Chapter V

DISCUSSION

According to Self-Determination Theory (SDT), students who enjoy learning are more likely to show interest, value the experience, make an effort toward achievement, and perform well. Students who don't enjoy learning are less likely to show interest, value the experience, make an effort toward achievement, and perform well (Miserandino, 1996; Deci, 1995; Vallerand et al., 1993).

Perceptions of self-determination and self-concept are student motivational resources that affect their performance. Teachers can play a role in helping students develop these motivational resources by providing autonomy-supportive classrooms, which support students' needs for self-determination and positive self-concept. Research guided by SDT (Deci & Ryan, 1985, 1991; Ryan, 1995) has had a concern with these issues.

The major purposes of the present study were as follows: 1) to develop a model of the effects of motivational resources (e.g., intrinsic motivation and math self-concept) on math performance, 2) to use data from the TIMSS-R study of math achievement to test major assumptions of SDT, 3) to examine whether math self-concept explains additional and significant variance in math performance, after we control for the effect of intrinsic motivation on math performance, and 4) to examine whether autonomy support in the classroom

predicts math performance both directly and indirectly through the mediator of math self-concept of students.

We have proposed a motivational model of math performance based on SDT (Deci & Ryan, 1985). In developing our model of motivation, we drew upon the theoretical perspectives of Deci and Ryan (1985), Fortier, Vallerand, and Guay (1995), and Vallerand (1997). In our model, we propose 1) that motivational resources (e.g., intrinsic motivation and external regulation) affect math performance; 2) that math self-concept affects math performance both directly and indirectly through the mediator of intrinsic motivation; and 3) that autonomy support significantly predicts math performance both directly and indirectly through the mediator of math self-concept.

In the present model, we also add teachers' autonomy support in the classroom as a predictor of math self-concept of students. This model extends previous work (especially Vallerand, 1997) by incorporating teacher practices (autonomy support in particular) and student math self-concept, and by evaluating the effects of these factors on the criterion variable of math performance.

Achievement as a Motivational Consequence

SDT proposed that self-determined, or autonomous motivation (intrinsic motivation and identified regulation) is related to positive academic and emotional outcomes, whereas non-self determined motivation is related to negative outcomes (Deci & Ryan, 1991).

The present results confirm that intrinsic motivation positively affects math performance, whereas external regulation negatively affects math performance. However, our essential finding was that a unique and substantial proportion of math achievement arises from math self-concept, consistent with the predictions of SDT. In other words, math self-concept explains additional and significant variance in math performance, even after we control for the effect of intrinsic motivation on math performance.

In the present study, we have found that math performance is determined by motivation, but even more by math self-concept. Both predictors, intrinsic motivation and math self-concept, accounted for unique variance in math performance, and the motivational model as a whole accounted for 22% of the variance. By itself, the variable of intrinsic motivation explained 2.25% of the variance in math performance (2.25% represents the square of the r = .15 correlation between intrinsic motivation and math performance). Adding the variable of math self-concept allowed us to explain an additional 19.75% of the variance in math performance.

In offering this conclusion (i.e., math performance is not only a motivation issue, but it is also a math self-concept issue), we recognize the possible importance of additional aspects of self-concept and also self-efficacy. Self-efficacy expectations (Bandura, 1997) and outcome expectations are known to affect student performance. Bandura and his colleagues (Bandura, Pastorelli, Barbaranelli, & Caprara, 1999) proposed that academic self-efficacy focuses on perceived ability to achieve academic outcomes, and consists of children's beliefs in their efficacy to master academic subjects; to manage learning activities; and to

achieve academic expectations. Perceived academic efficacy affects engagement in academic pursuits and social activities.

However, some researchers (Marsh & Yeung, 1997) have raised questions about the causal ordering of academic self-concept and academic achievement. For example, Byrne (1984) proposed that changes in academic self-concept lead to changes in subsequent academic achievement. Calsyn and Kenny (1997) contrasted the self-enhancement and skills development models of self-concept and achievement relation. The self-enhancement model proposed that academic self-concept affects academic achievement. In contrast, the skill-development model proposed that academic achievement affects academic self-concept. Calsyn and Kenny (1997) attempted to evaluate causal ordering by comparing the sizes of effects of prior achievement on subsequent self-concept to effects of prior self-concept on subsequent achievement.

Marsh (1990a) argued that this comparative approach is not appropriate because both paths are significant no matter which one is larger. Marsh (1993a) argued that the size and statistical significance of the path from prior academic self-concept to subsequent achievement is important because the issue of whether prior academic achievement affects subsequent academic self-concept is generally accepted. A compromise between the self-enhancement and the skill-development models is a “reciprocal effect” model in which prior academic self-concept affects subsequent academic achievement, and prior academic achievement affects subsequent academic self-concept (Marsh & Yeung, 1997).

