
<th>Instrument Used to Measure the Outcome Variable (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IE subscale of IMI</td>
<td>LCQ</td>
</tr>
<tr>
<td>2</td>
<td>VU subscale of IMI</td>
<td>LCQ</td>
</tr>
<tr>
<td>3</td>
<td>PT subscale of IMI</td>
<td>LCQ</td>
</tr>
<tr>
<td>4</td>
<td>PC subscale of IMI</td>
<td>LCQ</td>
</tr>
<tr>
<td>5</td>
<td>ASRQ</td>
<td>LCQ</td>
</tr>
<tr>
<td>(Used to calculate RAI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Benchmark Tests</td>
<td>LCQ</td>
</tr>
<tr>
<td>(Interim I and Posttest I)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. IE = interest/enjoyment; VU = value/usefulness; PT = pressure/tension; PC = perceived competence; IMI = Intrinsic Motivation Inventory; ASRQ = Academic Self-Regulation Questionnaire; RAI = Relative Autonomy Index; LCQ = Learning Climate Questionnaire.
Research Design

Self-determination theory is an empirically-based theory that has a rich foundation in quantitative analysis (Ryan & Deci, 2000b, p. 69; Ryan & Deci, 2006, pp. 1563-1564; Ryan & Niemiec, 2009). Because psychological needs for autonomy, competence, and relatedness are espoused to be universal, the ability to generalize research findings is important within SDT. The findings of quantitative research can be generalized to the greater population from which the sample of the study is taken (Field, 2009; Salkind, 2009, 2011).

This study employed a quantitative research methodology to examine the relationship between students' perceptions of their teachers' autonomy support and these student-level variables related to learning mathematics: (a) interest and enjoyment, (b) value and usefulness, (c) pressure and tension, (d) perceived competence, (e) autonomous self-regulation (i.e., self-determined motivation), and (f) academic achievement. This was a correlational research study. Data in this study was analyzed through multiple regression. Multiple regression involves finding linear models that best predict outcomes (Field, 2009). This study used multiple regression to find the model most closely associated with teacher autonomy support and middle grades students' intrinsic motivation and academic achievement in mathematics.

Procedures

The research was conducted from the first day of the first semester, August 8, 2011, until the last day of the first semester, December 16, 2011. The first semester was 88 days, encompassing 18 weeks of the school calendar. Seventh grade students were taught the same mathematics curriculum as predetermined by the public school district in
which the study took place. The mathematics learning objectives and academic standards were the same for all seventh grade students in this study. Students had the same mathematics teachers for the entire semester from August through December.

Prior to the data collection and the subsequent data analyses, permission was obtained from the Institutional Review Board (IRB) of the researcher's university and the school district where this research was conducted. Appendix F includes the IRB approval letter, and Appendix G includes the local school district approval level. Parental consent was obtained in written form from the parents of students who participated in this study (see Appendix H). Student assent was obtained in written form from students who participated in this study (see Appendix I).

In order to help ensure honest responses from students, the questionnaires used in this study were not administered by participants' teachers. A researcher who did not know the students administered the three questionnaires. Since students evaluated their teachers in some of the questionnaires, participants were assured that their responses would remain completely anonymous, would not be seen by their teachers, and would not affect their grade in any way. The researcher who administered the questionnaires asked participants to read each question carefully and to take as much time as they needed to complete the questionnaires so that they did not feel rushed. A standardized prompt read to participants prior to administering the questionnaires is listed in Appendix J.

Participants completed the LCQ, IMI, and ASRQ questionnaires during the week of October 24, 2011. The mathematics Interim I test was given to students on October 7, 2011, and the Posttest I was given to students during the last week of the first semester. The results of participants' self-report questionnaires (e.g., the LCQ, IMI, and ASRQ)
and the data generated from the math tests were collected and entered into an SPSS database.

Data Analysis

This study examined the relationship between teachers’ autonomy support and students’ (a) interest and enjoyment in mathematics, (b) value and usefulness of mathematics, (c) pressure and tension in mathematics, (d) perceived competence in mathematics, (e) relative autonomy (i.e., self-determined academic motivation), and (f) academic achievement in middle grades mathematics. First, it was hypothesized that there would be a statistically significant relationship between teachers’ autonomy support and students’ intrinsic motivation as measured by the amount of interest/enjoyment, value/usefulness, pressure/tension, and perceived competence they experienced in their prealgebra class. Second, it was hypothesized that there would be a statistically significant relationship between teachers’ autonomy support and students’ relative autonomy (i.e., their autonomous self-regulation). The idea that teachers who offer more autonomy support facilitate students’ self-determined motivation provided the rationale for this hypothesis which was based on extant SDT research that found a statistically significant relationship between teachers’ autonomy support and students’ self-determined orientation for learning (Black & Deci, 2000; Grolnick & Ryan, 1987; Williams & Deci, 1996). Third, it was hypothesized that there would be a statistically significant relationship between teachers’ autonomy support and students’ academic achievement. This hypothesis was informed by previous research that found students’

- grades (Black & Deci, 2000; Jang et al., 2009; Soenens & Vansteenkiste, 2005),
• test performance (Black & Deci, 2000; Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008), and
• conceptual learning (Benware & Deci, 1984; Boggiano et al., 1993; Grolnick & Ryan, 1987; Jang, 2008; Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008) were greater when teachers provided autonomy support.

It was believed that students of autonomy-supportive teachers would report greater levels of interest/enjoyment, value/usefulness, perceived competence, and self-determined academic motivation, experience less pressure and tension, and achieve higher academically in their prealgebra class than students whose teachers were less autonomy supportive.

This study used multiple regression to test these hypotheses and to examine if there was a statistically significant relationship between teachers’ autonomy support and students’ intrinsic motivation and academic achievement. The multiple regression model was followed with hierarchical linear regression to identify the most parsimonious model having the most predictive power. This study predicted a moderate positive correlation between teachers’ autonomy support and students’ intrinsic motivation and academic achievement in middle grades mathematics. This prediction was based on research that found teacher autonomy support was significantly related to students’ intrinsic motivation and academic achievement (Black & Deci, 2000; Grolnick & Ryan, 1987; Jang et al., 2009; Soenens & Vansteenkiste, 2005; Vansteenkiste, Timmermans, et al., 2008).
Assumptions of Multiple Regression

Field (2009) maintained that ten assumptions exist for regression (pp. 220-221). They are listed below.

- Variable type: The outcome should be a continuous variable. The predictor variables can be continuous or categorical. If categorical, it should have only two values—one or zero.
- Non-zero variance. The predictors should have some variance (i.e., the variables all cannot be the same value).
- Independence of values on the outcome variable. One participant’s score should not be dependent on another participant’s score.
- Predictors are uncorrelated with external variables. There should be no external variables that correlate highly with the predictors.
- There should not be influential data points.
- Lack of autocorrelation. Residual errors should not be autocorrelated.
- Homoscedasticity. There should be equal variance at each level of the predictor variable.
- Normally distributed error. Residual error should be normally distributed.
- Linearity. The relationship between a predictor and outcome should be linear.
- No perfect multicollinearity. The predictor variables should not correlate too highly.

There were several criteria for judging whether each assumption was met. The assumptions of (a) variable type, (b) non-zero variance, (c) independence of values on the
outcome variable, and (d) predictor variables uncorrelated with external variables can be confirmed by looking at the data set. They can also be confirmed by what is known from data collection or theory. Therefore, these assumptions were assumed to be true.

There should not be influential data points. To determine if there were influential data points, all cases that had a standardized residual value above three were examined. If a case had a standardized value above three and a Cook's value above 1, it was considered an influential data point; the multiple regression analysis was run with and without influential data points.

A Durbin-Watson test was used to determine if there were independent errors. If the test-value was between one and three, independence of errors was assumed. The Durbin-Watson test addressed the assumption of autocorrelation.

Visual analysis was used for assumptions of homoscedasticity, normally distributed errors, and linearity. Scatterplots between the predictors and outcome, a Zpred*Zresid plot, and a histogram of the residual errors were examined. The scatterplot was analyzed for linearity. The residual plot was analyzed for a random scattering of data points. The histogram was analyzed for a normal distribution.

Multicollinearity was examined in two ways. First, to ascertain a general idea of whether there was multicollinearity and where it might be, a correlation matrix of all variables was examined to see if there were any correlations between predictor variables higher than .90. Second, collinearity statistics were then used according to the following criteria from Field (2009):

- If the largest VIF is greater than 10, then there is cause for concern.
• If the average VIF is substantially greater than 1, then the regression may be biased.

• Tolerance below 0.1 indicates a serious problem.

• Tolerance below 0.2 indicates a potential problem.

Criteria for Rejecting the Null Hypotheses

The following criteria were used to reject the null hypotheses. The null hypotheses were rejected if the $p$ value for the predictor variables' (i.e., interest/enjoyment, value/usefulness, pressure/tension, perceived competence, relative autonomy, and academic achievement) parameter was .05 or less. The null hypotheses were also rejected if the confidence interval of the parameter did not include zero.

Summary

This study was conducted in order to address the need for more research on the relationship between autonomy-supportive instruction and adolescent motivation and achievement in a middle school mathematics setting. The participants in this study were 362 seventh grade mathematics students. Students in the sample attended a public middle school in a suburban metropolitan school district in the southeastern United States that had a population of 1,941 students.

Students responded to three self-report questionnaires in order to measure their intrinsic motivation and to assess their teachers' autonomy support. Students also completed two standardized multiple-choice prealgebra tests. This data was then collected and analyzed.

Multiple regression determined if a statistically significant relationship existed between teachers’ autonomy support and students’ intrinsic motivation and academic
achievement. The multiple regression model was followed with hierarchical linear regression. From this data, a linear model was determined in order to identify the variables most closely related to teacher autonomy support. The overarching goal of this research was to identify the instructional practices that best nurture students' inner motivational resources and thus facilitate their intrinsic motivation and increase their academic achievement in mathematics.
CHAPTER 4

Results of Data Analysis

Introduction

Self-determination theory (SDT) espouses that people have innate psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2000b). Individuals experience growth, healthy development, and a sense of well-being when their surrounding social environment nurtures these three needs (Burton, Lydon, D'Alessandro, & Koestner, 2006; Deci et al., 1991; Reeve, 2009; Vansteenkiste et al., 2009). While other contemporary theories of motivation contend that competence and relatedness are important constructs related to students' motivational development, academic performance, and sense of well-being, SDT is unique in its empirical exploration of a psychological need for autonomy. Many research studies within the last three decades have investigated the relationship between learning environments that support students' autonomy and positive educational outcomes. The findings of these studies suggest that students benefit developmentally and academically when teachers utilize instructional techniques that support students' autonomy (Reeve, 2009). However, very little research has explored the relationship between autonomy-supportive teaching and middle school students' intrinsic motivation and academic achievement in mathematics.
The purpose of this study was to apply SDT to investigate the relationship between seventh grade students' perceived teacher autonomy support and their intrinsic motivation and academic achievement in a prealgebra course. This study investigated the relationship between students' perceptions of their teachers' autonomy support and (a) students' intrinsic motivation in studying mathematics as measured by the levels of interest/enjoyment, value/usefulness, pressure/tension, and perceived competence they experience; (b) students' autonomous self-regulation; and (c) students' mathematical achievement. The variables related to perceived teacher autonomy support and participants' intrinsic motivation were assessed through 362 participants' responses on three self-report questionnaires. Academic achievement in mathematics was assessed by averaging participants' scores on two standardized tests in their prealgebra class.

Participants' responses to the questionnaires and their academic achievement data were applied within a multiple regression analysis in order to find the most predictive linear model of teacher autonomy support. Because autonomy-supportive teaching has been shown to benefit students in a variety of ways (Reeve, 2009), the goal of this study was to identify the variables most closely related to teacher autonomy support. A specific aim was to further understand and identify instructional practices associated with young adolescent students' intrinsic motivation and academic achievement in mathematics.

This chapter presents the results of this research study. It describes the participants of the study and how they were selected. It explains the procedures used to collect and analyze the data. It also provides reliability analyses of the questionnaires, relevant descriptive statistics, bivariate correlations between pertinent variables, and
results of the multiple regression analysis used to answer the research questions in this study.

Research Questions and Hypotheses

The research questions and related hypotheses of this study are listed below.

1. Is there a statistically significant relationship between teacher autonomy support and seventh grade students' interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

H₀₁: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

H₁₁: There will be a statistically significant relationship between teacher autonomy support and seventh grade students' interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

2. Is there a statistically significant relationship between teacher autonomy support and seventh grade students' value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

H₀₂: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' value/usefulness of mathematics,
controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

H_{A2}: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

3. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement?

H_{O3}: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement.

H_{A3}: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement.

4. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement?
H₀₄: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students’ perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement.

Hₐ₄: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement.

5. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement?

H₀₅: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students’ autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement.

Hₐ₅: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement.

6. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ academic achievement in mathematics, controlling...
for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation?

$H_{06}$: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation.

$H_{a6}$: There will be a statistically significant relationship between teacher autonomy support and seventh grade students' academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation.

*Participants and Setting*

This research was conducted at a public middle school located in a suburban metropolitan area of the southeastern United States during the first semester of the 2011-2012 school year. The middle school had a student population of 1,941 in grades six through eight. The school's student body was ethnically and socioeconomically diverse. The school’s population was approximately 22% African American, 20% Asian, 38% Caucasian, 15% Hispanic, and 5% Multiracial. Forty-four percent of the school’s population was enrolled in the federally-funded free/reduced lunch program. Twenty-seven percent of the school’s student population qualified for the school district’s gifted education program. The school consistently ranked among the highest achieving schools in the district and state based on students’ performance on district and state assessments, and it had a longstanding tradition of being an academically strong school.
Three hundred sixty-two seventh grade students participated in the study. The sample of the study was highly representative of the gender, ethnicity, and socioeconomic status of the school population. Twenty-four percent of the participants were African American \( (n = 88) \), 18% were Asian \( (n = 65) \), 38% were Caucasian \( (n = 137) \), 15% were Hispanic \( (n = 55) \), 4% were Multiracial \( (n = 14) \), and 1% were of another ethnicity \( (n = 3) \). Approximately 47% of the participants were enrolled in the free/reduced lunch program \( (n = 171) \). Approximately 54% of the participants were male \( (n = 196) \) and 46% were female \( (n = 166) \).

The sample included students from 18 separate math classes and five different seventh grade math teachers. In order to maintain confidentiality, the five teachers mentioned in this study are referred to using letters A through E, respectively. All seventh grade students at the school enrolled in general education math classes were invited to participate in the study, but every student did not assent to participate. Appendices H and I list the parental consent and student assent forms, respectively.

Participants were enrolled in general education math classes and were taught the same standard-based curriculum as determined by the state and school district. Two Honors classes and two collaborative special education classes were included in the study. Students qualified for Honors classes based on their standardized tests scores from fifth and sixth grade and by recommendation from their sixth grade math teacher. Collaborative classes consisted of general education students and students who had qualified for special education services. In the collaborative classes, a certified special education teacher worked in the same classroom as the math teacher and assisted students who had qualified for special education services. Special education students placed in a
collaborative class had a learning need that was determined to be best served through inclusion within a mainstream classroom; a collaborative class was identified as being the least restrictive environment for these students (U. S. Department of Education, 2010).

Table 12 describes the number of students that participated in this study, their class period, and their teacher.

Table 12

Questionnaire Distribution by Teacher and Class Period

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Number of Classes Surveyed</th>
<th>Period</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>24 18 17</td>
<td>59</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>25 26a 22 23</td>
<td>96</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>21 19b 15 16</td>
<td>71</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>18 19 17</td>
<td>54</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>22 17 22a 21b</td>
<td>82</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>92 98 95 77</td>
<td>362</td>
</tr>
</tbody>
</table>

aHonors class. bSpecial education collaborative class.

Data Collection Procedures

The following narrative describes the procedures used to collect data for this study. Participants completed a series of three questionnaires according to the following method. A researcher entered the classroom at the beginning of the class period. The timing of the researcher’s arrival had been prearranged with the classroom teacher. The researcher arrived at the beginning of each class period in order to avoid interrupting the teacher’s lesson and in order to have students’ full attention. The teacher left the classroom once the researcher arrived. The teacher left the classroom in order to ensure
honest, authentic responses from students since students were evaluating their teachers on two of the questionnaires.

After the teacher left, the researcher greeted the class. The researcher then gave each participating student an empty file folder. The researcher told participants that the folders would be used to collect their completed questionnaires.

The researcher read a standardized prompt aloud prior to administering the questionnaires. The prompt included information about the purpose of the research, ensured participants that their responses would be kept confidential and anonymous, explained that the surveys would not affect their grade in any way, and encouraged them to be honest in their responses. Appendix J lists the prompt as it was read to participants.

Participants were given three separate questionnaires to complete, the Learning Climate Questionnaire (LCQ), the Intrinsic Motivation Inventory (IMI), and the Academic Self-Regulation Questionnaire (ASRQ). Participants completed the LCQ first, then the IMI, and then the ASRQ. Participants were not given a second questionnaire until every participant had completed the first one. For example, the IMI was not administered to students until every participant had completed the LCQ and placed it inside their folder. This was done in order to help ensure that students took their time on each questionnaire, read each item carefully, and did not feel hurried. In addition to the opening prompt read to participants, each questionnaire had a more specific set of brief directions that was read aloud before the questionnaire was given to students (see the headings on Appendices B, D, and E). The researcher also explained to participants how to use the Likert scales for each questionnaire. Participants completed all three questionnaires in about 20 minutes. Students who did not participate in the study sat
quietly or quietly read a book while the others completed the questionnaires. The researcher collected the participants’ file folders, thanked them for their participation, and asked if there were any questions. The researcher then left the classroom, and the students’ teacher returned.

All of the questionnaires were administered and collected over the course of one week. Questionnaires were administered on five separate days during the week of October 24, 2011 to participants in each teacher’s classroom according to the following schedule: teacher A (Monday, October 24), teacher B (Tuesday, October 25), teacher C (Wednesday, October 26), teacher D (Thursday, October 27), and teacher E (Friday, October 28). The questionnaires were collected in a concentrated time frame in order to ensure that participants had a similar amount of time to evaluate their teachers’ autonomy support.

**Learning Climate Questionnaire**

Participants completed the LCQ first. Previous research has used the LCQ to evaluate the degree to which students feel that their teacher supports their autonomy (Black & Deci, 2000; Hardre & Reeve, 2003; Jang et al., 2009; Williams & Deci, 1996). The LCQ used in this study consisted of nine items. Each item represented nine different constructs related to teacher autonomy support (e.g., “My teacher provides me with choices and options”). Students rated their teacher using a 7-point Likert scale (1 = *strongly disagree* and 7 = *strongly agree*). The alpha reliability for this scale was high (α = .90). The LCQ can be seen in its entirety as it was given to students in Appendix B. The LCQ measured all six research questions in this study. Participant’s mean score on the LCQ was used as the outcome variable within the multiple regression analysis.
Table 13 shows the nine items related to teacher autonomy support and their intercorrelations. Table 13 also shows the descriptive statistics for each indicator of autonomy support. "Conveys confidence" and "Shows me respect" had the highest averages ($M = 5.36$). "Listens carefully" had the lowest average ($M = 4.22$).

Table 13

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1: Provides choices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 2: Feel understood</td>
<td>.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 3: Conveys confidence</td>
<td>.50</td>
<td>.65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 4: Encourages questions</td>
<td>.47</td>
<td>.43</td>
<td>.43</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 5: Listens carefully</td>
<td>.52</td>
<td>.59</td>
<td>.48</td>
<td>.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 6: Answers questions fully</td>
<td>.42</td>
<td>.50</td>
<td>.46</td>
<td>.53</td>
<td>.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 7: Tries to understand</td>
<td>.44</td>
<td>.52</td>
<td>.48</td>
<td>.49</td>
<td>.57</td>
<td>.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 8: Shows me respect</td>
<td>.53</td>
<td>.59</td>
<td>.62</td>
<td>.41</td>
<td>.51</td>
<td>.48</td>
<td>.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 9: Able to share feelings</td>
<td>.49</td>
<td>.61</td>
<td>.51</td>
<td>.43</td>
<td>.56</td>
<td>.42</td>
<td>.47</td>
<td>.58</td>
<td></td>
</tr>
</tbody>
</table>

$M^a$  
$4.91$  $4.74$  $5.36$  $5.32$  $4.22$  $5.28$  $4.71$  $5.36$  $4.25$

$SD$  
$1.50$  $1.72$  $1.59$  $1.72$  $1.87$  $1.65$  $1.83$  $1.85$  $1.93$

Note. $N = 362$. AS = autonomy support; Variables 1–9 are indicators for autonomy support, and they appear as items on the LCQ as listed in Appendix B. There is evidence that each item measured a unique autonomy-supportive practice since all correlations are well below $.90$ (Field, 2009, pp. 223-224). For all correlations in this table, $p < .01$.

$^a$ Scores ranged from 1 (strongly disagree) to 7 (strongly agree).
*Intrinsic Motivation Inventory*

Participants completed the IMI after the LCQ. Previous research has used the IMI to assess participants' feelings related to a target activity (Deci et al., 1994; Ryan et al., 1990); the IMI used in this study assessed the feelings, thoughts, and emotions participants experienced in their prealgebra class. The IMI used in this study consisted of 20 questions with four embedded subscales: the Interest/Enjoyment (IE) subscale, the Value/Usefulness (VU) subscale, the Pressure/Tension (PT) subscale, and the Perceived Competence (PC) subscale. Items from each subscale were randomly placed throughout the IMI; no items from the same subscale were listed consecutively. Students rated their teacher using a 7-point Likert scale (1 = *not at all true* and 7 = *very true*). The IMI was used to measure research questions 1 through 4 in this study.

The IMI consisted of 20 questions, but only 19 were used in the statistical analyses of this study. After running reliability analyses, one question on the PT subscale was determined to be unreliable, so it was dropped from the scoring. The IMI is listed in Appendix D. A key is provided in Appendix D to identify the items that correspond with the IE, VU, PT, and PC subscales. This key was not included on the questionnaire given to students.

*Interest/enjoyment subscale.* Previous studies have used the IE subscale to measure students' intrinsic motivation in an academic setting (Black & Deci, 2000). The IE subscale used in this study consisted of six items. Each of the six items measured students' intrinsic motivation (e.g., "I find this class very interesting"). Question numbers 1, 5, 8, 10, 13, and 18 of the IMI were items on the IE subscale. Item 13, "I think this class is very boring," was reversed scored by subtracting the score from eight. The alpha
reliability for this scale was high (α = .92). Three trained experts in the field determined that the IE subscale items had face validity (S. B. Carr, J. S. Hall, & W. O. Lacefield, personal communication, April 26, 2011). Since intrinsic motivation was one of the primary variables under investigation in this study, the IE subscale had more questions than the other three subscales of the IMI in order to ensure good reliability. The IE subscale measured research question 1 in this study. Each participant’s mean score on the IE subscale was used as a predictor variable within the multiple regression analysis.

Value/usefulness subscale. The VU subscale has been used to explore the extent to which contextual supports for autonomy enhance students’ self-determined motivation (Deci et al., 1994). The VU subscale consisted of five items. Each of the five items measured the degree to which students found the math content they were learning valuable and useful (e.g., “It is very clear to me how valuable and how useful what I am learning in this class will be in my life”). Question numbers 2, 7, 14, 17, and 19 of the IMI were items on the VU subscale. The alpha reliability for this scale was high (α = .91). Three trained experts in the field determined that the VU subscale items had face validity (S. B. Carr et al., personal communication, April 26, 2011). The VU subscale measured research question 2 in this study. Each participant’s mean score on the VU subscale was used as a predictor variable within the multiple regression analysis.

Pressure/tension subscale. Previous research has used the PT subscale to investigate the relationship between intrinsic motivation and felt pressure and tension (Grolnick & Ryan, 1987; McAuley et al., 1989). Pressure is believed to undermine intrinsic motivation. Each of the items on the PT subscale aimed to measure the extent to which students felt pressure in their math class (e.g., “I feel very tense in this class”).
Question numbers 3, 6, 9, 12, and 16 of the IMI were items on the PT subscale. Item 9, "I feel very relaxed in this class," was reversed scored by subtracting the score from eight.

The PT subscale consisted of five items, but only four were used in statistical analyses. Question number 12, "I feel anxious in this class," was removed from scoring because it had low reliability. The low reliability could have been due to students' unfamiliarity with the word anxious. Another possible explanation of the psychometric inconsistency of question 12 concerns the multiple interpretations of the word anxious since anxious can be defined as eager (W. O. Lacefield, personal communication, January 17, 2012). Some students are eager and excited to engage in mathematics, but that is not what the PT subscale aimed to assess. The alpha reliability for the five-item PT subscale was in acceptable range ($\alpha = .72$), but the alpha reliability for the four-item PT subscale was higher ($\alpha = .75$). The four-item PT subscale measured research question 3 in this study. Each participant's mean score on the PT subscale was used as a predictor variable within the multiple regression analysis.

Perceived competence subscale. Previous research has used the PC scale to examine the relationship between students' perceived competence and teacher autonomy support (Black & Deci, 2000). The PC subscale used in this study consisted of four items. Each of the four items measured how capable students felt they were of learning the mathematical content of the class (e.g., "I feel confident in my ability to learn math"). Question numbers 4, 11, 15, and 20 of the IMI were items on the PC subscale. The alpha reliability for this scale was good ($\alpha = .85$). Three trained experts in the field determined that the PC subscale items had face validity (S. B. Carr et al., personal communication, April 26, 2011). The PC subscale measured research question 4 in this study. Each
participant’s mean score on the PC subscale was used as a predictor variable within the multiple regression analysis.

**Academic Self-Regulation Questionnaire**

Participants completed the ASRQ last. The ASRQ has been used in many studies in various cultures to measure students’ self-determined motivation for learning (Chirkov & Ryan, 2001; Grolnick & Ryan, 1987; Hardre & Reeve, 2003; Ryan & Connell, 1989; Vansteenkiste et al., 2009; Yamauchi & Tanaka, 1998; Zhou et al., 2009). The ASRQ consisted of 16 items (see Appendix E). The alpha reliability for the ASRQ was good ($\alpha = .78$). The ASRQ measured research question 5 in this study.

The ASRQ only had two stems. Both stems had eight items relating to reasons why students work on their classwork and try to do well in school. Students indicated how true each reason was for them by circling either “Very true,” “Sort of true,” “Not very true,” or “Not at all true” for each item. “Very true” was given a weight of 4 points, “Sort of true” was given a weight of 3 points, “Not very true” was given a weight of 2 points, and “Not at all true” was given a weight of 1 point.

Four subscales embedded within the ASRQ assessed the degree to which students experience academic behavior as autonomous, or self-determined. Question numbers 1, 6, 9, 12, and 16 assessed the degree to which students’ behavior was externally regulated (e.g., “Because I’ll get in trouble if I don’t do well”). Question numbers 2, 4, 10, 13, and 15 assessed the degree to which students’ behavior was regulated by introjection (e.g., “Because I want the teacher to think I’m a good student”). Question numbers 3, 8, and 14 assessed the degree to which students’ behavior was regulated through identification (e.g., “Because I want to learn new things”). Question numbers 5, 7, and 11 assessed the
degree to which students' behavior was *intrinsically* motivated and truly self-regulated (e.g., "Because it's fun").

The means of the four ASRQ subscales were used to calculate students' Relative Autonomy Index (RAI). The RAI was calculated using the following algorithm:

\[
2(\text{Intrinsic Motivation subscale mean}) + (\text{Identified Regulation subscale mean}) - (\text{Introjected Regulation subscale mean}) - 2(\text{External Regulation subscale mean}).
\]

Previous research has used students' RAI to measure their self-determined academic motivation (Grolnick & Ryan, 1987; Ryan & Connell, 1989; Soenens & Vansteenkiste, 2005; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005; Zhou et al., 2009). Students' RAI was used as one of the predictor variables in the multiple regression analysis.

The means of the four ASRQ subscales were also correlated with the predictor variables in this study (i.e., interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement) and with perceived teacher autonomy support to determine if significant relationships existed between these variables. The reliability coefficients of the four subscales of the ASRQ were as follows: external regulation (\(\alpha = .60\)), introjected regulation (\(\alpha = .75\)), identified regulation (\(\alpha = .76\)), and intrinsic motivation (\(\alpha = .81\)). The last question (item 16) of the ASRQ was dropped from scoring because it had low reliability; item 16 was item 5 of the external regulation subscale. Prior to removing item 16 from the ASRQ, the alpha coefficient of the ASRQ was .77, and the alpha coefficient of the external regulation subscale was .59.

Table 14 shows the alpha reliability coefficients for all the questionnaires used in this study. The degree to which inferences can be drawn and accurate conclusions made
from data analyses is directly related to the validity and reliability of the instruments that produced the data. Unreliable instruments render any research study worthless. Because five of the six research questions in this study relied on self-report questionnaires, the importance of the reliability of the questionnaires used in this study cannot be overstated.

Table 14

*Cronbach's Alpha Reliability Coefficients for Questionnaires*

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Number of Items</th>
<th>Cronbach’s α&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Climate Questionnaire</td>
<td>9</td>
<td>.90</td>
</tr>
<tr>
<td>Interest/Enjoyment subscale</td>
<td>6</td>
<td>.92</td>
</tr>
<tr>
<td>Value/Usefulness subscale</td>
<td>5</td>
<td>.91</td>
</tr>
<tr>
<td>Pressure/Tension subscale</td>
<td>4</td>
<td>.75</td>
</tr>
<tr>
<td>Perceived Competence subscale</td>
<td>4</td>
<td>.85</td>
</tr>
<tr>
<td>Academic Self-Regulation Questionnaire</td>
<td>15</td>
<td>.78</td>
</tr>
<tr>
<td>Subscales of the ASRQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Regulation</td>
<td>4</td>
<td>.60</td>
</tr>
<tr>
<td>Introjected Regulation</td>
<td>5</td>
<td>.75</td>
</tr>
<tr>
<td>Identified Regulation</td>
<td>3</td>
<td>.76</td>
</tr>
<tr>
<td>Intrinsic Motivation</td>
<td>3</td>
<td>.81</td>
</tr>
</tbody>
</table>

*Note. N = 362. ASRQ = Academic Self-Regulation Questionnaire.*

<sup>a</sup>Alpha coefficients (α) of .70 or higher indicate strong reliability (Field, 2009, pp. 673-681).

*Academic Achievement*

Academic achievement reflects how well students understand subject area content, so it is important for educators to identify variables related to students' academic
achievement. Academic achievement can be assessed in many ways (Butler & McMunn, 2006; Marzano, 2006; Nitko & Brookhart, 2010). In this study, academic achievement was measured by averaging participants’ scores on two district-generated standardized multiple-choice math tests taken approximately nine weeks apart from each other.

The two tests were entitled Interim I and Posttest I, respectively. Using participants’ average of two tests rather than only their Posttest I score was determined to be a more reliable measure of their mathematical achievement. Students completed the Interim I on October 7, 2011 and the Posttest I on December 12, 2011. The two benchmark tests measured research question 6 in this study. The mean of participants’ score on the Interim I and Posttest I was used as a predictor variable within the multiple regression analysis. Students completed a district-generated pretest during the first week of school; this data was collected, but pretest scores were not used in the multiple regression analyses.

Including the variable of academic achievement was deemed theoretically important because of its relation to other variables in this study. Research has shown that students perform well academically when they find class interesting, value what they are asked to learn, feel relaxed instead of pressured, feel competent, and exhibit self-determined academic motivation (Anderman & Anderman, 2009; Brophy, 2010; Perry, Turner, & Meyer, 2006; Reeve, 2009; Wentzel & Wigfield, 2009). Teacher autonomy support has been shown to facilitate increased test performance (Vansteenkiste et al., 2004; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008), and, in correlational studies, it has been significantly and positively related to test performance (Black & Deci, 2000). The tests used in these studies were open-ended tests
that assessed participants' conceptual understanding. Conversely, the tests used in the current study were multiple-choice, standardized tests designed to measure students' rote knowledge and conceptual understanding. Prior to the current study, no SDT research had investigated the relationship between perceived teacher autonomy support and adolescents' achievement on standardized math tests.

Data Security and Storage

Each participant's completed set of questionnaires were kept inside an individual file folder. All file folders from one class period were kept together with a rubber band. The bound class-set of student questionnaires was stored inside a large manila envelope. The letter used to represent participants' math teacher was written on the front of the storage envelope.

After all students completed the Posttest I, a school administrator accessed participants' test scores, downloaded the scores into an Excel spreadsheet, and then forwarded them to the researcher involved with the current study. Participants' test scores were labeled according to their student number so that students' names were not identified. The researcher then entered the test scores into an SPSS database.

The researcher involved with this study entered participants' questionnaire responses and academic achievement data into an SPSS database over the course of three weeks. After all the data had been entered into the SPSS system, SPSS software was used to conduct relevant statistical analyses. SPSS was used to conduct reliability analyses of the questionnaires, run tests for the assumptions of multiple regression, find the descriptive statistics and bivariate correlations between the predictor variables and teacher autonomy support, and conduct the multiple regression analyses.
Data Analyses and Results

This study used multiple linear regression to determine if there was a statistically significant relationship between seventh grade students' motivation and achievement in mathematics and their teachers' autonomy support. The goal was to identify the strongest predictors of teacher autonomy support within a seventh grade prealgebra classroom setting. Multiple regression analysis was used to answer all six research questions in this study. The original multiple regression model was followed with hierarchical linear regression to identify the most parsimonious model with the most predictive power. Bivariate correlations between predictor variables and teacher autonomy support were found as well. Table 15 includes the results of the multiple regression analysis.

Table 15

Predictors of Teacher Autonomy Support

<table>
<thead>
<tr>
<th>Variable</th>
<th>b</th>
<th>Standardized Coefficient (β)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.02</td>
<td></td>
<td>[1.31, 2.73]</td>
</tr>
<tr>
<td>Interest/enjoyment</td>
<td>0.50</td>
<td>.64***</td>
<td>[0.43, 0.57]</td>
</tr>
<tr>
<td>Value/usefulness</td>
<td>0.24</td>
<td>.25***</td>
<td>[0.15, 0.33]</td>
</tr>
<tr>
<td>Pressure/tension</td>
<td>0.02</td>
<td>.02</td>
<td>[-0.06, 0.09]</td>
</tr>
<tr>
<td>Perceived competence</td>
<td>-0.08</td>
<td>-.08'</td>
<td>[-0.17, 0.01]</td>
</tr>
<tr>
<td>Relative autonomy (RAI)</td>
<td>-0.02</td>
<td>-.04</td>
<td>[-0.07, 0.02]</td>
</tr>
<tr>
<td>Academic achievement</td>
<td>0.00</td>
<td>-.02</td>
<td>[-0.01, 0.01]</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F$</td>
<td>69.60***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $N = 362$. CI = confidence interval.

$^1 p < 0.10$. $^{***} p < 0.001$. 
The regression analysis revealed the following results. The overall model significantly predicted teacher autonomy support, $F (6, 355) = 69.60, p < .001$. Two predictor variables within the model, interest/enjoyment ($b = 0.50$) and value/usefulness ($b = 0.24$), were significant at the $p < .001$ level. The other four predictor variables, pressure/tension ($b = 0.02, p = .642$), perceived competence ($b = -0.08, p = .086$), relative autonomy ($b = -0.02, p = .325$), and academic achievement ($b = 0.00, p = .709$), were not significant within the regression model. The regression model accounted for 54% of the variance within the model ($R^2 = .54$). An $R^2$ value of 0.00 indicates that a guess using the mean is just as good a predictor as the regression model, and an $R^2$ value of 1.00 indicates that the regression model could make perfect predictions of teacher autonomy support (Field, 2009, pp. 201-204). In this study, the six-variable predictor model accounted for a majority, approximately 54%, of perceived teacher autonomy support.

The multiple regression analysis was used to answer all six research questions in this study. The research hypotheses for questions 1 and 2, $H_{A1}$ and $H_{A2}$, were accepted, and the null hypotheses, $H_{O1}$ and $H_{O2}$, were rejected. Interest/enjoyment and value/usefulness were found to be statistically significant predictor variables of teacher autonomy support within the regression model. The null hypotheses $H_{O3}$, $H_{O4}$, $H_{O5}$, and $H_{O6}$ were accepted, and the research hypotheses $H_{A3}$, $H_{A4}$, $H_{A5}$ and $H_{A6}$ were rejected for research questions three, four, five, and six. Pressure/tension, perceived competence, relative autonomy, and academic achievement were not statistically significant predictor variables within the regression model. Table 16 displays the interplay between the results of the regression analysis and the research questions in this study.
Table 16

*Research Questions and Null Hypotheses for the Multiple Regression Analysis*

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Predictor Variable</th>
<th>Null Hypothesis</th>
<th>Criteria for Accepting or Rejecting the Null Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Interest/enjoyment</td>
<td>Rejected</td>
<td>( p &lt; 0.001 )</td>
</tr>
<tr>
<td>2</td>
<td>Value/usefulness</td>
<td>Rejected</td>
<td>( p &lt; 0.001 )</td>
</tr>
<tr>
<td>3</td>
<td>Pressure/tension</td>
<td>Accepted</td>
<td>( ns )</td>
</tr>
<tr>
<td>4</td>
<td>Perceived competence</td>
<td>Accepted</td>
<td>( ns )</td>
</tr>
<tr>
<td>5</td>
<td>Relative autonomy (RAI)</td>
<td>Accepted</td>
<td>( ns )</td>
</tr>
<tr>
<td>6</td>
<td>Academic achievement</td>
<td>Accepted</td>
<td>( ns )</td>
</tr>
</tbody>
</table>

*Note.* \( ns \) = not statistically significant.