Results of research investigating their issue are mixed. For example,

some researchers (Shavelson & Bolus, 1982) reported that prior academic self-concept significantly affected subsequent academic achievement in school subjects, but prior academic achievement had no effect on subsequent academic self-concept, supporting the self-enhancement model. However, Skaalvik and Hagvet (1990) found that prior academic achievement significantly affected subsequent academic self-concept, supporting the skill development model. Some researchers (Helmke & vanAken, 1995; Marsh, 1998; Marsh & Yeung, 1997) found that prior math self-concept significantly affected subsequent math achievement, and that prior math achievement significantly affected subsequent math self-concept, supporting a “reciprocal effects” model. Of course, it is also possible that math self-concept is influenced by a student’s ability, which affects math performance as well. In path analysis terms, that would mean that at least part of the correlation between math self-concept and math achievement is spurious.

Some researchers (Marsh, 1989; Hagvet, 1990; Wigfield, 1991) have offered a developmental perspective on the relation between academic self-concept and academic achievement. Marsh et al. (1998, 1990, 2003) proposed that children’s self-perceptions become more realistic with age, and that academic self-concept is more highly correlated with academic achievement. Past research has supported this proposal. For example, some researchers found that prior self-concept significantly affected subsequent achievement for the older cohort, but there was no significant effect of prior self-concept on subsequent achievement for the younger cohort. Pietsch’s (2003) findings supported the

theory that older children's math self-concept significantly affected their math performance.

SDT (Deci & Ryan, 1985) proposed that the needs for autonomy (deChrams, 1968; Deci, 1975), competence (Harter, 1978; White, 1963), and relatedness (Baumeister & Leary, 1996; Reis, 1994) are essential for achievement. Past research has supported this proposal.

Consistent with the predictions of SDT, teacher's support of autonomy in the classroom positively predicted math performance in the present study. However, the relative strength of the autonomy path to math performance was weak. It may be that the effects of autonomy support by teachers vary depending on the class climate.

Consistent with the predictions of SDT, math self-concept significantly predicted math performance. This suggests that math self-concept plays an important role in predicting significant math performance. In classrooms, students who have a low math self-concept are less likely to perform well.

Needs Affecting Motivation: A Self-Determination Perspective

Self-Determination Theory (SDT) proposes that the needs for autonomy (deCharms, 1968; Deci 1975), competence (Harter, 1978; White, 1963), and relatedness (Baumeister & Leary, 1995; Reis, 1994) affect motivation (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Ryan & Deci, 2000; Sheldon, Ryan, & Reis, 1996).

When some researchers (Deci & Ryan, 1985; Deci, Schwartz, Sheinman, & Ryan, 1981) distinguished between autonomy supportive versus controlling environments, they hypothesized that autonomy-supportive climates would enhance intrinsic motivation, and that controlling climates would undermine intrinsic motivation. Much of the research guided by SDT has supported this reasoning. For example, some researchers found that when teachers or parents supported autonomy, children showed intrinsic motivation (e.g., Deci & Ryan, 1985, 1987; Deci, Nezleck, & Sheinman, 1981; Deci, Schwartz, Sheinman, & Ryan, 1981; Flink, Boggiano, & Barrett, 1990; Pittman, Emery, & Boggiano, 1982; Pelletier & Vallerand, 1996; Ryan & Grolnick, 1986; Williams, Freedman, & Deci, 1998).

SDT (Deci & Ryan, 1985) argues that competence can enhance intrinsic motivation, but it will not do so, unless accompanied by autonomy. In other words, people must feel both autonomous and competent to be intrinsically motivated. SDT also argues that relatedness, defined as the need to feel related to significant others, can enhance intrinsic motivation. Past research has supported this reasoning. For example, Anderson and his colleagues (Anderson, Manoogian, & Reznick, 1976) found that when teachers were uncaring, students were less likely to show intrinsic motivation.

One unexpected finding in the present study was that math self-concept was found to influence intrinsic motivation negatively. This negative relationship was found both for the path coefficients and for the simple relationship between the two variables. It could be that students who have a high math self-concept are more likely to think that their present math courses are

boring, which leads to a low intrinsic motivation, as measured by the TIMSS questionnaire items (e.g., “Math is boring.”).

SDT argues that self-perceptions of autonomy and competence should interact to increase well-being (Deci & Ruan, 1985, 2000; Fisher, 1978; Ryan, 1982). Past research (Grolnick, Ryan, and Deci, 1991; Williams & Deci, 1996; Williams, Freedman, & Deci, 1998) showed that autonomously motivated people show greater competence, and that autonomous motivation and perceived competence both affect school performance.

Consistent with the predictions of SDT, math self-concept significantly affected math performance through the mediator of intrinsic motivation. This suggests that intrinsic motivation is a significant mediator of the math self-concept-performance relationship, although the negative sing of the indirect effect was unexpected.

Consistent with the predictions of SDT, in our “flat” SEM Models, with autonomy support treated as a level-1 variable, autonomy support significantly affected math performance both directly and indirectly through the mediator of math self-concept, and did so in a way that was above and beyond the effect that intrinsic motivation had on math performance.