*Assumptions of Multiple Regression*

This dataset satisfied all of the assumptions for multiple linear regression (Field, 2009). The results of a Durbin-Watson test indicated no autocorrelation, \( d = 1.99 \). Casewise diagnostics indicated that there were no cases with a standardized residual above 3.00, so there were no influential data points or outliers in the data set. A visual analysis of scatterplots, a histogram of regression standardized residuals (see Figure 5), and a residuals plot (see Figure 6) indicated linearity, normally distributed errors, and homoscedasticity, respectively. An analysis of the correlation matrix and of collinearity statistics (i.e., VIF and tolerance) indicated no multicollinearity since the correlations between the predictor variables were less than .90 (see Table 17), the largest VIF was well below ten (1.72), the average VIF was not substantially greater than one \( (M = 1.49) \), and all tolerances were greater than 0.20. The outcome and predictor variables were all continuous and did not have zero variance. Independence of observations was assumed.
**Figure 5.** Histogram of regression standardized residuals.

**Figure 6.** Residuals plot.
Table 17

*Correlation Matrix of Six Predictor Variables Associated with Autonomy Support*

<table>
<thead>
<tr>
<th>Variable</th>
<th>IE</th>
<th>VU</th>
<th>PT</th>
<th>PC</th>
<th>RAI</th>
<th>AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VU</td>
<td>.53***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT</td>
<td>-.39***</td>
<td>-.30***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>.43***</td>
<td>.45***</td>
<td>-.41***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAI</td>
<td>.49***</td>
<td>.43***</td>
<td>-.32***</td>
<td>.29***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td>.09</td>
<td>.05</td>
<td>-.20***</td>
<td>.38***</td>
<td>.04</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Correlations < .90 offer evidence that there is not multicollinearity (Field, 2009, pp. 223-224). IE = Interest/Enjoyment subscale; VU = Value/Usefulness subscale; PT = Pressure/Tension subscale; PC = Perceived Competence subscale; RAI = Relative Autonomy Index; AA = academic achievement. ***p < .001.

The correlation matrix between the predictor variables listed in Table 17 highlights several salient relationships. The strongest correlation between all variables occurred between interest/enjoyment and value/usefulness \((r = .53, p < .001)\). This indicates that as students found class interesting and enjoyable, they were more likely to value what they were learning and find it useful; likewise, as they found the math content valuable and useful, they were more likely to take interest in it and enjoy it.

Pressure/tension was significantly and negatively related to the other five variables. Pressure/tension had the strongest negative relationship with perceived competence \((r = -.41, p < .001)\). This indicates that students tended to experience more pressure as they perceived themselves to be less competent in their prealgebra class; likewise, as perceived competence increased, pressure/tension decreased. Academic achievement was
significantly related to pressure/tension \((r = -0.20, p < 0.001)\) and perceived competence \((r = 0.38, p < 0.001)\) but not to interest/enjoyment \((r = 0.09, p = 0.091)\), value/usefulness, \((r = 0.05, p = 0.354)\), or relative autonomy \((r = 0.04, p = 0.437)\), although it did have a weak positive relationship with these variables. Pressure/tension and perceived competence were the only variables significantly related to all other predictor variables. There was a moderately strong significant correlation between participants’ self-determined academic motivation (i.e., their RAI) and the degree to which they found class interesting and enjoyable \((r = 0.49, p < 0.001)\). Students who engaged in academic work for more autonomous and self-determined reasons (i.e., intrinsic motivation and identified regulation) were more likely to find their school work interesting and enjoyable than students who engaged in school work as a result of controlling motivations (i.e., introjected and external regulations). The statistically significant relationships between the four predictor variables included on the IMI were expected since all four variables were constructs closely associated with intrinsic motivation.

*Hierarchical Multiple Regression*

The purpose of this study was to find the most predictive model of teacher autonomy support within a seventh grade prealgebra middle school setting. The original multiple regression model was followed with hierarchical linear regression in order to identify the variables most closely related to teacher autonomy support. Table 18 shows the results of seven different regression tests in which the least significant predictor variable was removed from the analysis with each successive regression. Table 18 displays the changes in the \(R^2\) value, the \(F\)-ratio, and the standardized coefficients (\(\beta\)) for each regression model compared to Model 1.
### Table 18

**Hierarchical Multiple Regression Analyses Predicting Teacher Autonomy Support**

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>$R^2$</th>
<th>$F$</th>
<th>$\beta$</th>
<th>$\Delta R^2$</th>
<th>$\Delta F$</th>
<th>$\Delta \beta$</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>.54</td>
<td>69.60***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td>.54</td>
<td>83.69***</td>
<td>.00</td>
<td>14.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>.64***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VU</td>
<td>.25***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PT</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>-.09*</td>
<td></td>
<td>-.06</td>
<td></td>
<td></td>
<td>[-0.07, 0.02]</td>
<td></td>
</tr>
<tr>
<td>RAI</td>
<td>-.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 3</td>
<td>.54</td>
<td>104.39***</td>
<td>.00</td>
<td>34.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>.63***</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>VU</td>
<td>.24***</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PT</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>-.09*</td>
<td></td>
<td>-.05</td>
<td></td>
<td></td>
<td>[-0.17, 0.00]</td>
<td></td>
</tr>
<tr>
<td>Model 4</td>
<td>.54</td>
<td>139.30***</td>
<td>.00</td>
<td>69.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>.62***</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>VU</td>
<td>.24***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>-.09*</td>
<td></td>
<td>-.17</td>
<td></td>
<td></td>
<td>[-0.01, -0.01]</td>
<td></td>
</tr>
<tr>
<td>Model 5</td>
<td>.53</td>
<td>204.05***</td>
<td>.01</td>
<td>134.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>.60***</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VU</td>
<td>.21***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 6</td>
<td>.50</td>
<td>180.57***</td>
<td>.04</td>
<td>110.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>.72***</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>PC</td>
<td>-.03</td>
<td></td>
<td>-.12</td>
<td></td>
<td></td>
<td>[-0.05, 0.05]</td>
<td></td>
</tr>
<tr>
<td>Model 7</td>
<td>.28</td>
<td>68.44***</td>
<td>.26</td>
<td>1.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VU</td>
<td>.50***</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PC</td>
<td>.05</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 362. Regression Model 1 included the six predictor variables from the research questions of this study. The results of the regression analysis for Model 1 are listed in Table 15. IE = Interest/Enjoyment subscale; VU = Value/Usefulness subscale; PT = Pressure/Tension subscale; PC = Perceived Competence subscale; RAI = Relative Autonomy Index; AA = academic achievement; CI = confidence interval. *p < .05. ***/p < .001.
The hierarchical multiple regression analyses revealed the following results. The $F$-ratio was significant in all seven models at the $p < .001$ level. All seven regression models significantly predicted perceived teacher autonomy support among seventh grade prealgebra students in a middle school setting. There was less than a 0.1% probability that the results of the regression analyses were the result of chance.

Some of the predictor variables accounted for more unique variance in the regression models than others. Interest/enjoyment and value/usefulness were significantly related to teacher autonomy support at the $p < .001$ level in all regression models in which they were included. Perceived competence became significantly related to teacher autonomy support at the $p < .05$ level ($b = -0.09, p = .046$) in Model 2 when academic achievement was removed. Perceived competence remained significant at this level in Model 3 ($b = -0.09, p = .046$) when relative autonomy was removed and in Model 4 ($b = -0.09, p = .024$) when pressure/tension was removed. However, perceived competence was not significant in Model 6 ($b = -0.3, p = .498$) or in Model 7 ($b = 0.05, p = .293$) when it was included only with interest/enjoyment and value/usefulness, respectively. Pressure/tension, relative autonomy, and academic achievement were not significantly related to autonomy support in any of the regression models in which they were included, and removing these variables did not make the model less predictive (i.e., $R^2 = .54$ in Model 2, Model 3, and Model 4).

Interest/enjoyment and value/usefulness were the most significant predictors of teacher autonomy support. The regression model accounted for 54% of the variance when all six predictor variables were included, and it accounted for 53% of the variance when only the variables interest/enjoyment and value/usefulness were included. Removing the
variables pressure/tension, relative autonomy, and academic achievement from the regression analysis did not change the value of $R^2$, and the variance only dropped by 1% ($R^2 = .53$) when perceived competence was removed from the analysis in Model 5.

Interest/enjoyment accounted for the greatest amount of unique variance in the model as evidenced by Model 6 and Model 7. When interest/enjoyment was removed in Model 7, the $R^2$ value decreased by .26 compared to Model 1 and by .22 compared to Model 6. Furthermore, when value/usefulness was dropped in Model 6 yet interest/enjoyment remained, the $R^2$ value stayed relatively stable ($R^2 = .50$). Comparing Model 6 to Model 7 shows that interest/enjoyment accounted for more unique variance in the regression model than value/usefulness. Value/usefulness only accounted for about 3% of unique variance when paired with interest/enjoyment as seen by comparing Model 5 to Model 6.

The hierarchical linear regression analyses found Model 4 to be the most parsimonious model for predicting teacher autonomy support ($R^2 = .54$). Model 4 included the predictor variables interest/enjoyment ($b = 0.48$, $p < .001$), value/usefulness ($b = 0.23$, $p < .001$), and perceived competence ($b = -0.09$, $p = .024$). Figure 7 displays a model of the variables most closely related to perceived teacher autonomy support as determined through conducting hierarchical multiple regression analyses.
Figure 7. The most parsimonious model of the relationship between seventh grade students’ intrinsic motivation and perceived teacher autonomy support according to hierarchical multiple regression analyses.
Note. $N = 362$.
*p < .05. ***p < .001.

Bivariate Correlations between Predictor Variables and Teacher Autonomy Support

Multiple linear regression was used to test the research questions in this study, and hierarchical multiple regression analyses identified the most parsimonious model of perceived teacher autonomy support. The relationships between each individual predictor variable and perceived teacher autonomy support were also of interest in this study. Table 19 includes the bivariate correlations between the predictor variables in this study and perceived teacher autonomy support.
Table 19

Correlations between Six Predictor Variables and Perceived Teacher Autonomy Support

<table>
<thead>
<tr>
<th>Perceived Teacher Autonomy Support</th>
<th>IE</th>
<th>VU</th>
<th>PT</th>
<th>PC</th>
<th>RAI</th>
<th>AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCQ (M)</td>
<td>.71***</td>
<td>.52***</td>
<td>-.26***</td>
<td>.28***</td>
<td>.35***</td>
<td>.02</td>
</tr>
</tbody>
</table>

Note. N = 362. LCQ = Learning Climate Questionnaire; IE = Interest/Enjoyment subscale; VU = Value/Usefulness subscale; PT = Pressure/Tension subscale; PC = Perceived Competence subscale; RAI = Relative Autonomy Index; AA = academic achievement.

***p < .001.

Academic achievement was positively but not significantly related to perceived autonomy support (r = .02, p = .73). All other correlations between predictor variables and perceived teacher autonomy support were statistically significant at the p < .001 level. The strongest correlation occurred between participants' interest and enjoyment in their math class and perceived teacher autonomy support (r = .71, p < .001). The amount of pressure and tension participants experienced in their math class was statistically significant and negatively associated with perceived autonomy support, as expected. Figures 8, 9, 10, 11, 12, and 13 illustrate the nature and strength of the relationships between the predictor variables in this study and perceived teacher autonomy support through scatterplot displays.
There was a statistically significant strong positive relationship between interest/enjoyment and perceived teacher autonomy support ($r = .71, p < .001$). If the scatterplot in Figure 8 were divided into four equal quadrants, most of the data points would fall into the upper-right and lower-left quadrants. There are virtually no data points in the lower-right quadrant and very few in the upper-left quadrant. As displayed in Figure 8, students who did not perceive their teachers to be autonomy-supportive seldom found their math class interesting and enjoyable (i.e., the many data points in the lower-left quadrant and the lack of data points in the lower-right quadrant). Students who
perceived their teachers to be highly autonomy-supportive were significantly more likely to find their math class interesting and enjoyable (i.e., the many data points located in the upper-right quadrant and the few data points in the upper-left quadrant).

Figure 9. Scatterplot and regression line of value/usefulness and perceived teacher autonomy support.

There was a statistically significant strong positive relationship between value/usefulness and perceived teacher autonomy support \((r = .52, p < .001)\). Students who perceived their teachers to be highly autonomy-supportive were significantly more likely to find value and usefulness with the prealgebra curriculum. As displayed in the scatterplot in Figure 9, many of the data points were above four on the value/usefulness
axis, suggesting that most participants in this study had determined that the math curriculum was important to them and could help them in some way. It appears as though most participants had begun to internalize and integrate the value of learning mathematics.

![Correlation Scatterplot](image)

**Figure 10.** Scatterplot and regression line of pressure/tension and perceived teacher autonomy support.

There was a statistically significant negative relationship between pressure/tension and perceived teacher autonomy support ($r = -.26, p < .001$). As shown in Figure 10, students who perceived a lack of autonomy support were significantly more likely to experience pressure and tension in their prealgebra class. Students who
perceived their teachers to be highly autonomy-supportive experienced less pressure and anxiety.

![Correlation Scatterplot](image)

*Correlation Scatterplot: R^2 Linear = 0.078*

**Figure 11.** Scatterplot and regression line of perceived competence and perceived teacher autonomy support.

There was a statistically significant positive relationship between perceived competence and perceived teacher autonomy support ($r = .28, p < .001$). Other studies have found an association between students’ perceived competence and perceived teacher autonomy support (Black & Deci, 2000). In this study, many participants averaged a maximum score of 7 on the PC subscale of the IMI regardless of perceived teacher autonomy support. This phenomenon can be seen at the far right side of Figure 11.
There was a statistically significant positive relationship between participants’ RAI and perceived teacher autonomy support \( (r = .35, p < .001) \). The RAI scale ranged from -9 to 9 (notice the units of measure range from -10 to 10 on the RAI axis in Figure 12). A score of -9 indicated the least autonomous and lowest possible self-determined orientation for learning, and a score of 9 represented the most autonomous and greatest possible self-determined orientation for learning. Previous studies found that autonomy-supportive teaching was associated with an increase in students’ self-determined academic motivation (Black & Deci, 2000; Vansteenkiste et al. 2009; Zhou et al., 2009).
and this study found a statistically significant positive association between students’ autonomous motivation for learning prealgebra and perceived teacher autonomy support.

Figure 13. Scatterplot and regression line of academic achievement and perceived teacher autonomy support.

There was a weak positive relationship between students’ academic achievement and perceived teacher autonomy support ($r = .02, p = .73$). This relationship was not statistically significant. Figure 13 depicts the low association between academic achievement and perceived teacher autonomy support in this study.
Indicators of Autonomy Support and Predictor Variables

The nine indicators of autonomy support used in this study were correlated with the predictor variables in order to identify the specific autonomy supportive teacher practices most closely related to students’ intrinsic motivation and academic achievement. Table 20 displays these correlations.

Table 20

Correlation Matrix for the Nine Indicators of Autonomy Support and the Six Predictor Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>IE</th>
<th>VU</th>
<th>PT</th>
<th>PC</th>
<th>RAI</th>
<th>AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1: Provides choices</td>
<td>.55***</td>
<td>.37***</td>
<td>-20***</td>
<td>.23***</td>
<td>.28***</td>
<td>-.05</td>
</tr>
<tr>
<td>AS 2: Feel understood</td>
<td>.60***</td>
<td>.45***</td>
<td>-26***</td>
<td>.32***</td>
<td>.35***</td>
<td>.11*</td>
</tr>
<tr>
<td>AS 3: Conveys confidence</td>
<td>.51***</td>
<td>.44***</td>
<td>-30***</td>
<td>.34***</td>
<td>.27***</td>
<td>.12*</td>
</tr>
<tr>
<td>AS 4: Encourages questions</td>
<td>.47***</td>
<td>.37***</td>
<td>-.12*</td>
<td>.05</td>
<td>.16**</td>
<td>-.05</td>
</tr>
<tr>
<td>AS 5: Listens carefully</td>
<td>.54***</td>
<td>.31***</td>
<td>-19***</td>
<td>.18***</td>
<td>.26***</td>
<td>-.01</td>
</tr>
<tr>
<td>AS 6: Answers questions fully</td>
<td>.50***</td>
<td>.37***</td>
<td>-.16**</td>
<td>.20***</td>
<td>.20***</td>
<td>.03</td>
</tr>
<tr>
<td>AS 7: Tries to understand</td>
<td>.51***</td>
<td>.42***</td>
<td>-.12*</td>
<td>.15**</td>
<td>.23***</td>
<td>-.05</td>
</tr>
<tr>
<td>AS 8: Shows me respect</td>
<td>.54***</td>
<td>.37***</td>
<td>-20***</td>
<td>.19***</td>
<td>.32***</td>
<td>-.01</td>
</tr>
<tr>
<td>AS 9: Able to share feelings</td>
<td>.55***</td>
<td>.42***</td>
<td>-20***</td>
<td>.23***</td>
<td>.30***</td>
<td>.03</td>
</tr>
</tbody>
</table>

Note. N = 362. Variables 1–9 are indicators for autonomy support. IE = Interest/Enjoyment subscale; VU = Value/Usefulness subscale; PT = Pressure/Tension subscale; PC = Perceived Competence subscale; RAI = Relative Autonomy Index; AA = academic achievement.

*p < .05. **p < .01. ***p < .001.
The nine indicators of autonomy support were most closely associated with interest/enjoyment, and they were more closely related to value/usefulness than to pressure/tension, perceived competence, relative autonomy, and academic achievement. Pressure/tension was negatively associated with all nine indicators of autonomy support, as expected. The strongest correlation occurred between the indicator “Feel understood” and interest/enjoyment ($r = .60, p < .001$). “Encourages questions” was surprisingly unrelated to perceived competence ($r = .05, p = .393$). “Feel understood” ($r = .11, p = .031$) and “Conveys confidence” ($r = .12, p = .028$) were the only indicators of autonomy support significantly related to academic achievement, and they were significant at the $p < .05$ level. Five of the nine indicators of autonomy support were negatively related to academic achievement; these interactions were unexpected.

**Individual Teacher Comparison and Analyses**

This was a correlational study. It did not utilize an experimental design (i.e., it did not have separate control and treatment groups, and no variables were isolated and manipulated). However, it was believed that students who had teachers who were more autonomy-supportive would demonstrate higher levels of interest/enjoyment, value/usefulness, perceived competence, and academic achievement and experience less pressure and tension in their prealgebra class than students whose teachers were less autonomy supportive. Table 21 shows the descriptive statistics of the nine indicators of autonomy support for each teacher. Teachers A and E tended to have the highest averages on each of the nine indicators, followed by Teacher C. Teacher B had the lowest average for every indicator of autonomy support (i.e., all nine items on the LCQ).
Table 21

Descriptive Statistics for Each Indicator of Autonomy Support by Teacher

<table>
<thead>
<tr>
<th>Variable</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
</tr>
<tr>
<td>AS 1: Provides choices</td>
<td>5.02</td>
</tr>
<tr>
<td></td>
<td>(1.37)</td>
</tr>
<tr>
<td>AS 2: Feel understood</td>
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<td></td>
<td>(1.60)</td>
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<tr>
<td>AS 3: Conveys confidence</td>
<td>5.68</td>
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<td></td>
<td>(1.25)</td>
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<tr>
<td>AS 4: Encourages questions</td>
<td>5.24</td>
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<tr>
<td></td>
<td>(1.72)</td>
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<tr>
<td>AS 5: Listens carefully</td>
<td>4.61</td>
</tr>
<tr>
<td></td>
<td>(1.85)</td>
</tr>
<tr>
<td>AS 6: Answers questions fully</td>
<td>5.35</td>
</tr>
<tr>
<td></td>
<td>(1.65)</td>
</tr>
<tr>
<td>AS 7: Tries to understand</td>
<td>5.01</td>
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<td></td>
<td>(1.61)</td>
</tr>
<tr>
<td>AS 8: Shows me respect</td>
<td>5.89</td>
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<td></td>
<td>(1.45)</td>
</tr>
<tr>
<td>AS 9: Able to share feelings</td>
<td>4.81</td>
</tr>
<tr>
<td></td>
<td>(1.89)</td>
</tr>
<tr>
<td>LCQ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.18</td>
</tr>
<tr>
<td></td>
<td>(1.15)</td>
</tr>
</tbody>
</table>

*Note.* Variables 1–9 are indicators for autonomy support. Teacher A (n = 59); Teacher B (n = 96); Teacher C (n = 71); Teacher D (n = 54); Teacher E (n = 82). LCQ = Learning Climate Questionnaire. For each indicator of autonomy support, scores ranged from 1 (*strongly disagree*) to 7 (*strongly agree*).
Table 22

Means and Standard Deviations for Perceived Teacher Autonomy Support and the Predictor Variables by Teacher

<table>
<thead>
<tr>
<th>Teacher</th>
<th>LCQ M (SD)</th>
<th>IE M (SD)</th>
<th>VU M (SD)</th>
<th>PT M (SD)</th>
<th>PC M (SD)</th>
<th>RAI M (SD)</th>
<th>AA M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (n = 59)</td>
<td>5.18 (1.15)</td>
<td>4.55 (1.51)</td>
<td>5.76 (1.17)</td>
<td>2.80 (1.25)</td>
<td>5.35 (1.13)</td>
<td>-0.09 (2.88)</td>
<td>62.99 (14.25)</td>
</tr>
<tr>
<td>B (n = 96)</td>
<td>4.50 (1.41)</td>
<td>3.50 (1.62)</td>
<td>5.40 (1.27)</td>
<td>2.82 (1.47)</td>
<td>5.28 (1.34)</td>
<td>-0.82 (2.53)</td>
<td>57.36 (15.31)</td>
</tr>
<tr>
<td>C (n = 71)</td>
<td>5.02 (1.19)</td>
<td>4.04 (1.61)</td>
<td>5.35 (1.36)</td>
<td>2.86 (1.24)</td>
<td>5.33 (1.34)</td>
<td>-0.53 (2.50)</td>
<td>58.44 (15.27)</td>
</tr>
<tr>
<td>D (n = 54)</td>
<td>4.85 (1.33)</td>
<td>3.47 (1.77)</td>
<td>5.07 (1.71)</td>
<td>3.04 (1.58)</td>
<td>4.85 (1.58)</td>
<td>-1.21 (2.76)</td>
<td>59.12 (13.08)</td>
</tr>
<tr>
<td>E (n = 82)</td>
<td>5.12 (1.24)</td>
<td>4.67 (1.54)</td>
<td>5.76 (1.18)</td>
<td>2.62 (1.37)</td>
<td>5.61 (1.20)</td>
<td>-1.11 (1.95)</td>
<td>58.67 (14.03)</td>
</tr>
<tr>
<td>Total (N = 362)</td>
<td>4.90 (1.30)</td>
<td>4.04 (1.68)</td>
<td>5.48 (1.34)</td>
<td>2.81 (1.39)</td>
<td>5.31 (1.33)</td>
<td>-0.77 (2.52)</td>
<td>59.05 (14.57)</td>
</tr>
</tbody>
</table>

Note. LCQ = Learning Climate Questionnaire; IE = Interest/Enjoyment subscale; VU = Value/Usefulness subscale; PT = Pressure/Tension subscale; PC = Perceived Competence subscale; RAI = Relative Autonomy Index; AA = academic achievement. For the LCQ, scores ranged from 1 (strongly disagree) to 7 (strongly agree). For the IE, VU, PT, and PC subscales, scores ranged from 1 (not at all true) to 7 (very true). For the RAI, scores ranged from -9 (non-self-determined) to 9 (self-determined).

Table 22 shows the descriptive statistics for perceived autonomy support and the predictor variables according to teacher. Teacher A and Teacher E had the two highest averages for autonomy support, interest/enjoyment, value/usefulness, and perceived competence and the lowest averages for pressure/tension. According to the RAI, Teacher A’s students had the most autonomous academic motivation and most self-determined
orientation for learning. Teacher A had the highest average for autonomy support and the highest average for academic achievement. Teacher B had the lowest average for autonomy support and the lowest average for academic achievement. The bottom row of Table 22 allows comparisons to be made for each teacher to the overall mean score for each respective variable.

Table 23 shows the descriptive statistics for participants' academic achievement on the prealgebra tests according to teacher. Students in Teacher B’s class had the second highest Pretest average but the lowest Posttest I average; teacher B had the lowest average for perceived autonomy support (see Table 22).

Table 23

*Means and Standard Deviations of Participants' Scores on District-Generated Math Assessments, Listed by Teacher*

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Assessment</th>
<th>Pretest</th>
<th>Interim I</th>
<th>Posttest I</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (n = 59)</td>
<td>M (SD)</td>
<td>51.37 (15.00)</td>
<td>52.45 (18.26)</td>
<td>73.53 (14.73)</td>
</tr>
<tr>
<td>B (n = 96)</td>
<td>M (SD)</td>
<td>49.82 (16.03)</td>
<td>46.44 (15.10)</td>
<td>68.28 (18.39)</td>
</tr>
<tr>
<td>C (n = 71)</td>
<td>M (SD)</td>
<td>47.16 (14.14)</td>
<td>44.70 (16.76)</td>
<td>72.17 (16.87)</td>
</tr>
<tr>
<td>D (n = 54)</td>
<td>M (SD)</td>
<td>46.87 (12.58)</td>
<td>46.98 (15.36)</td>
<td>71.27 (14.23)</td>
</tr>
<tr>
<td>E (n = 82)</td>
<td>M (SD)</td>
<td>48.44 (15.82)</td>
<td>47.82 (15.50)</td>
<td>69.51 (15.62)</td>
</tr>
<tr>
<td>Total (N = 362)</td>
<td>M (SD)</td>
<td>48.80 (14.98)</td>
<td>47.47 (16.20)</td>
<td>70.62 (16.34)</td>
</tr>
</tbody>
</table>
Table 24 shows the correlations between perceived teacher autonomy support and the predictor variables according to each teacher. Interest/enjoyment and value/usefulness had the strongest relationship with teacher autonomy support for all teachers. RAI was significantly related to teacher autonomy support for four of the five teachers. Academic achievement was not significantly related to autonomy support for any of the five teachers, had a small positive relationship with autonomy support for Teacher B and Teacher C, and had a weak negative relationship with autonomy support for Teachers A, D, and E.

Table 24

*Teacher Comparison: Correlations between Predictor Variables and Perceived Teacher Autonomy Support*

<table>
<thead>
<tr>
<th>Teacher</th>
<th>LCQ (M)</th>
<th>IE</th>
<th>VU</th>
<th>PT</th>
<th>PC</th>
<th>RAI</th>
<th>AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.18</td>
<td>.62***</td>
<td>.56***</td>
<td>-.06</td>
<td>.25</td>
<td>.34**</td>
<td>-.09</td>
</tr>
<tr>
<td>(n = 59)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>4.50</td>
<td>.76***</td>
<td>.58***</td>
<td>-.20</td>
<td>.29**</td>
<td>.30**</td>
<td>.13</td>
</tr>
<tr>
<td>(n = 96)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>5.02</td>
<td>.69***</td>
<td>.46***</td>
<td>-.33**</td>
<td>.27*</td>
<td>.46***</td>
<td>.11</td>
</tr>
<tr>
<td>(n = 71)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4.85</td>
<td>.67***</td>
<td>.42**</td>
<td>-.25</td>
<td>.37**</td>
<td>.26</td>
<td>-.07</td>
</tr>
<tr>
<td>(n = 54)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>5.12</td>
<td>.71***</td>
<td>.60***</td>
<td>-.42***</td>
<td>.20</td>
<td>.45***</td>
<td>-.17</td>
</tr>
<tr>
<td>(n = 82)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. LCQ = Learning Climate Questionnaire; IE = Interest/Enjoyment subscale; VU = Value/Usefulness subscale; PT = Pressure/Tension subscale; PC = Perceived Competence subscale; RAI = Relative Autonomy Index; AA = academic achievement.
*p < .05. **p < .01. ***p < .001.
As seen in Table 24, Teacher A and Teacher E had the two highest averages for perceived autonomy (\(M = 5.18\) and \(M = 5.12\), respectively) yet also had the two highest negative correlations between autonomy support and academic achievement (Teacher A, \(r = -0.09, p = .507\), and Teacher E, \(r = -0.17, p = .126\)). For teachers A and E, as perceived teacher autonomy support increased, academic achievement tended to decrease, but not significantly. The negative association between perceived autonomy support and academic achievement for Teacher A and Teacher E is illustrated in Figures 14 and 15, respectively. Teacher B, who had the lowest average for perceived teacher autonomy support (\(M = 4.50\)), had the strongest positive correlation between autonomy support and academic achievement (\(r = .13, p = .226\)). Figure 16 displays the relationship between perceived autonomy support and academic achievement for Teacher B.

*Figure 14. Scatterplot and regression line of academic achievement and perceived teacher autonomy support for Teacher A.*
Figure 15. Scatterplot and regression line of academic achievement and perceived teacher autonomy support for Teacher E.

Figure 16. Scatterplot and regression line of academic achievement and perceived teacher autonomy support for Teacher B.
Patterns among Four Types of Motivation Espoused by Self-Determination Theory

Self-determination theory asserts that human motivation lies along a continuum of relative autonomy in which some behaviors are more self-determined than others because they emanate from within the self and have an internal perceived locus of causality (Deci & Ryan, 2000; Ryan & Deci, 2000b). At one end of the continuum are nonautonomous behaviors associated with ill-being and poor performance. At the other end of the continuum lie behaviors that are highly autonomous, self-guided, and associated with well-being and optimal performance. The different types of motivation posited by SDT and the characteristics related to the different types of motivation appear in Figure 17.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Nonself-Determined</th>
<th>Self-Determined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amotivation</td>
<td>Extrinsic Motivation</td>
<td>Intrinsic Motivation</td>
</tr>
<tr>
<td>Non-Regulation</td>
<td>Introjected Regulation</td>
<td>Identified Regulation</td>
</tr>
<tr>
<td>External Regulation</td>
<td>Identified Regulation</td>
<td>Integrated Regulation</td>
</tr>
<tr>
<td>Intrinsic Motivation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Perceived Locus of Causality**
- Amotivation: Impersonal
- Extrinsic Motivation: External
- Introjected Regulation: Somewhat External
- Identified Regulation: Somewhat Internal
- Integrated Regulation: Internal
- Intrinsic Motivation: Internal

**Relevant Regulatory Processes**
- Amotivation: Nonintentional, Nonvaluing, Incompetence, Lack of Control Satisfaction
- External Regulation: Compliance, External Rewards & Punishments
- Introjected Regulation: Self-control, Ego-Involvement, Internal Rewards & Punishments
- Identified Regulation: Personal Importance, Conscious Valuing
- Integrated Regulation: Congruence, Awareness, Synthesis with Self
- Intrinsic Motivation: Interest, Enjoyment, Inherent

Table 25

*Correlations between Indicators of Autonomy Support, Predictor Variables of the Regression Model, and Four Types of Motivation Posited by Self-Determination Theory*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type of Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IM</td>
</tr>
<tr>
<td>1. AS 1: Provides choices</td>
<td>.36***</td>
</tr>
<tr>
<td>2. AS 2: Feel understood</td>
<td>.39***</td>
</tr>
<tr>
<td>3. AS 3: Conveys confidence</td>
<td>.31***</td>
</tr>
<tr>
<td>4. AS 4: Encourages questions</td>
<td>.28***</td>
</tr>
<tr>
<td>5. AS 5: Listens carefully</td>
<td>.36***</td>
</tr>
<tr>
<td>6. AS 6: Answers questions</td>
<td>.22***</td>
</tr>
<tr>
<td>Fully</td>
<td></td>
</tr>
<tr>
<td>7. AS 7: Tries to understand</td>
<td>.31***</td>
</tr>
<tr>
<td>8. AS 8: Shows me respect</td>
<td>.36***</td>
</tr>
<tr>
<td>9. AS 9: Able to share feelings</td>
<td>.38***</td>
</tr>
<tr>
<td>10. Perceived teacher autonomy</td>
<td>.44***</td>
</tr>
<tr>
<td>support (LCQ)</td>
<td></td>
</tr>
<tr>
<td>11. Interest/enjoyment subscale</td>
<td>.61***</td>
</tr>
<tr>
<td>12. Value/usefulness subscale</td>
<td>.44***</td>
</tr>
<tr>
<td>13. Pressure/tension subscale</td>
<td>-.26***</td>
</tr>
<tr>
<td>14. Perceived competence subscale</td>
<td>.32***</td>
</tr>
<tr>
<td>15. Relative Autonomy Index</td>
<td>.77***</td>
</tr>
<tr>
<td>16. Academic achievement</td>
<td>.01</td>
</tr>
<tr>
<td>17. EX</td>
<td>-.17**</td>
</tr>
<tr>
<td>18. IJ</td>
<td>.35***</td>
</tr>
<tr>
<td>19. ID</td>
<td>.57***</td>
</tr>
<tr>
<td>20. IM</td>
<td>–</td>
</tr>
</tbody>
</table>

\[ M^* \]

\[ SD \]

\[
\begin{array}{cccc}
2.31 & 3.34 & 3.03 & 2.85 \\
0.79 & 0.64 & 0.66 & 0.64
\end{array}
\]
Table 25 lists the correlations between the variables under investigation in this study and the means of the four subscales of the ASRQ. The correlations in this table offer evidence of motivation lying along a continuum of relative autonomy in which more autonomous forms of motivation (i.e., intrinsic motivation and identified regulation) are associated with autonomy support and more controlling forms of motivation (i.e., introjected regulation and external regulation) are associated with a lack of autonomy support. Participants’ perceived teacher autonomy support (variables 1-10 in Table 25) and intrinsic motivation in mathematics (variables 11-15 in Table 25) were always more strongly correlated with autonomous forms of motivation (i.e., intrinsic motivation and identified regulation) than they were with controlling forms of motivation (i.e., introjected regulation and external regulation).

The data in Table 25 shows that autonomy-supportive teaching was significantly related to students’ self-determined motivation for learning prealgebra. It might have been that students who had a more self-determined orientation for learning perceived their teachers to be more autonomy-supportive, or it might have been that by supporting students’ autonomy, teachers produced more autonomous forms of motivation within their students. The direction of the relationship between perceived teacher autonomy support and students’ self-determined academic motivation cannot be determined due to
the nature of this research, but it is clear that significant relationships existed between perceived teacher autonomy support and autonomous, self-determined forms of academic motivation.

Externally regulated academic motivation was negatively associated with both forms of autonomous motivation, and it was more negatively associated with intrinsic motivation than with identified regulation (see line 17 of Table 25). External regulation was negatively related to intrinsic motivation at the $p < .01$ level ($r = -.17, p = .002$) and negatively related to identified regulation at the $p < .05$ level ($r = -.11, p = .044$). External regulation was positively related to introjected regulation and significant at the lowest possible level, $p < .001$ ($r = .28, p < .001$). When participants’ academic motivation was not very well internalized or deeply integrated into their self-system (i.e., their values, goals, and interests), they tended to find prealgebra significantly less interesting, valuable, and useful; experience a significantly higher degree of pressure and tension; feel significantly less competent; and achieve significantly worse than participants who had more autonomous motivation for learning (see lines 11-16 in Table 25). Intrinsic motivation had the lowest average of the four subscales on the ASRQ ($M = 2.31$), yet identified regulation had the highest ($M = 3.34$).

Students who were autonomously motivated were more likely to have higher academic achievement than students who were less self-motivated; however, introjected regulation had the most positive association with academic achievement (see line 16 of Table 25). There was a significant negative correlation between externally regulated motivation for learning and academic achievement at the $p < .05$ level ($r = -.11, p = .043$), indicating that students whose academic motivation was influenced primarily by
external motivators, such as fear of punishment, were significantly more likely to have low academic achievement than students who had more autonomous academic motivation (see line 16 of Table 25). Figure 18 exhibits the relationship between externally regulated academic motivation and mathematical achievement in this study. There was a significant negative relationship at the $p < .01$ level between external regulation and the indicators of autonomy support “Feel understood” ($r = -0.16, p = .002$) and “Shows me respect” ($r = -0.14, p = .008$), suggesting that as students felt respected and understood by their teachers, their academic motivation became more autonomous and self-determined (see line 2 and line 8, respectively, of Table 25).

![Negative association between external regulation & academic achievement](image)

*Figure 18.* Scatterplot and regression line of academic achievement and externally regulated academic motivation, $p < .05$ ($r = -0.11, p = .043$).
A statistically significant strong negative correlation occurred between externally regulated academic motivation and participants' self-determined orientation for learning \( (r = -.72, p < .001) \), as expected. This relationship is displayed in Figure 19. A statistically significant strong positive correlation occurred between intrinsic motivation and self-determined academic motivation \( (r = .77, p < .001) \), as expected. This relationship is displayed in Figure 20. These strong associations are displayed in line 15 of Table 25.
Postive association between
intrinsic motivation & autonomous academic motivation

Figure 20. Scatterplot and regression line of participants’ autonomous motivation for learning and intrinsic motivation.

Summary

The purpose of this study was to apply self-determination theory to investigate the relationship between seventh grade students’ intrinsic motivation and academic achievement in mathematics and their teachers’ autonomy support. The aim was to determine if students’ intrinsic motivation and academic achievement were significantly related to teacher autonomy support. A second objective was to identify the strongest predictors of teacher autonomy support in order to illuminate the instructional practices
most closely associated with young adolescents' intrinsic motivation and academic achievement in mathematics.