We considered potential individual and class level variability among the variables included in the study by implementing the self-determination framework. The application of multilevel modeling techniques allowed the hierarchical examination of individual, group, and cross-level effects.

Our essential finding was that when autonomy support was appropriately treated as a level-2 variable, teachers’ autonomy support in the

classroom significantly affected math performance, consistent with the predictions of SDT, but it did not significantly affect math self-concept. We speculate that a teacher's support of autonomy in the classroom does not have a significant effect on perceived self competence (math self-concept) although it has a significant effect on student performance.

Several recent studies have reported findings from the TIMSS assessment, concerning the effects on achievement of important demographic variables, including gender and parent's education level. For example, Mullis et al. (2000) found that there was a significant gender difference in math self-concept internationally, but that gender was not related to math performance. Mullis et al. (2000) also found that there was a significant gender difference in attitudes towards mathematics internationally.

Mullis et al. (2000) also found that parents' education was positively related to students' math achievement. The pattern across countries was that eighth-grade students whose parents had more education were also those who had higher achievement in math. Consistent with past research, in the present study mother's education significantly affected math performance through the mediator of math self-concept, both in the flat SEM models and when autonomy support was approximately treated as a level-2 variable. One of the primary contribution of our study may be that a multilevel modeling analysis supported a model in which a teacher's support of autonomy in the classroom (a level-2 variable) positively affected the math achievement of students.

Limitations

Three aspects of the present research limit the generalizability of the findings. First, school contexts surely affect some of the relationship tested here. Deci and Ryan (1985, 1991) assumed that the degree to which the social context satisfies the need of autonomy, competence, and relatedness must affect motivation and behavioral consequences, irrespective of context, culture, and gender. Although we considered individual and class level variability among the variables included in the study in implementing the self-determination framework (Deci & Ryan, 1985), and tested gender effects in the present study, it would have been useful to test school effects and the interaction of school and gender.

Second, we relied on data from a self-report questionnaire to assess our important theoretical variables. Several researchers such as Vallerand (1997) have previously found that self-report measures predict students' performance. However, our reliance on a self-reported questionnaire may overestimate the reliabilities that we found among the constructs.

Third, the TIMSS data were collected using a cross-sectional design. Experiences affecting one's math self-concept and intrinsic motivation can occur over time. Therefore, a longitudinal research design might more effectively estimate causal effects in our model.

Conclusion

Our findings have practical implications. SDT argues that self-perceptions of autonomy and competence should interact to increase well-being (Deci & Ruan, 1985, 2000; Fisher, 1978; Ryan, 1982). Past research (Grolnick, Ryan, and Deci, 1991; Williams & Deci, 1996; Williams, Freedman, & Deci, 1998) showed that autonomously motivated people show greater competence, and that autonomous motivation and self-perceived competence both affect school performance. Consistent with the predictions of SDT, when teachers support autonomy of students in the classroom, they provide a classroom climate that fosters math achievement. As teachers try to support students' competencies, they are more likely to foster students' self-perceptions of competence, which, in turn, promotes math achievement.

SDT (Deci & Ryan, 1985) proposes that the needs for autonomy (deChams, 1968; Deci, 1975) and competence (Harter, 1978) are essential for achievement. In the study, we found that a teacher's support of autonomy significantly affected math achievement. The present findings supported a model of motivation by implementing the self-determination framework. The findings provide some insight into how educators may begin to increase the content-area interest of students. In particular, the present results suggest that teachers should seek to foster an autonomy-supportive climate, not only in the interests of fostering positive math self-concept, but also because autonomy support also

directly affected math achievement. We must recognize that autonomy-promoting activities (such as students working independently) may be useful educational activities that directly affect math achievement by increasing subject matter knowledge.

SDT proposes that self-determined, or autonomous motivation (intrinsic motivation and identified regulation) is related to positive academic and emotional outcomes, whereas non-self determined motivation is related to negative outcomes (Deci & Ryan, 1991). Consistent with the predictions of SDT, we found that intrinsically motivated students were more likely to perform well. As intrinsic motivation and math self-concept are enhanced, these motivational resources in turn foster math achievement. When we looked at the contribution of the two motivational resources (math self-concept and intrinsic motivation), we saw an interesting pattern concerning the size of their effects. When we looked at how motivational resources affected math performance, we found that the math self-concept effect (β=0.500) was bigger than the intrinsic motivation effect (β=0.136). Therefore, the present study suggests that both types of motivational resources significantly and uniquely affect achievement. It could be argued that achievement has deeper roots in math self-concept. However, the possibility of a reverse causal relationship between ability and math self-concept suggests that we be cautious in drawing such conclusions.

Duda and Hall (2000) argued that it is important for researchers to explore motivational models. Even though rural and socioeconomically challenged schools lack access to external resources, they can turn to effective motivation management as a way of promoting achievement. The present study

suggests a way to improve math performance in that we could highlight the effectiveness of this motivational intervention strategy, i.e. providing students with a learning climate that supports students' autonomy. Such autonomy-promoting changes could positively affect students' math self-concept, and directly benefit math performance.