Three hundred sixty-two seventh grade students enrolled in a large public suburban middle school located in the southeastern United States participated in this study. The motivational variables were assessed through participants' responses to three questionnaires. Academic achievement was measured by participants' mean score from two benchmark tests generated by the school district. The 362 participants were divided among five seventh grade math teachers.

The Learning Climate Questionnaire assessed students' perceptions of their math teachers’ autonomy support. The Intrinsic Motivation Inventory consisted of the Interest/Enjoyment, Value/Usefulness, Pressure/Tension, and Perceived Competence subscales and measured participants' intrinsic motivation in their prealgebra class. The Academic Self-Regulation Questionnaire consisted of four subscales used to measure participants' self-determined orientation for learning. Reliability analysis using Cronbach's alpha coefficient found that the Learning Climate Questionnaire ($\alpha = .90$), Interest/Enjoyment subscale ($\alpha = .92$), Value/Usefulness subscale ($\alpha = .91$), Pressure/Tension subscale ($\alpha = .75$), Perceived Competence subscale ($\alpha = .85$), and Academic Self-Regulation Questionnaire ($\alpha = .78$) each had good reliability.

Multiple linear regression was used to test the six research questions in this study. The null hypothesis was rejected for research question 1 (interest/enjoyment, $p < .001$) and for research question 2 (value/usefulness, $p < .001$). The null hypothesis for research question 3 (pressure/tension, ns), 4 (perceived competence, ns), 5 (relative autonomy, ns), and 6 (academic achievement, ns) was accepted.
Hierarchical multiple regression identified the most parsimonious model of teacher autonomy support. Three variables, interest/enjoyment \((b = 0.48, p < .001)\), value/usefulness \((b = 0.23, p < .001)\), and perceived competence \((b = -0.09, p = .024)\), accounted for the greatest amount of variance in the multiple regression model \((R^2 = .54)\). Interest/enjoyment accounted for the most unique variance and was the most predictive variable of teacher autonomy support. Pressure/tension, relative autonomy, and academic achievement were unrelated to teacher autonomy support within the regression model, but pressure/tension \((r = -0.26, p < .001)\) and participants’ relative autonomy \((r = .35, p < .001)\) were significantly related to teacher autonomy support outside of the regression model as bivariate correlations.

The two teachers who had the highest averages for autonomy support also had the highest averages for interest/enjoyment, value/usefulness, and perceived competence and the lowest averages for pressure/tension. The teacher with the highest average for teacher autonomy support had the highest average for academic achievement, and the teacher with the lowest average for autonomy support had the lowest average for academic achievement. For three teachers, autonomy support was negatively related to academic achievement, although not significantly related.

This study found evidence to support the SDT claim that motivation lies upon a continuum of relative autonomy in which some forms of motivation are more autonomous and self-determined than others. Intrinsic motivation and identified regulation were more closely associated with autonomy support than introjected regulation and external regulation. Students with a more autonomous orientation for learning experienced less pressure and tension and greater interest/enjoyment,
value/usefulness, perceived competence, and academic achievement than participants
who had less self-determined academic motivation. Chapter 5 presents an overview of the
study, a review of the findings, conclusions, implications, limitations, and
recommendations for future research.
CHAPTER 5

Summary, Conclusions, and Recommendations

Introduction

This chapter includes an overview of the purpose, methodology, findings, and implications of this research study. Limitations of the research are also provided. Conclusions are discussed within the context of related research, and recommendations are made for future research.

Teachers attempt to motivate their students using a variety of strategies, but research suggests that certain motivational strategies are more effective and beneficial to students than others (Brophy, 2010; Matteson et al., 2011; Reeve, 1998, 2009; Wentzel & Wigfield, 2009). Self-determination theory asserts that teachers can cultivate students’ inner motivational resources by supporting their autonomy (Deci & Ryan, 1987; Reeve & Halusic, 2009; Reeve et al., 2008). To support students’ autonomy, teachers can take students’ perspectives, acknowledge students’ feelings, provide rationales for uninteresting lessons, allow and accept students’ expressions of negative affect, provide open access to instructional materials, recognize students’ interests, provide hints instead of answers, provide adequate amount of time for assignment completion, praise mastery, communicate with non-controlling language, avoid using criticisms and directives (e.g., “should,” “ought to,” “need to”), and provide students with information and opportunities for choice (Reeve, 2002, 2009; Reeve & Assor, 2011; Reeve & Halusic, 2009; Reeve & Jang, 2006; Reeve et al., 2008). Autonomy support has been shown to enhance students’
motivation, engagement, conceptual learning, academic performance, and psychological well-being (Reeve, 2009). However, very little research has examined the relationship between autonomy-supportive instruction and adolescent learning in a middle school mathematics setting.

**Summary of the Study**

The purpose of this study was to determine if seventh grade students’ intrinsic motivation and academic achievement were significantly related to perceived teacher autonomy support. This correlational study used multiple regression analyses to identify the variables most closely related to perceived teacher autonomy support. The six research questions and related hypotheses of this study are listed below.

1. **Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement?**

   **H₀₁:** There will not be a statistically significant relationship between teacher autonomy support and seventh grade students’ interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

   **H₁:** There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ interest/enjoyment in mathematics, controlling for value/usefulness, pressure/tension, perceived competence, autonomous motivation, and academic achievement.
2. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement?

H_{02}: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

H_{A2}: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ value/usefulness of mathematics, controlling for interest/enjoyment, pressure/tension, perceived competence, autonomous motivation, and academic achievement.

3. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement?

H_{03}: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics, controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement.

H_{A3}: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ pressure/tension in mathematics,
controlling for interest/enjoyment, value/usefulness, perceived competence, autonomous motivation, and academic achievement.

4. Is there a statistically significant relationship between teacher autonomy support and seventh grade students' perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement?

H$_{04}$: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement.

H$_{a4}$: There will be a statistically significant relationship between teacher autonomy support and seventh grade students' perceived competence in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, autonomous motivation, and academic achievement.

5. Is there a statistically significant relationship between teacher autonomy support and seventh grade students' autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement?

H$_{05}$: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students' autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement.
H_{A5}: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ autonomous motivation in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and academic achievement.

6. Is there a statistically significant relationship between teacher autonomy support and seventh grade students’ academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation?

H_{O6}: There will not be a statistically significant relationship between teacher autonomy support and seventh grade students’ academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation.

H_{A6}: There will be a statistically significant relationship between teacher autonomy support and seventh grade students’ academic achievement in mathematics, controlling for interest/enjoyment, value/usefulness, pressure/tension, perceived competence, and autonomous motivation.

This research took place at a suburban public middle school located in the southeastern United States. The school had a population of 1,941 students, and 637 were seventh grade students. The 483 seventh grade students enrolled in the school district’s standard math course were invited to participate in this study, and 362 students assented to participate. The participants were divided among five math teachers and completed a series of three self-report questionnaires. The questionnaires assessed participants’ perceived teacher autonomy support, intrinsic motivation in their math class, and self-
determined academic motivation. Participants’ academic achievement was measured by averaging their score on two district-generated standardized multiple-choice math tests.

Review of Findings

Multiple linear regression was used to test the six research questions in this study. The null hypothesis was rejected for research question 1 (interest/enjoyment), \( p < .001, b_1 = 0.50, 95\% \text{ CI } [0.43, 0.57] \) and for research question 2 (value/usefulness), \( p < .001, b_2 = 0.24, 95\% \text{ CI } [0.15, 0.33] \). Interest/enjoyment and value/usefulness statistically predicted teacher autonomy support within the regression model. The null hypotheses were accepted for research question 3 (pressure/tension), \( p = .642, b_3 = 0.02, 95\% \text{ CI } [-0.06, 0.09] \); research question 4 (perceived competence), \( p = .086, b_4 = -0.08, 95\% \text{ CI } [-0.17, 0.01] \); research question 5 (relative autonomy), \( p = .325, b_5 = -0.02, 95\% \text{ CI } [-0.07, 0.02] \); and research question 6 (academic achievement), \( p = .709, b_6 = 0.00, 95\% \text{ CI } [-0.01, 0.01] \). Pressure/tension, perceived competence, relative autonomy, and academic achievement did not statistically predict teacher autonomy support within the regression model.

Hierarchical multiple regression identified the most parsimonious model of teacher autonomy support. Interest/enjoyment significantly predicted teacher autonomy support, \( R^2 = .50, F(1, 360) = 361.21, p < .001, 95\% \text{ CI } [0.49, 0.61] \). Value/usefulness added to this prediction, \( R^2 = .53, \Delta R^2 = .03, F(2, 359) = 204.05, p < .001, 95\% \text{ CI } [0.12, 0.28] \). Perceived competence also explained unique variance in predicting teacher autonomy support, \( R^2 = .54, \Delta R^2 = .01, F(3, 358) = 139.30, p = .024, 95\% \text{ CI } [-0.17, -0.01] \). Pressure/tension, relative autonomy, and academic achievement were unrelated to teacher autonomy support at every level of the hierarchical regression. However,
pressure/tension \((r = -.26, p < .001)\) and participants' relative autonomy \((r = .35, p < .001)\) were significantly related to teacher autonomy support outside of the regression model as bivariate correlations.

Teacher A and Teacher E had the two highest averages for autonomy support and also had the two highest averages for interest/enjoyment, value/usefulness, and perceived competence and the lowest averages for pressure/tension. Teacher A had the highest average for teacher autonomy support \((M = 5.18)\) and the highest average for academic achievement \((M = 62.99)\); Teacher B had the lowest average for autonomy support \((M = 4.50)\) and the lowest average for academic achievement \((M = 57.36)\). For three teachers, autonomy support was negatively related to academic achievement, although not significantly related.

This study found evidence to support the SDT claim that motivation lies upon a continuum of relative autonomy in which some forms of motivation are more autonomous and self-determined than others. Intrinsic motivation and identified regulation were more closely associated with autonomy support than introjected regulation and external regulation. Students with a more autonomous orientation for learning experienced less pressure and tension and greater interest/enjoyment, value/usefulness, perceived competence, and academic achievement than participants who had less self-determined academic motivation.

**Conclusions**

The purpose of this study was to determine if perceived teacher autonomy support was significantly related to seventh grade middle school students’ intrinsic motivation, autonomous self-regulation, and academic performance in a prealgebra course. Very little
research has explored the interplay between a teacher’s motivating style and middle school students’ motivation and achievement in mathematics. Each variable under investigation in this study is considered in turn below.

**Teacher Autonomy Support**

The nine items measuring autonomy support all had averages above four; this suggests that the math teachers in this study provided a relatively high degree of autonomy support. The two indicators of autonomy support “Conveys confidence” and “Shows me respect” had the highest averages ($M = 5.36$). While it is unknown whether teachers fostered an entity-based theory of intelligence (e.g., “You can do it because you’re smart”) or an incremental theory of intelligence (e.g., “You can do it if you work hard at it”), it appears as though students felt that their teachers conveyed confidence in their ability to perform well in prealgebra (for discussions about mastery learning goals vs. performance goals, see Dweck, 2000; Dweck & Leggett, 1988; Seifert, 2004). Respecting students is crucial because doing so satisfies their basic psychological needs for autonomy, competence, and relatedness (see Appendix C).

The indicator of autonomy support “Listens carefully” had the lowest average ($M = 4.22$). However, it was still above average (i.e., the mean score on a 7-point Likert scale = 4). For some reason(s), students evidently felt that their teachers did not listen intently to their questions, viewpoints, and/or opinions. It would be interesting to know why students felt this way, and it seems important to consider how teachers might become better listeners. Maybe teachers felt pressure to complete their lessons each day and were too busy “covering the curriculum” to listen carefully to their students. “Student voice” is a component of student engagement (Reeve, 2009; Jang et al., 2010), so ensuring that
students have an authentic voice in the classroom is one way to promote academic engagement. It seems that listening to students' opinions and perspectives would nurture students' voice and promote engagement. This finding highlights the importance of focusing on students and not just the curriculum. This data implies that focusing on students' needs for autonomy and relatedness, in addition to their need for competence, might prove increasingly difficult in the era of school accountability as teachers feel pressure to disseminate curricular content in a limited amount of time.

The correlations between all predictor variables (with the exception of academic achievement) were statistically significant at the $p < .001$ level with perceived teacher autonomy support. The nine indicators of autonomy support were most strongly correlated with interest/enjoyment, followed by value/usefulness, relative autonomy, perceived competence, and pressure/tension, respectively. Cohen (1988) suggested the following guidelines to determine effect sizes for correlations: .10 (small), .30 (moderate), and .50 (large). The strongest correlation occurred between participants' interest/enjoyment in their prealgebra class and teacher autonomy support ($r = .71, p < .001$). Students who perceived their teachers to be highly autonomy-supportive found class interesting and enjoyable, and students who did not feel that their teachers were autonomy-supportive seldom found their math class interesting or enjoyable; this finding holds important implications for theory and practice, as later discussed. The relationship between value/usefulness and teacher autonomy support was also large ($r = .52, p < .001$), though not as large as interest/enjoyment. There was a significant association between participants' confidence in their ability to learn math and perceived autonomy support, suggesting that autonomy-supportive teachers foster students' psychological
need for competence \( (r = .28, p < .001) \). The amount of pressure and tension participants experienced in their math class was statistically significant and negatively related to perceived autonomy support \( (r = -.26, p < .001) \), as expected.

The strength and direction of these correlations are similar to previous studies’ findings (Black & Deci, 2000; Grolnick & Ryan, 1987; Williams & Deci, 1996). This current research adds to the preponderance of evidence illuminating the close relationship between teacher autonomy support and students’ intrinsic motivation and internalization. This study is unique in finding a strong association between autonomy support and intrinsic motivation among young adolescent students learning prealgebra. Students found their prealgebra class more interesting, found more value in what they learned, felt more competent, and experienced less pressure and anxiety when their teachers supported their autonomy.

The nine indicators of autonomy support were more closely related to autonomous forms of motivation than they were to controlling forms of motivation, as expected. There was a significant negative relationship at the \( p < .01 \) level between external regulation and the indicators of autonomy support “Shows me respect” \( (r = -.14, p = .008) \) and “Feel understood” \( (r = -.16, p = .002) \), suggesting that as students felt respected and understood by their teachers, their academic motivation became more autonomous and self-determined. Previous research found significant associations between teacher autonomy support and autonomous academic motivation (Black & Deci, 2000; Hardre & Reeve, 2003; Jang, 2008; Reeve et al., 2002; Soenens & Vansteenkiste, 2005; Vallerand et al., 1997; Vansteenkiste, Zhou, et al., 2005; Williams & Deci, 1996; Zhou et al., 2009). Teacher A had the highest average for autonomy support and her
participants had the most self-determined academic motivation. Teacher autonomy support was significantly and positively related to students’ Relative Autonomy Index (RAI) for four of the five teachers, as expected; although the direction of this relationship cannot be determined due to the correlational nature of this research, it might be that providing autonomy support fosters high quality academic motivation associated with positive learning outcomes and well-being (Grolnick & Ryan, 1987; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005).

The relationship between autonomy support and academic achievement in this study elicited close scrutiny. “Feel understood” ($r = .11, p = .031$) and “Conveys confidence” ($r = .12, p = .028$) were the only indicators of autonomy support significantly related to academic achievement. Students’ academic achievement tended to increase in relation to how well they felt understood by their teacher and as their teacher expressed belief in their ability to succeed. Five of the nine indicators of autonomy support were negatively related to academic achievement; these interactions were unexpected and appear counterintuitive and unusual. It seems odd that providing students with choices and options, encouraging questions, listening carefully, expressing empathy, and showing respect would each be negatively associated with academic achievement (see Table 20). This may be because students who had lower academic achievement received more positive attention from their teacher and thus perceived greater autonomy support; likewise, higher achieving students might have received less attention from their teachers, and thus rated them as less autonomy supportive. The No Child Left Behind (2002) legislation encourages teachers to offer a great deal of support for low-achieving students, and, as a result, higher achieving students are often disproportionately neglected...
since they are often perceived as less academically needy (Banchero, 2011; Meier & Wood, 2004). Insight into the relationship between autonomy support and academic achievement is provided in greater detail under the subheading Academic Achievement.

Interest/Enjoyment

Interest/enjoyment was the most salient variable in this study. It was significantly related to perceived teacher autonomy support at the $p < .001$ level within the regression model, and it accounted for the most unique variance within the regression model ($R^2 = .50$). It also had the strongest relationship among all variables with autonomy support outside of the regression model ($r = .71, p < .001$) and had moderate-to-strong correlations with value/usefulness ($r = .53, p < .001$), pressure/tension ($r = -.39, p < .001$), perceived competence ($r = .43, p < .001$), and relative autonomy ($r = .49, p < .001$). Interest/enjoyment was the only predictor variable significantly related at the $p < .001$ level to autonomy support for all five teachers. The nine indicators of autonomy support were more strongly correlated with interest/enjoyment than with any other variable in this study, highlighting the seemingly inextricable relationship between autonomy support and intrinsic motivation.

Interest/enjoyment was more closely related to autonomous forms of motivation (i.e., intrinsic motivation, $r = .61, p < .001$, and identified regulation, $r = .45, p < .001$) than it was to controlled forms of motivation (introjected regulation, $r = .31, p < .001$, and external regulation, $r = -.16, p = .003$). The direction and strength of these correlations were expected and congruent with other SDT research (Black & Deci, 2000; Chirkov & Ryan, 2001; Grolnick & Ryan, 1987; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005). Participants who had a more autonomous orientation
for learning were more likely to enjoy prealgebra and find it interesting than participants who had a more controlled, extrinsically motivated academic motivation.

Interest/enjoyment was surprisingly unrelated to academic achievement ($r = .09, p = .091$). It was expected that interest/enjoyment would facilitate active engagement with curricular content and lead to deep learning. More discussion on the relationship between interest/enjoyment and academic achievement is offered under the subheading Academic Achievement.

*Value/Usefulness*

Other than interest/enjoyment, value/usefulness accounted for the most unique variance within the regression model ($R^2 = .53, \Delta R^2 = .03$). It was significant within the regression model at the $p < .001$ level, had a moderately strong relationship with autonomy support outside of the regression model ($r = .52, p < .001$), and had moderately strong relationships with interest/enjoyment ($r = .53, p < .001$), perceived competence ($r = .45, p < .001$), and relative autonomy ($r = .43, p < .001$). Value/usefulness was significantly and negatively related to pressure/tension ($r = -.30, p < .001$). Students who found value in the prealgebra curriculum were more likely to find it interesting and enjoyable, feel competent and capable, feel less pressure, and have a more autonomous orientation for learning.

The nine indicators of autonomy support were closely related to value/usefulness. The close association between autonomy support and value/usefulness was expected and is congruent with previous SDT research; autonomy-supportive environments appear quite adept at facilitating the internalization of extrinsic motivation (Chirkov & Ryan, 2001; Deci et al., 1994; Jang, 2008; Kaplan & Madjar, 2012; Reeve et al., 2002; Ryan &
Deci, 2000a, 2000b, 2002; Soenens & Vansteenkiste, 2005; Vansteenkiste, Timmermans, et al., 2008; Williams & Deci, 1996). “Feel understood” was the indicator of autonomy support most closely related to value/usefulness ($r = .45, p < .001$). This moderately strong relationship suggests that the more students felt understood by their teacher the more they tended to value prealgebra. As teachers help students feel understood, they support their innate psychological need for autonomy and their internal perceived locus of causality, which facilitates students’ eagerness to integrate math instruction and helps them begin to understand the importance of learning math. Previous research has shown that teachers can help students feel understood by allowing them to express negative affect, allowing them to solve problems in a variety of ways, and by providing personally meaningful rationales for learning (Assor et al., 2002; Boggiano et al., 1993; Jang, 2008; Reeve & Halusic, 2009; Reeve & Jang, 2006; Reeve et al., 2008).

Value/usefulness was more closely related to intrinsic motivation ($r = .44, p < .001$) and identified regulation ($r = .61, p < .001$) than it was to introjected regulation ($r = .33, p < .001$) and external regulation ($r = -.17, p = .001$). Participants who had a more autonomous orientation for learning were more likely to find prealgebra valuable and useful than participants who had a more controlled, extrinsically motivated academic motivation. These interactions were consistent with previous SDT research (Grolnick & Ryan, 1987; Hardre & Reeve, 2003; Soenens & Vansteenkiste, 2005; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005). Congruent with SDT, value/usefulness was more strongly correlated with identified regulation ($r = .61$) than with intrinsic motivation ($r = .44$) since value/usefulness is more closely related to identified regulation than it is to
intrinsic motivation (i.e., behaviors engaged in solely for their inherent enjoyment). Value/usefulness is more closely related to internalization than intrinsic motivation.

Value/usefulness had the highest average of the four predictor variables included on the Intrinsic Motivation Inventory \(M = 5.48\). The relatively high mean score for value/usefulness suggests that participants in this study had determined that the math curriculum was important to them and could help them in some way; it appears as though most participants had begun to internalize and integrate the value of learning mathematics. This could be due to the influence of socializing agents (i.e., parents, siblings, peers, previous teachers) emphasizing the value of education as it relates to the quality of one’s life and one’s future opportunities. The school where this research took place had a longstanding tradition of being a high-achieving school academically, and the elementary schools that fed into the middle school were also top-performing schools. The academic culture of the cluster of schools was one that highly valued education, and this culture likely facilitated students’ internalization of the importance of learning mathematics. Such a phenomenon is consistent with SDT tenets which assert that proximal socializing agents either nurture or undermine students’ internalization and integration of extant social values. An emphasis on the importance of learning can be communicated in a controlling, pressure-inducing way (that will likely forestall the internalization process and subdue self-determination) or in an informational, autonomy-supportive way (e.g., through offering rationales). Since the participants in this study seemed to have internalized the value of learning mathematics, it appears as though participants’ teachers and parents had communicated in a more autonomy-supportive manner the importance and value of learning mathematics.
Value/usefulness was surprisingly unrelated to academic achievement ($r = .05, p = .354$). It was expected that students who found value and utility within the prealgebra curriculum would tend to have high academic achievement. More discussion on the relationship between value/usefulness and academic achievement is offered under the subheading Academic Achievement.

**Pressure/Tension**

Pressure/tension accounted for no unique variance within the regression model and was statistically unrelated to teacher autonomy support. Outside of the regression model, pressure/tension was significantly and negatively related to autonomy support ($r = -.26, p < .001$), interest/enjoyment ($r = -.39, p < .001$), value/usefulness ($r = -.30, p < .001$), perceived competence ($r = -.41, p < .001$), and relative autonomy ($r = -.32, p < .001$). It was one of only two predictor variables significantly related to academic achievement ($r = -.20, p < .001$).

Students who felt more pressure and tension performed significantly worse on the benchmark tests. This is consistent with previous research on math anxiety; when students feel anxious in math, they tend to perform worse academically (Ashcraft & Kirk, 2001; Hembree, 1990; Richardson & Suinn, 1972; Wigfield & Meece, 1988). It is unknown if students' sense of pressure contributed to their low achievement or if a preexisting pattern of low mathematical achievement produced greater math anxiety, possibly fostering a state of learned helplessness, reduced agency, and low self-efficacy. Notably, the significant negative relationship between pressure/tension and perceived competence was moderately strong, although this was expected since math anxiety has a
deleterious effect on students' competency beliefs and attitude toward learning math (Ashcraft & Kirk, 2001; Hembree, 1990; Wigfield & Meece, 1988).

All nine indicators of autonomy support were significantly and negatively related to pressure/tension. Students of the two teachers who offered the most autonomy support felt the least amount of pressure and tension. Pressure/tension was negatively related to autonomy support for all five teachers. The significant negative association between autonomy support and students' sense of pressure in prealgebra holds important implications for math teachers: It is likely that an autonomy-support motivating style can be used as an instructional technique to assuage students' math anxiety.

Pressure and tension had a greater negative association with intrinsic motivation \( (r = -.26, p < .001) \) and identified regulation \( (r = -.33, p < .001) \) than with introjected regulation \( (r = -.13, p = .017) \), and it was positively and significantly related to external regulation \( (r = .20, p < .001) \). Students whose academic motivation was more externally regulated and less fully internalized were more likely to feel pressure and tension in their prealgebra class. These findings are consistent with other SDT research that found a negative relationship existed between pressure/tension and

- teacher autonomy support (Black & Deci, 2000; Flink et al., 1990; Grolnick & Ryan, 1987),
- perceived competence (Black & Deci, 2000),
- relative autonomy (Black & Deci, 2000; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005), and
- academic performance (Black & Deci, 2000; Grolnick & Ryan, 1987; Vansteenkiste et al., 2009).
Perceived Competence

When the predictor variables pressure/tension, relative autonomy, and academic achievement were removed from the regression model through hierarchical multiple regression, perceived competence accounted for a small amount of unique variance ($R^2 = .54$, $\Delta R^2 = .01$) and was significant at the $p < .05$ level. Outside of the regression model, perceived competence was significantly related to autonomy support ($r = .28$, $p < .001$), interest/enjoyment ($r = .43$, $p < .001$), value/usefulness ($r = .45$, $p < .001$), pressure/tension ($r = -.41$, $p < .001$), and relative autonomy ($r = .29$, $p < .001$). It was one of only two predictor variables significantly related to academic achievement ($r = .38$, $p < .001$). Students who had lower mathematical achievement felt less competent in their prealgebra class, and students who felt more capable performed better on the benchmark tests.

Eight of the nine indicators of autonomy support were significantly related to perceived competence. The indicator of autonomy support “Encourages questions” was unrelated to perceived competence. Participants who perceived themselves as highly capable mathematically did not sense that their teachers encouraged them to ask questions as often as students who perceived themselves to be less capable. It was as if participants thought “I am not that good in math, but my teacher encourages me to ask questions” while others thought, “I am good at math, but my teacher does not encourage me to ask questions.” This might be because teachers who perceived certain students to be highly capable did not ask those students as many questions. It appears as though the teachers in this study could have created a more equitable classroom culture by welcoming questions from the more high-achieving students. There is also evidence that
students who perceived themselves to be more competent in math felt less well understood by their teachers since the indicator of autonomy support "Tries to understand" was only significant at the $p < .01$ level rather than the $p < .001$ level.

Participants of the two teachers who offered the most autonomy support felt the most competent. Perceived competence was significantly related to autonomy support for three of the five teachers, but these correlations were small-to-moderate and were never significant at the $p < .001$ level. Prior research found associations between perceived competence and autonomy support (Black & Deci, 2000; Deci, Nezlek, et al., 1981; Hardre & Reeve, 2003; Trouilloud et al., 2006; Vallerand et al., 1997; Williams & Deci, 1996; Zhou et al., 2009), so these findings are consistent with previous SDT research.

Perceived competence was more closely related to intrinsic motivation ($r = .32, p < .001$) and identified regulation ($r = .35, p < .001$) than it was to introjected regulation ($r = .26, p < .001$) and external regulation ($r = -.14, p = .009$). Students motivated by contingencies (i.e., internal rewards such as guilt-avoidance or ego-enhancement and external motives such as avoiding punishment) felt less competent in their prealgebra class compared to students who were motivated for more deeply internalized and autonomous academic reasons. Students who personally valued the math and enjoyed learning it felt more competent.

Relative Autonomy Index

Relative autonomy accounted for no unique variance within the regression model and was statistically unrelated to teacher autonomy support. Outside of the regression model, relative autonomy was significantly related to autonomy support ($r = .35, p < .001$), interest/enjoyment ($r = .49, p < .001$), value/usefulness ($r = .43, p < .001$),
pressure/tension ($r = -.32, p < .001$), and perceived competence ($r = .29, p < .001$). Participants RAI was unrelated to academic achievement ($r = .04, p = .437$). Students who had a more self-determined orientation for learning were less likely to feel pressure and more likely to enjoy prealgebra, value what they were learning, and feel competent compared to students who had a less autonomous academic orientation. This finding is congruent with other studies that found positive learning outcomes associated with more self-determined academic motivation (Black & Deci, 2000; Hardre & Reeve, 2003; Grolnick & Ryan, 1987; Pelletier et al., 2001; Soenens & Vansteenkiste, 2005; Vallerand et al., 1997; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005; Zhou et al., 2009).

All nine indicators of autonomy support were significantly related to relative autonomy. Relative autonomy was significantly related to autonomy support for four of the five teachers in this study. Teacher A had the highest average for autonomy support and her students had the most autonomous academic motivation and most self-determined orientation for learning. This could mean that students who had a higher RAI simply perceived their teacher to be more autonomy-supportive, liked school more, and had a more positive academic outlook, or it could mean that Teacher A’s autonomy support produced more autonomous motivation within students, which is similar to what Black and Deci (2000) found.

The RAI scale ranged from -9 to 9. A score of -9 indicated the least autonomous and lowest possible self-determined orientation for learning, and a score of 9 represented the most autonomous and greatest possible self-determined orientation for learning. The
average RAI of the 362 participants in this study was -0.77. This suggests that, overall, participants had a slightly controlled orientation for learning.

Scores on the four subscales of the Academic Self-Regulation Questionnaire (ASRQ) ranged from 1 to 4 with 1 = “Not at all true” and 4 = “Very true.” Intrinsic motivation had the lowest average of the four subscales on the ASRQ ($M = 2.31$), yet identified regulation had the highest ($M = 3.34$). This suggests that although math class might not have been fun to students, they identified with the value of doing well in school. Koestner and Losier (2002) found that identified regulation was a more important predictor than intrinsic motivation of students’ well-being and continued enrollment in college. Chirkov & Ryan (2001) found that parental autonomy support was more closely related to students’ internalization of the school-related goals, whereas teacher autonomy support was more closely related to intrinsic motivation in school. These findings suggest that identified regulation might provide a deeper reservoir of motivational resources to draw upon compared to salient feelings of interest and enjoyment during task-involvement. Deeply internalized values might be more important than intrinsic motivation in relation to persistence, well-being, and performance. In other words, an ability to effectively engage in tasks that might not be inherently fun or interesting—but that are important—is a valuable asset. Identified regulation might facilitate greater self-determination than intrinsic motivation, in some cases.

The finding of intrinsic motivation having the lowest average of the four subscales is consistent with other research that found intrinsic motivation tends to gradually deteriorate with each advancing grade (Archambault et al., 2010; Gottfried et al., 2001; Wigfield et al., 1991). By the seventh grade, 362 student responses generated
an average score of 2.31 on a scale of 1 to 4, where a score of “2” meant “not very true” and 3 meant “sort of true” (see Appendix E). It was relatively uncommon for the participants in this study to find their schoolwork fun and enjoyable, and it was more likely that they completed their schoolwork either because it was important to them (identified regulation, $M = 3.34$); to impress their teacher, feel proud of themselves, or not feel guilty or ashamed (introjected regulation, $M = 3.03$); or to avoid getting in trouble (external regulation, $M = 2.85$).

This study found evidence to support the SDT claim that motivation lies upon a continuum of relative autonomy in which some forms of motivation are more autonomous and self-determined than others. Externally regulated academic motivation was negatively associated with both forms of autonomous motivation, and it was more negatively associated with intrinsic motivation ($r = -.17, p = .002$) than with identified regulation ($r = -.11, p = .044$), as expected. SDT asserts that external regulation and intrinsic motivation lie on opposite ends of the continuum of self-determined behavior (see Figure 17 in Chapter 4); these correlations support that notion. Furthermore, external regulation was positively related to introjected regulation and significant at the lowest possible level ($r = .28, p < .001$). This data offers strong evidence of motivation lying along a continuum of autonomy, with distinct learning outcomes associated with those different types of motivation, as espoused by SDT. Students with a more autonomous orientation for learning experienced less pressure/tension and greater interest/enjoyment, value/usefulness, perceived competence, and academic achievement in prealgebra than participants who had less self-determined academic motivation. Likewise, when participants’ academic motivation was not very well internalized or deeply integrated into
their self-system (i.e., their values, goals, and interests), they tended to find prealgebra significantly less interesting, valuable, and useful; experience a significantly higher degree of pressure and tension; feel significantly less competent; and achieve significantly worse than participants who had more autonomous motivation for learning.

Introjected regulation had the most positive association with academic achievement ($r = .06, ns$), and intrinsic motivation ($r = .01, ns$) and integrated regulation ($r = -.01, ns$) had virtually no relationship whatsoever with students’ performance on the standardized math tests. The finding that introjection was more closely related to academic achievement is potentially interesting. Although the positive correlation between academic achievement and introjected regulation was weak and not significant, the fact that it was more closely related to academic achievement than autonomous forms of motivation (i.e., intrinsic motivation and identified regulation) merits elucidation.

Referring to the phenomena of introjection, Niemiec et al. (2008) explained:

*Introjection involves the adoption of external regulations and values without really assimilating them. In a developmental sense, introjection typically results when socializers prompt behavior using contingent approval, essentially communicating to the socialized person, ‘I will love you only if you do as I say.’ This is experienced phenomenologically as having the satisfaction of the needs for relatedness and autonomy pitted against each other, which results in the experiences of internal compulsion, a lack of choice, and shame and guilt after failure…. Thus, introjection is likely to manifest among people who were exposed to a socialization strategy in which they were forced to decide between satisfaction of one psychological need at the expense of another, and this controlling practice is then applied to one’s self. Therefore, through introjection, the person controls the self through the administration of contingent consequences in the forms of pride and self-esteem after adherence or success and guilt and shame after lapses or failure. Such controlled behavior regulation has been found*
to be associated with a variety of negative consequences for motivation and well-being, including increased tension, anxiety, vulnerability, and depression. (p. 110)

Introjected regulation often stems from "the satisfaction of the needs for relatedness and autonomy pitted against each other" and forces a person (i.e., children, students, adolescents, partners) to choose between satisfaction of one basic psychological need over the other. This creates a lose-lose scenario. Many parents and some teachers provide conditional regard (Assor et al., 2004); accordingly, introjected regulation can be a powerful motivator since children have an innate need for relatedness, and, as posited within the attachment framework, they particularly have a need to feel a sense of relatedness to their primary caregivers. It might have been that students who performed well academically felt a great deal of pressure from their parents (or teachers) to do well academically, and this desire to not disappoint their parents and to gain their approval fueled their academic performance. In this way, introjected regulation might have enhanced students' academic performance yet diminished their sense of well-being. This example illustrates how conditional regard and contingent approval, though potentially motivating, engender a controlling form of behavioral regulation that undermines needs for relatedness and autonomy and inhibits true self-determination.

There was a significant negative correlation between externally regulated motivation for learning and academic achievement at the $p < .05$ level ($r = -.11, p = .043$), indicating that students whose academic motivation was influenced primarily by external motivators, such as fear of punishment, were significantly more likely to have low academic achievement than students who had more autonomous academic motivation. It might also have been that students with low academic achievement had acquired a state of learned helpless, or within the SDT framework, what is referred to as
amotivation. Repeated failure can thwart students' need for competence and lead to amotivation, which is characterized by very little—if any—effort. Low performing students might have lost a great deal of self-determined academic motivation by seventh grade if they had experienced years of difficulty and low academic achievement in mathematics.

*Academic Achievement*

Motivation is widely recognized as an important variable related to students’ academic performance (Brophy, 2010; Schunk, 2011; Wentzel & Wigfield, 2009; Zimmerman & Schunk, 2001, 2011). Just as many factors contribute to students’ motivation, many factors contribute to students’ academic achievement in mathematics (Brahier & Speer, 2011; Middleton & Jansen, 2011; Middleton & Spanias, 1999). This study predicted that there would be a significant relationship between teacher autonomy support and students’ performance on two standardized math tests.

In this study, academic achievement was positively but not significantly related to teacher autonomy support ($r = .02, p = .73$). Academic achievement accounted for no unique variance within the regression model. Academic achievement was significantly related to only two predictor variables, pressure/tension and perceived competence. Only two indicators of autonomy support, “Feel understood” ($r = .11, p = .031$) and “Conveys confidence” ($r = .12, p = .028$), were significantly related to academic achievement; they were significant at the $p < .05$ level, and the correlations were small.

No other SDT research has investigated the relationship between perceived teacher autonomy support and students’ achievement on standardized tests, but the results of this study are congruent with other findings on academic achievement within the SDT
framework (see Table 2 for detailed comparisons). There are several possible explanations for the lack of association between teacher autonomy support and students’ academic achievement in prealgebra. The school district responsible for producing the benchmark tests used Webb’s (2002a, 2002b, 2007) Depth of Knowledge (DOK) design to create the tests. Over half of the questions on the tests were Level 1 DOK questions. Level 1 DOK questions assess recall and reproduction of knowledge (Webb, 2002a, 2002b, 2007). Although the benchmark tests used in this study has some conceptually-based questions (i.e., Level 2 and Level 3 DOK), they mostly assessed rote learning. The benchmark test generally measured rote recall of knowledge rather than assessing deep conceptual understanding. Previous experimental research has found that an autonomy-supportive motivating style did not significantly enhance rote learning compared to a controlling motivating style (Boggiano et al., 1993; Grolnick & Ryan, 1987; Jang, 2008; Vansteenkiste, Simons, et al., 2005; Vansteenkiste, Timmermans, et al., 2008), and two of these studies found that rote learning was higher for students in the controlling conditions (Grolnick & Ryan, 1987; Vansteenkiste, Simons, et al., 2005).

Another possible explanation is the internal validity of the instruments used to measure academic achievement. The average score on the Interim I was lower than the Pretest average for three of the five teachers in this study (see Table 23). This is alarming. It is unusual for students to perform better before they receive nine weeks of instruction, so this could mean that the Interim I had problems with construct validity.

It is notable that perceived competence was significantly related to achievement, and this association was moderate \( r = .38, p < .001 \). As Hardre and Reeve (2003) concluded, it might be that “achievement has relatively deeper roots in perceived
competence” (p. 355) compared to self-determined motivation. Fostering students need for competence might be more important in regards to academic achievement, whereas fostering students’ need for autonomy might be more important for promoting self-determined motivation. Both competence and autonomy nurture students’ intrinsic motivation and well-being, so teachers can aim to satisfy these needs through their instruction.

*Theoretical and Practical Implications*

The findings of this study hold several key implications for motivational theory and classroom practice. This study explored the associations between six specific variables and perceived teacher autonomy support. The unique contributions of this study’s findings are discussed in turn below.

Self-determination theory maintains that people have innate psychological needs for autonomy, competence, and relatedness. SDT specifies autonomy and competence as particularly important needs related to intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000b, 2002). Many motivational theories cite an inextricable connection between perceived competence and intrinsic motivation. Feelings of success generate confidence and a sense of control, self-efficacy, and self-determination, that, in turn, foster intrinsically motivated behavior, and intrinsically motivated behavior leads to growth and optimal development. Several theories of motivation, in addition to SDT, cite a link between perceived value and motivation, namely expectancy-value theory (Wigfield & Eccles, 2000). However, SDT is unique with its assertion that a sense of autonomy is necessary to sustain intrinsic motivation and to engender other high-quality autonomous motivation (i.e., identified regulation and integrated regulation).
This study tested if perceived competence, value/usefulness, and perceived autonomy support were variables related to students’ intrinsic motivation. All three variables were significantly and positively related to intrinsic motivation. The strongest correlation occurred between autonomy support and intrinsic motivation ($r = .71, p < .001$), followed by value/usefulness and intrinsic motivation ($r = .52, p < .001$) and perceived competence and intrinsic motivation ($r = .28, p < .001$). Moreover, as predictors of autonomy support within the regression model, intrinsic motivation accounted for 50% of the variation, compared to 3% for value/usefulness, and only 1% for perceived competence. The bivariate correlations and results of the hierarchical regression analyses offer strong support for SDT’s claim that support for autonomy is essential for cultivating and sustaining intrinsic motivation. This finding suggests that autonomy appears to be a central—and perhaps fundamental—human psychological need, essential for optimal performance and well-being.

This study also found clear empirical evidence that motivation is not a dichotomous construct, conceptualized solely as intrinsic and extrinsic motivation. Rather, extrinsic motivation appears to vary in how autonomous it is. Some forms of extrinsically-regulated behavior are more autonomous and self-determined than others.

Many studies found that autonomy support was more closely related to autonomous forms of extrinsic motivation than to controlling forms of extrinsic motivation (Black & Deci, 2000; Hardre & Reeve, 2003; Jang, 2008; Pelletier et al., 2001; Vallerand et al., 1997). In this study, intrinsic motivation and identified regulation were more closely associated with autonomy support, whereas introjected regulation and external regulation were more closely associated with a lack of autonomy support. This
finding suggests that autonomy support fosters and expedites the internalization process and stimulates students to do things they would not have initiated on their own.

Autonomy support increases students' willingness to comply with their teacher's request because the teacher, through the provision of autonomy support, has enabled the student to find personal meaning, value, and importance in the task at hand. Autonomy support appears to be an important mechanism that allows students to grow, mature, develop, and become more self-determined, self-initiating, and self-actualized.

Well-being and optimal learning has been positively associated with autonomous motivation in many studies, whereas controlled motivation was typically associated with ill-being and diminished performance (Black & Deci, 2000; Chirkov & Ryan, 2001; Grolnick & Ryan, 1987; Pelletier et al., 2001; Ryan et al., 1999; Vallerand et al., 1997; Vansteenkiste et al., 2004; Vansteenkiste et al., 2009; Vansteenkiste, Zhou, et al., 2005; Zhou et al., 2009). In this study, students with a more autonomous orientation for learning experienced less pressure/tension and greater interest/enjoyment, value/usefulness, perceived competence, and academic achievement in prealgebra than participants who had less self-determined academic motivation. Likewise, when participants' academic motivation was not very well internalized or deeply integrated into their self-system (i.e., their values, goals, and interests), they tended to find prealgebra significantly less interesting, valuable, and useful; experience a significantly higher degree of pressure and tension; feel significantly less competent; and achieve significantly worse than participants who had more autonomous motivation for learning. Cultivating students' autonomous motivation through the provision of autonomy support appears to be an important educational aim for teachers. If autonomy support fosters self-
determined motivation and self-determined motivation is related to happiness, productivity, and well-being, then teachers might strive to support students’ autonomy.

The results of this study challenge the beliefs of some teachers that certain students cannot be motivated. Motivation is not a fixed entity. Students’ motivational responses stem from the learning conditions established by their teachers. Moreover, students’ cognitive processes appear to be linked to their emotional experiences in their math classes (Ashcraft & Kirk, 2001; Frenzel et al., 2007; Tsai et al., 2008). Teachers can embrace the opportunity to positively influence students’ behavioral and cognitive processes through supporting students’ autonomy. Recognizing that they can influence students’ motivation might enhance teachers’ own sense of agency, self-efficacy, and perceived competence and empower them to become more satisfied and productive educators.

This study found a moderate negative association between perceived teacher autonomy support and students’ pressure and tension in mathematics ($r = -.26, p < .001$), which indicates that as autonomy support increased, students’ sense of pressure and tension decreased (and as perceived autonomy support decreased, pressure/tension tended to increase). This study also found a moderately strong negative correlation between pressure/tension and perceived competence ($r = -.41, p < .001$), as expected; however, there was a positive relationship between teacher autonomy support and perceived competence ($r = .28, p < .001$). Within the mathematics classroom environment, it appears as though an autonomy-supportive motivating style might mitigate the harmful influences of math anxiety by alleviating students’ sense of pressure and bolstering their perceived competence. An autonomy-supportive motivating style might reduce students’
math anxiety as teachers take students’ internal frame of reference and support their internal perceived locus of causality through demonstrating empathy, allowing expressions of negative affect, listening, conveying confidence, encouraging questions, highlighting deep curricular connections, fostering relevance, providing personally meaningful rationales during uninteresting yet important activities, framing intrinsic learning goals, providing opportunities for choice, and many other things as listed in Tables 3 and 4 in Chapter 2. Future longitudinal studies might explore if teacher autonomy support has a moderating effect on students’ math anxiety, just as perceived autonomy support was found to moderate the adverse impact of low TEEs on students’ later perceived competence (Trouilloud et al., 2006).

Limitations

This study is not without limitations. The external regulation subscale of the ASRQ had an alpha coefficient below .70. Teacher D had a student teacher for several weeks in September and October 2011. The sample of this study, though diverse, somewhat limits the generalizability of the findings. This cross-sectional study relied heavily on student self-report measures; observations and interviews could have provided greater validity and insight into this study. These limitations are discussed in greater detail below.

Cronbach’s alpha reliability coefficient for the external regulation subscale of the ASRQ was .60. An alpha coefficient of .70 or higher is a widely accepted benchmark within social science research as the standard criterion for a scale to be considered internal consistent (Field, 2009, pp. 673-681). Although this subscale did not meet the standard criterion for good reliability, studies that used questionnaires with alpha
coefficients under .60 are often published in distinguished refereed research journals (e.g., Assor et al., 2005; Vallerand et al., 1997; Zhou et al., 2009). The less than ideal reliability for the external regulation subscale is considered a minor limitation. Also, including the same number of items on each subscale of the ASRQ would have allowed for more equal comparisons to be made across subscales when calculating the RAI (see Appendix E).

A problem unforeseen when this study was designed arose concerning Teacher D. Teacher D had a student teacher during the months of September and October. This student teacher interacted with Teacher D’s three classes to varying degrees over this time period, but had an increased amount of time teaching these students during the month of October. When administering the questionnaires, the researcher in charge of this study asked the participants to only think about their primary teacher and not the student teacher when responding to these questionnaires. Multiple regression analyses were run with and without Teacher D’s participants and found that including these participants’ surveys did not skew, disproportionately influence, or significantly change the analyses and results.

This study drew participants from only one school, which limits the generalizability of the findings. However, the ethnic and socioeconomic diversity of this school enhances the generalizability of this study’s findings. The sample of this study was rather heterogeneous; no racial majority existed, and 44% of the sample qualified for the free/reduced lunch program. Much SDT research has been conducted among rather homogenous samples (e.g., Israeli students, Belgian students, rural American students,
high-achieving German students, and so on). The diversity within the sample of the current study is a relative strength of the study.

This data was cross-sectional in nature. All the data was gathered in a period of roughly 20 minutes, with the exception of the two benchmark tests. Participants completed the Interim I several weeks before the survey data was collected and completed the Posttest I several weeks after the surveys were collected. Since participants used self-reported measures to generate the data on the motivational variables, some of the relations between variables might be overestimated due to shared method variance.

Recommendations for Future Research

Statistical analyses other than multiple regression might have been better suited to measure the data collected in this study, namely, structural equation modeling (SEM) and hierarchal linear modeling (HLM). Structural equation modeling (SEM) might have been better suited for this data set, relative to multiple regression, because there were many (six) predictors variables in this study. SEM shows how multiple predictor variables interact with each other and illuminates the relationships among the predictor variables in a way that multiple regression cannot. Some variables may act as a moderator or a mediator to other variables and influence the way certain variables interact with each other and with the outcome variable. For example, in this study, perceived competence was positively related to teacher autonomy support when value/usefulness was not a variable in the regression analysis. However, when value/usefulness was added, perceived competence became negatively related to autonomy support. This interaction between value/usefulness and perceived competence could indicate that value/usefulness was a moderator to perceived competence in this study.
The participants in this study were nested within five different teachers' classes and nested within a specific class period. Hierarchical linear modeling (HLM) is a statistical analysis that can be used to control for a nested effect (Field, 2009; Raudenbush & Bryk, 2002). More variance can be accounted for when controlling for nestedness. Educational research that compares students within one school to students within another school often utilizes HLM since there are many levels of nestedness (i.e., students are nested within different class periods which are nested within different teachers which are nested within different grade levels which are nested within different schools). It was determined that HLM would not be necessary since this study only used one school and one grade level. Some published studies that drew participants from multiple schools and multiple grade levels did not use HLM (e.g., Hardre & Reeve, 2003); every study that compares students from one teacher's class to students in another teacher's class does not necessarily use HLM, although Trouilloud et al. (2006) explicitly recommended researchers use HLM in such instances. It is quite possible that if an HLM analysis were applied to this data set, more variance could have been explained.

Future studies could use a longitudinal design to monitor changes in students' perceived teacher autonomy support throughout the year and any possible learning outcomes associated with these changes. It would be interesting to see if students perceive teachers to be more autonomy-supportive earlier in the school year, before pressures from above, pressures from below, and pressures from within accumulate and increase the likelihood of a teacher using a controlling motivating style (Pelletier et al., 2002). Or, perhaps the opposite is true: As students get to know their teacher better as the school year progresses, they begin to perceive their teacher as more autonomy-
supportive, and, as a result, their motivation and achievement increase. It might also be useful to compare perceived autonomy support across grade levels and content areas. For instance, questions such as these might be important to explore: “Do sixth grade students perceive their teachers as more autonomy-supportive than eighth grade students? If so, why?” and “Do language arts teachers tend to be more autonomy-supportive than math teachers? If so, why? Does certain curricular content lend itself to using a more autonomy-supportive teaching style?”

It might also be helpful to apply a mix-methods design to investigate learning outcomes related to teacher autonomy support. In the current study, there was a strong, significant, positive relationship between students’ perceived teacher autonomy support and (a) their interest/enjoyment in prealgebra and (b) their value/usefulness of prealgebra. However, it is unclear exactly why prealgebra was interesting, enjoyable, and valuable to students. Classroom observations by researchers blind to a study’s purpose and interviews with students and teachers might provide more insight into what exactly autonomy-supportive teachers do that students find so interesting. It can be inferred that supporting students’ autonomy makes class more interesting to students, but the current study does little to illuminate how math curricula might possible affect students’ motivation, engagement, learning, and academic achievement. An autonomy-supportive motivating style appears to be an important instructional strategy associated with many positive learning outcomes, but it remains unclear what autonomy-supportive teachers do with curricular content to support students’ motivation and learning. Future studies might investigate what types of curricula and assessment autonomy-supportive teachers use, how they use it, and the effect that such curricula have on students’ motivation and
learning. Finally, independent observations could be used to assess teacher autonomy support, as other studies have done (Boggiano et al., 1993; Flink et al., 1990; Jang et al., 2010), in addition to students' self-reported measures of perceived teacher autonomy support.

There is also a need for more experimental designs to explore students' need for autonomy and how schools might become more autonomy-supportive. Nineteen of the 32 studies reviewed in Chapter 2 were correlational designs. Research on autonomy-support lends itself to correlational studies for two reasons: (a) correlational studies explore phenomenon as they naturally occur in the real-world (Field, 2009), which lends itself to research in school settings, and (b) it can be challenging to think of ways to effectively and ethically experimentally design a study in which an autonomy-supportive motivating style is contrasted with a controlling motivational style. Given what is known about the deleterious impact of a controlling teaching style on students' conceptual understanding, motivation, and well-being, it can be unethical to create an experiment that contrasts an autonomy-supportive learning environment with a controlling environment. It is possible to create ethical experimental studies, but it requires thoughtfulness and insight (see Reeve et al., 2004; Vansteenkiste et al., 2004; Vansteenkiste, Simons et al., 2005, and Vansteenkiste, Timmermans et al., 2008, for examples). The problem is that once something is shown to benefit students, it becomes problematic to withhold it from students. For example, it would be a poor experiment to assign a project to students, divide them into two groups, and only give one group of students a rubric for the project. That might have been a sound study 40 years ago during the open classroom movement in America when researchers were investigating how well students learned under
nondirected conditions, but it is now considered best practice to set clear guidelines and expectations for students. Likewise, the last three decades have produced a preponderance of evidence in favor of an autonomy-supportive motivating style, so it becomes challenging to design experimental studies in which one group of students is intentionally exposed to controlling teacher behaviors or is not offered autonomy-support. Nevertheless, there remains a need to further identify more autonomy-supportive teacher practices and identify the positive learning outcomes linked to autonomy-supportive teaching. For example, identifying cognitive autonomy support and its characteristics has proven to be a valuable addition to understanding specific ways teachers can support students’ autonomy and nurture their cognitive growth and development, especially in mathematics (Stefano, Perencevich, DiCintio, & Turner, 2004; Tsai et al., 2008).

Future researchers that use Pressure/Tension subscale of the Intrinsic Motivation Inventory might note that in the current study, the item that used the word “anxious” lowered the internal consistency of the Pressure/Tension subscale (see item 12 of Appendix D). Several participants asked the researcher administering the Intrinsic Motivation Inventory what the word anxious meant. Anxious might have been interpreted by participants as “eager,” yet students’ eagerness to learn math was not what the Pressure/Tension subscale aimed to assess.

Summary

The purpose of this study was to determine if seventh grade students’ intrinsic motivation and academic achievement were significantly related to perceived teacher autonomy support. This correlational study used multiple regression analyses to identify
the variables most closely related to perceived teacher autonomy support. A series of hierarchical multiple regressions determined the most parsimonious model possessing the greatest predictive power of perceived teacher autonomy support.

Three variables emerged as significant predictors of autonomy support. Interest/enjoyment accounted for the most amount of unique variance, $R^2 = .50$, $F(1, 360) = 361.21, p < .001$, 95% CI [0.49, 0.61], followed by value/usefulness, $R^2 = .53$, $\Delta R^2 = .03$, $F(2, 359) = 204.05, p < .001$, 95% CI [0.12, 0.28], and then perceived competence, $R^2 = .54$, $\Delta R^2 = .01$, $F(3, 358) = 139.30, p = .024$, 95% CI [-0.17, -0.01]. These three variables combined to account for and predict 54% of perceived teacher autonomy support. This data indicates that students experienced significant feelings of interest/enjoyment, value/usefulness, and perceived competence as their teacher supported their autonomy. By controlling for each respective variable in the regression analyses, it became clear that students experienced feelings of interest/enjoyment, value/usefulness, and perceived competence independent from one another, although students primarily experienced interest/enjoyment, relative to value/usefulness and perceived competence, when their teachers supported their autonomy.

These findings have interesting theoretical implications. While other motivational theories recognize value/usefulness and perceived competence as key constructs related to students’ motivation, self-determination theory is unique in claiming that autonomy is an essential facet of intrinsic motivation. This study found that interest/enjoyment was the greatest predictor of perceived autonomy support, over and beyond value/usefulness and perceived competence. This finding supports SDT’s assertion that autonomy and
intrinsic motivation seem inherently connected, and that experiencing satisfaction of the need for autonomy engenders feelings of interest and enjoyment.

These findings are also important for classroom practice. This study found that math teachers supported their students’ autonomy and nurtured their intrinsic motivation as they

- offered students’ choices and options;
- helped students feel understood by (a) showing empathy, (b) encouraging and welcoming students’ active, authentic voice, and (c) attempting to understand students’ goals, values, and interests;
- conveyed confidence in students’ ability to do well;
- encouraged students to ask questions;
- listened carefully to how students would like to do things;
- answered students’ questions fully and carefully;
- tried to understand students’ thoughts and perspectives before suggesting a new way to do things; and
- showed students respect (see Appendix B).

These nine instructional practices do not cost money to implement. They do not require teachers to fill out additional paper work or put in extra time before or after work. They do require teachers to consider their ontological beliefs about motivating students, which is a crucial first step in raising their awareness about the importance of maintaining an empirically-supported framework to motivate students (Beyers, 2011; Matteson et al., 2011; Reeve, 1998).
Teachers are more likely to internalize the value of becoming more autonomy-supportive under conditions in which ideas are communicated in an informational, autonomy-supportive way. It is important to note—as others did many years ago with their own research—that the findings of the current research study will be valuable as a training device only if the data from it are presented to teachers informationally rather than controllingly. Just as children need autonomy-oriented classrooms to be intrinsically motivated and to perceive themselves as competent, teachers need an autonomy-oriented context within which to benefit from feedback about their own orientations....Data...presented to the teachers informationally, can help them develop a more intrinsic orientation and a stronger self-esteem. These outcomes should, in turn, filter down to the students. (Deci, Schwartz, et al., 1981, p. 649)

According to SDT, teachers will be less likely to deeply internalize the value of using an autonomy-supportive motivating style if they are told that they “should” or “must” become more autonomy-supportive, or that “Good teachers support students’ autonomy.” Such controlling statements are likely to supplant teachers’ sense of autonomy and undermine their needs for competence and relatedness. Teacher-educators and local school administrators can listen to K-12 classroom teachers, allow them to express negative affect, take their perspective, and communicate with noncontrolling language about the empirically-supported educational benefits of using an autonomy-supportive motivating style.

The current study joins many others in finding a significant, positive relationship between perceived teacher autonomy support and students’ intrinsic motivation,
perceived competence, internalization, and an autonomous academic orientation for learning, respectively. This study is the first to find such results among a sample of seventh grade students learning mathematics in an American middle school setting. Supporting students’ autonomy appears to foster their self-determination and well-being.
Appendix A

Permission to Reproduce the Continuum of Self-Determined Behavior
Re: Permission to reproduce SDT table

Ed

To Kenneth Whaley

Ken,

Yes, you have our permission to reproduce the figure in your dissertation. To reproduce it in a publication would require getting permission from APA because they own the copyright.

Ed

On 2/6/12 2:15 AM, "Kenneth Whaley" <kiv314@hotmail.com> wrote:

Hi,

Is it okay with you if I use the "Continuum of Self-Determined Behavior" diagram in my dissertation as cited in:


APA standards require that I have written consent/permission to re-use the SDT continuum from either you or Richard Ryan. This is not for publication, just as a reference in my dissertation. My Chair said it would be good to have the diagram in my dissertation.

Best,

Ken
Appendix B

Learning Climate Questionnaire
This questionnaire contains items that are related to your experience with your teacher in this class. Teachers have different styles in dealing with students, and I would like to know more about how you have felt about your encounters with your teacher. Your responses are confidential. Please be honest and candid.

For each of the following statements, please indicate how true it is for you, using the following scale:

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<tr>
<td>strongly disagree</td>
<td>neutral</td>
<td>strongly agree</td>
<td></td>
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1. My teacher provides me with choices and options.

   
   
   
   
   
   
   
   
   1 2 3 4 5 6 7
   | strongly disagree | neutral | strongly agree |

2. I feel understood by my teacher.

   
   
   
   
   
   
   
   
   1 2 3 4 5 6 7
   | strongly disagree | neutral | strongly agree |

3. My teacher conveys confidence in my ability to do well in this class.

   
   
   
   
   
   
   
   
   1 2 3 4 5 6 7
   | strongly disagree | neutral | strongly agree |
4. My teacher encourages me to ask questions.

1 2 3 4 5 6 7

strongly disagree neutral strongly agree

5. My teacher listens carefully to how I would like to do things.

1 2 3 4 5 6 7

strongly disagree neutral strongly agree

6. My teacher answers my questions fully and carefully.

1 2 3 4 5 6 7

strongly disagree neutral strongly agree

7. My teacher tries to understand how I see things before suggesting a new way to do things.

1 2 3 4 5 6 7

strongly disagree neutral strongly agree

8. My teacher shows me respect.

1 2 3 4 5 6 7

strongly disagree neutral strongly agree
9. I am able to share my feelings with my teacher about what I want to become.

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<tr>
<td></td>
<td>strongly disagree</td>
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Appendix C

The Relationship between the Three Basic Psychological Needs Espoused by SDT and the Items Assessed on the Learning Climate Questionnaire
Learning Climate Questionnaire Items (see Appendix B):

1. Provides Choices
2. Feel understood
3. Conveys confidence
4. Encourages questions
5. Listens carefully
6. Answers questions fully
7. Tries to understand
8. Shows me respect
9. Able to Share Feelings

Note. Drawing from the work of deCharms (1968, 1976), SDT defines the need for autonomy as a need to perceive oneself as the source or origin of one's own behavior. Accordingly, SDT defines autonomy as a sense of inner endorsement (Ryan & Deci, 2011). However, the relative inability to identify unique characteristics of a psychological need for autonomy has been cited as a weakness of the theory (A. Assor, personal communication, July 25, 2011); needs for autonomy are often closely related to needs for competence and relatedness, as displayed in this figure. The need for autonomy is not as distinguishable and as easy to define as the need for competence and the need for relatedness, which, in part, justifies empirical exploration of a psychological need for autonomy (see Jang et al., 2009, p. 649; Sierens et al., 2009, p. 58; and Vansteenkiste et al., 2009, p. 672, for more discussion on the relationship between autonomy-supportive teaching and basic needs satisfaction as this relationship is represented with the nine items measured on the LCQ).
Appendix D

Intrinsic Motivation Inventory
For each of the following statements, please indicate how true it is for you, using the following scale:

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<tbody>
<tr>
<td>not at all true</td>
<td>somewhat true</td>
<td>very true</td>
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1. While I am in this class, I am thinking about how much I enjoy it.

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<tr>
<td>not at all true</td>
<td>somewhat true</td>
<td>very true</td>
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2. It is very clear to me how valuable and how useful what I am learning in this class will be in my life.

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<tbody>
<tr>
<td>not at all true</td>
<td>somewhat true</td>
<td>very true</td>
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3. I feel nervous while in this class.

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<tr>
<td>not at all true</td>
<td>somewhat true</td>
<td>very true</td>
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4. I think I am pretty good at math.

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<tr>
<td>not at all true</td>
<td>somewhat true</td>
<td>very true</td>
<td></td>
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</tr>
</tbody>
</table>
5. I find this class very interesting.

1 2 3 4 5 6 7
not at all  somewhat  very
true         true     true

6. I feel very tense while in this class.

1 2 3 4 5 6 7
not at all  somewhat  very
true         true     true

7. I think the math I learn in this class is useful.

1 2 3 4 5 6 7
not at all  somewhat  very
true         true     true

8. This class is fun.

1 2 3 4 5 6 7
not at all  somewhat  very
true         true     true

9. I feel very relaxed in this class.

1 2 3 4 5 6 7
not at all  somewhat  very
true         true     true
10. I enjoy this class very much.

1 2 3 4 5 6 7
not at all somewhat very
true true true

11. I feel confident in my ability to learn math.

1 2 3 4 5 6 7
not at all somewhat very
true true true

12. I feel anxious while in this class.

1 2 3 4 5 6 7
not at all somewhat very
true true true

13. I think this class is very boring.

1 2 3 4 5 6 7
not at all somewhat very
true true true

14. I think learning the math in this class could help me.

1 2 3 4 5 6 7
not at all somewhat very
true true true
15. I am pretty skilled at math.

1 2 3 4 5 6 7
not at all somewhat very true true true

16. I feel pressured while in this class.

1 2 3 4 5 6 7
not at all somewhat very true true true

17. I believe the math I am learning in this class could be beneficial to me.

1 2 3 4 5 6 7
not at all somewhat very true true true

18. I think this class is very enjoyable.

1 2 3 4 5 6 7
not at all somewhat very true true true

19. I think the math I am learning in this class is important.

1 2 3 4 5 6 7
not at all somewhat very true true true
20. I am capable of learning the math in this class.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all true</td>
<td>somewhat true</td>
<td>very true</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Interest/enjoyment: 1, 5, 8, 10, 13(R), 18
Value/Usefulness: 2, 7, 14, 17, 19
Pressure/tension: 3, 6, 9(R), 12*, 16
Perceived competence: 4, 11, 15, 20

*This question was dropped from scoring.
R = item was reversed scored.
Appendix E

Academic Self-Regulation Questionnaire
Please respond to how true each of these reasons is for you. There are two groups of items, and those in each group pertain to the sentence that begins that group. Please indicate how true each reason is for you using the following scale:

<table>
<thead>
<tr>
<th>Very true</th>
<th>Sort of true</th>
<th>Not very true</th>
<th>Not at all true</th>
</tr>
</thead>
</table>

A. Why do I work on my classwork?

1. So that the teacher won’t yell at me.
   
   Very true   Sort of true   Not very true   Not at all true

2. Because I want the teacher to think I’m a good student.
   
   Very true   Sort of true   Not very true   Not at all true

3. Because I want to learn new things.
   
   Very true   Sort of true   Not very true   Not at all true

4. Because I’ll be ashamed of myself if it didn’t get done.
   
   Very true   Sort of true   Not very true   Not at all true

5. Because it’s fun.
   
   Very true   Sort of true   Not very true   Not at all true

6. Because that’s the rule.
   
   Very true   Sort of true   Not very true   Not at all true

7. Because I enjoy doing my classwork.
   
   Very true   Sort of true   Not very true   Not at all true

8. Because it’s important to me to work on my classwork.
   
   Very true   Sort of true   Not very true   Not at all true
B. Why do I try to do well in school?

9. Because that's what I'm supposed to do.
   Very true    Sort of true    Not very true    Not at all true

10. So my teachers will think I'm a good student.
    Very true    Sort of true    Not very true    Not at all true

11. Because I enjoy doing my school work well.
    Very true    Sort of true    Not very true    Not at all true

12. Because I will get in trouble if I don't do well.
    Very true    Sort of true    Not very true    Not at all true

13. Because I'll feel really bad about myself if I don't do well.
    Very true    Sort of true    Not very true    Not at all true

14. Because it's important to me to try to do well in school.
    Very true    Sort of true    Not very true    Not at all true

15. Because I will feel really proud of myself if I do well.
    Very true    Sort of true    Not very true    Not at all true

16. Because I might get a reward if I do well.
    Very true    Sort of true    Not very true    Not at all true

External Regulation:  1, 6, 9, 12, 16*
Introjected Regulation:  2, 4, 10, 13, 15
Identified Regulation:  3, 8, 14
Intrinsic Motivation:  5, 7, 11

*This question was dropped from scoring.
Appendix F

IRB Approval from Mercer University
20-Jul-2011

Mr. Kenneth Whaley
Mercer University
TiT College of Education - Atlanta
3001 Mercer University Drive
Atlanta, GA 30341

RE: The Relationship between Teachers Autonomy Support and Students Intrinsic Motivation and Academic Achievement in Middle Grades Mathematics: A Self-Determination Theory Perspective (H1107159)

Dear Mr. Whaley,

Your application entitled: The Relationship between Teachers Autonomy Support and Students Intrinsic Motivation and Academic Achievement in Middle Grades Mathematics: A Self-Determination Theory Perspective (H1107159) was reviewed by this Institutional Review Board for Human Subjects Research in accordance with Federal Regulations 21 C.F.R. 56.117(a) and 45 C.F.R. 46.110(b) (for expedited review) and was approved under Category 7 per 63 FR 60364.

Your application was approved for one year of study on 20-Jul-2011. The protocol expires 20-Jul-2012. If the study continues beyond one year, it must be re-evaluated by the IRB Committee.

New Application

Please complete the survey for the IRB and the Office of Research Compliance. To access the survey, click on the following link:

http://www.mercerosp.com/Survey?pr=WEB277URk328S

It has been a pleasure to work with you and much success with your project!!!

If you need any further assistance, please feel free to contact our office.

Mercer University IRB & Office of Research Compliance
Phone (478) 301-4101
Fax (478) 301-2329
ORC_Mercer@Mercer.edu

Respectfully,

Ava Chambless-Richardson, M ED., CIP, CIM
Member
Institutional Review Board
Appendix G

Research Proposal Approval from School District
GLOBAL SCHOOL RESEARCH REQUEST FORM

<table>
<thead>
<tr>
<th>Name of School:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Researcher:</td>
<td>Kenneth Whaley</td>
</tr>
<tr>
<td>Position or Grade:</td>
<td></td>
</tr>
</tbody>
</table>

A. Research Project

a. Title: The Relationship between Teachers' Autonomy Support and Students' Intrinsic Motivation and Academic Achievement in Middle Grades Mathematics: A Self-Determination Theory Perspective

b. Statement of Problem and research question:

Problem: The purpose of this study is to apply self-determination theory to investigate the relationship between students' perceptions of teacher autonomy support and students' intrinsic motivation and academic achievement in middle school mathematics courses. Research Question: Is there a statistically significant relationship between students' perceptions of their teachers' autonomy support and the following variables: 1) students' intrinsic motivation in studying mathematics as measured by the levels of interest/enjoyment, perceived competence, reduced anxiety, and value/usefulness they experience; 2) students' autonomous self-regulation; 3) students' mathematical achievement; and 4) students' grade level.

c. Subjects or population for the study: Students at [Middle School]

d. Reason for doing this research:

X Graduate Study at Mercer University/College
X Publication/Presentation
X Other (please specify) Dissertation

Dates research will be conducted: August 2011 to May 2012

B. All research and researchers must a) Protect the rights and welfare of all human subjects, b) Inform students and/or parents that they have the right not to participate in the study, c) Adhere to board policies and applicable laws which govern the privacy and confidentiality of students records.

C. This request applies to research conducted within and by local school personnel. All other research requests must be submitted to the Research & Evaluation Office according to the Research Proposal Format.

D. Principals ONLY need to approve Local School Research Requests. The copy sent to the Research & Evaluation Office is for filing purposes only. No further approval is necessary.

E. After approval by the principal, please forward a copy of this completed form to:

Via US Mail: Executive Director
Research & Evaluation Office
Public Schools

Via Fax: [Fax Number]

Principal's Signature: 6-16-2011

Data of Approval
Appendix H

Parent or Guardian Informed Consent Form
The Relationship between Teachers' Autonomy Support and Students' Intrinsic Motivation and Academic Achievement in Middle Grades Mathematics: A Self-Determination Theory Perspective

Parent or Guardian
Informed Consent Form

Your child has been asked to participate in a research study entitled The Relationship between Teachers' Autonomy Support and Students' Intrinsic Motivation and Academic Achievement in Middle Grades Mathematics: A Self-Determination Theory Perspective. The study will be conducted by Kenneth Whaley, Kenneth Whaley@mcmercer.edu, and Dr. Carr, advisor, 678-547-6064, carr sb@mercer.edu. The results will be used to further my understanding of student motivation and achievement in mathematics. Your son's/daughter's participation is voluntary. A decision to participate in the research will not affect his/her relationship with Middle School, his/her relationship with other teachers, or his/her academic standing.

I. The purpose of my study is to explore:
The research study is designed to examine the relationship between teachers' motivating style and students' motivation and achievement in middle school mathematics. The data from this research will be used to identify instructional practices that help students so that they can be implemented in other environments. The data will also be used to help me complete my dissertation at Mercer University.

II. Procedures:
If you allow your child to participate in this study, your child will be asked to respond to a survey regarding mathematics instruction. The survey will take approximately 30 minutes to complete. Your child will be asked to assent to participate in this research. (Assent means that your child will be asked to voluntarily participate in this research.) Your child will tell the teacher they want to participate by answering yes or no after the teacher verbally reads to your child what the research is about and what he/she will be asked to do. Students will respond to a series of questionnaires that will be used to assess the relationship between teachers' motivating style and students' motivation and achievement in middle school mathematics. All students who are surveyed will remain anonymous.

Parent/guardians who allow student to participate must:
In order for your child to participate, please sign and return this form.

III. Potential benefits to students and/or society:
There are no intended benefits for the participant. Student responses in the questionnaires will help the researcher understand instructional strategies that are associated with increased student motivation and mathematical achievement.

IV. Potential Risks/Discomfort
There are no foreseeable risks associated with the study.

Mercer University IRB Approval Date 07/28/2011
Informed Consent 07/01/2012
V. Withdrawal of Participation
Your child's participation is voluntary. Your child will not be penalized or lose any benefits that he/she are otherwise entitled to if you decide that your child will not participate in this research project. If your child decides to participate in this project, he/she may discontinue participation at any time without penalty or loss of benefits.

VI. Payment for Participation
Students will not be paid for their participation. There is no financial obligation for participants.

VII. Confidentiality
Student names will not be used so that your child cannot be identified. If your child chooses to respond to the questionnaires, the responses will be coded with a randomly generated code rather than a name so there will be no way to identify the participant. No students will be identified in the final research paper nor will the location of the school. All gathered information will be stored by Dr. Carr at Mercer University. All of the data collected will be numerically coded to protect the identity of the participants. Your child's individual responses will not be shared with others. All data will be coded with random identification numbers. A number will identify the information that I collect from the questionnaires. The list connecting participant numbers and names will be kept in separate locked cabinets.

Questions about the Research
If you have any questions about the research, please contact Kenneth Whaley. Phone: ___________________________ Email: Kenneth_Whaley@mercer.edu If you have questions later, you may contact Dr. Sherri Carr, Mercer University, 678-547-6064, carr_sb@mercer.edu

You have been given the opportunity to ask questions and these have been answered to your satisfaction. If you do agree to allow your child to participate in this research, please complete the information below:

1. I, ___________________________, do want ___________________________ to participate in this research study.

   Participant's Name (Print)   Date

   Parent/Guardian's Name   Parent Guardian's Signature   Date

Please return to your child's current mathematics teacher as soon as possible.

In order to conduct this research, this project has been reviewed and approved by Mercer University's Institutional Review Board (IRB). If you believe there is any infringement upon your child's rights as a research subject, please contact the IRB Chair at (478) 301-4011. The IRBs are the governing bodies that are set in place to ensure responsible and safe conduct of research investigations.
Appendix I

Informed Assent for Children Age 12-14
Informed Assent for Children Age 12-14

The Relationship between Teachers' Autonomy Support and Students' Intrinsic Motivation and Academic Achievement in Middle Grades Mathematics: A Self-Determination Theory Perspective

Investigators at Mercer University are doing a research study where we are trying to further our understanding of student motivation and achievement in mathematics.

The purpose of this study is to examine the relationship between teachers' motivating style and students' motivation and achievement in middle school mathematics. The data from this research will be used to help identify instructional practices that help students so that they can be implemented in other environments.

The person in charge of this study is Kenneth Whaley. Kenneth Whaley is a teacher at Middle School. This study will take place at Middle School in the Public Schools System.

You will be asked to complete a survey about your math class if you choose to participate in this study. Your responses will remain anonymous. Your parents will not see your responses to the survey questions. We will save your survey responses in a locked cabinet to do our research. Your information will be kept private. Only the researcher will know your answers. The only people that will see your answers are the people working on the research project.

Your parent(s) have said that it is okay for you to be in this research study. You do not have to be in this study if you do not want. You can change your mind at anytime by telling your Mom, Dad, Teacher, or the person conducting this study.

____ Yes, I want to be in this study. ____ No, I do not want to be in this study.

Signature of Participant          Date

Signature of Person Obtaining Assent Date
Appendix J

Questionnaire Administration Prompt
The following prompt was read aloud to participants prior to administering the first questionnaire, the Learning Climate Questionnaire.

Hi. How is everyone doing today?

I would like to ask you to respond to a few questions that will help teachers serve students better. Your honest responses to these questions will help me understand your experiences in this math class.

Your responses will be confidential and will remain anonymous. What does confidential mean? What does anonymous mean? Only I will know your answers; no one else will see them. That is why your teacher has left the classroom, so please be honest.

Only think about your current math teacher when answering these questions. Do not consider any math teachers that you have had in previous school years; only think about your experiences in this class with Ms. name of teacher.

This is not a grade or a test. There are no right or wrong answers—just your honest opinion. This is a survey, so I just want to know your honest opinion.

If at any point you have any questions, please raise your hand. Please take as much time as you need, and read each question carefully.
REFERENCES


Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist, 44*(3), 159-175.


