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Empirical study

Does amotivation matter more than motivation in predicting mathematics learning gains? A longitudinal study of sixth-grade students in France

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ABSTRACT

This study examines the change trajectories of different types of motivation proposed by self-determination theory and their relationships with mathematics achievement during the first year of junior high school. Multilevel growth models were used to describe the trajectories of motivation regulation in 1082 students over the course of one year. On average, all types of motivation, whether self-determined or non-self-determined, declined throughout the school year. Conversely, the trajectory of amotivation increased continuously. The growth parameters of these trajectories extracted and utilized as covariates in explaining mathematics achievement at the end of the school year. The mean initial levels of motivation contributed to the explanation of the variance in mathematics performance, as did their rates of change during the school year. Second, amotivation was the only motivation type to be significantly associated with mathematics achievement over the school year. Theoretical and applied implications are discussed.

1. Introduction

Achievement in mathematics is a growing matter of interest. Mathematics competences appear to be crucial in many countries, where key skills include active citizenship, social inclusion, and employability in a society of knowledge (OJL 394, 30.12.2006). However, with a 16-point decline score from 2003 and a growing gap in mathematics performance between high and low achievers, France now ranks 25th in the PISA 2012 index. Moreover, for many years, French youth have shown a serious decline in their interest toward mathematics and sciences (Keskpaik & Salles, 2013; Merle, 2003). To improve France's competitiveness in mathematics in the world, strict measures must be encouraged at the national level. To be effective, these measures should be based on studies addressing factors that have been demonstrated to have an impact on performance or on students' career choice in mathematical and scientific domains (Lubinski & Benbow, 2006). One such factor, motivation, has proved to play a role in how students select mathematics-relevant fields of study and research careers (European Commission, 2004). Although motivation is considered as a crucial factor for academic achievement, there is little agreement regarding which type of motivation should be promoted (Taylor et al., 2014). One way to understand why some students experience difficulties in the mathematics domain is to address how the different types of motivation contribute to mathematics achievement over time.

1.1. Self-Determination Theory

Although prior mathematics achievement scores and grades are often considered as the most powerful predictors of subsequent mathematics achievement (e.g., Duncan et al., 2007; Hemmings, Grootenboer, & Kay, 2010; Reynolds & Walberg, 1992), motivation has been recognized for over three decades as a crucial factor in explaining school achievement. According to Self-Determination Theory (SDT; Deci & Ryan, 1985, 2002; Ryan & Deci, 2009), behaviors can be motivated either intrinsically or extrinsically, or they can be amotivated. Whereas intrinsic motivation refers to an engagement in a task for the pleasure inherent in it, extrinsic motivation refers to an engagement in a task to obtain a reward or avoid external pressure (Ryan & Deci, 2002). This definition, which contrasts two kinds of motivation, has been enriched by a multifaceted conceptualization of motivation. This conceptualization distinguishes four forms of extrinsic motivation that vary in degree of autonomy (Deci & Ryan, 1985). From the least to the most autonomous, these four forms are external, introjected, identified, and integrated regulation. External regulation refers to the behaviors adopted

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by an individual in order to obtain a consequence external to the task, such as being offered a reward. Introjected regulation refers to behaviors that are slightly more internalized by the individual since he or she is motivated by an internal pressure or coercion such as avoidance of shame or guilt. Identified regulation is a more autonomy driven form of extrinsic motivation. In this case, action is accepted as personally important. Finally, integrated regulation, which is considered as the most autonomous kind of extrinsic motivation, occurs when regulations are fully assimilated with the self. However, some debate and inconsistent results have called into question the empirical distinction between the identified and integrated regulation subscales (Lonsdale, Hodge, & Rose, 2008; Mouratidis, Lens, & Vansteenkiste, 2010) and Vallerand (1997) asserted that integrated regulation is a type of motivation that is not prevalent until adulthood.

SDT proposes the existence of amotivation, which means to be neither intrinsically nor extrinsically motivated. This state occurs when individuals lack the intention to act or when behaviors are executed without intention or unknown reason (Legault, Green-Demers, & Pelletier, 2006; Ryan & Deci, 2002). According to Cheon and Reeve (2015), "*with amotivation the students have no reason to act—not intrinsic motivation, identified regulation, external regulation or introjected regulation*" (p. 100). More generally, amotivation refers to a complete lack of volition with respect to a particular task or domain. In this case, individuals cannot see the motive behind their behaviors (Ryan & Deci, 2000).

This lack of perceived contingency implies a dereliction of intention to act (Legault et al., 2006) and results from different reasons (e.g., Cheon & Reeve, 2015; Green-Demers, Legault, Pelletier, & Pelletier, 2008; Legault et al., 2006). For example, individuals may think that whatever they do, they are unable to achieve desired outcomes either because they lack the desire to expend the energy necessary to enact the task (i.e., amotivation low-effort belief), because they believe they lack sufficient ability or competence to perform the task (i.e., amotivation low-ability beliefs), because they do not value the activity (i.e., amotivation low task value) or because the task is perceived as unappealing or unattractive (i.e., amotivation unappealing task).

In the classroom context, amotivated students lack confidence in controlling their learning process and tend to exhibit inappropriate behaviors (Yates, 2009). Amotivated students interpret failure as a sign of personal lack of ability and doubt they can do anything to overcome their difficulties (Montagne & Van Garderen, 2003). This loss of behavioral agency also renders the school environment particularly unpredictable and leads students to perceive any attempt to learn or improve as vain (Bandura, 1993; Pintrich, 2003; Weiner, 1984, 1985). They question the usefulness of engaging in the activity (e.g., "I can't see the use of doing school work in mathematics"). In turn, these pessimistic attitudes and negative reactions interfere with their ability to learn (Cheon & Reeve, 2015) and may lead students to quit the activity (Dweck, 1999).

1.2. Amotivation and the continuum of autonomy

Another characteristic of SDT is the simplex pattern of correlations among the motivational forms. According to Deci and Ryan (1985, 2002), individuals scoring higher on the subscales measuring autonomous forms of motivation (i.e., intrinsic, integrated and identified) are expected to score lower at controlled forms of motivation (i.e., introjected, external) and amotivation. Moreover, the correlations between regulations that are near each other on the continuum should be higher than the correlation between regulations that are far apart. For example, individuals' scores on the external regulation subscale are more highly related to their scores on the introjection subscale than on the intrinsic motivation subscale. This simplex pattern also implies that the more autonomous motivational regulations are, the more strongly they correlate with positive consequences. By contrast, the controlled forms of motivation and amotivation are highly associated with negative consequences (Deci & Ryan, 2002). On the basis of this simplex pattern, SDT posits that the different kinds of motivation fall along a relative autonomy continuum in which amotivation is contrasted with both autonomous motivation and controlled motivation (Ryan & Deci, 2000).

This idea of a motivational continuum has however recently been questioned by Chemolli and Gagné (2014) who stated that, "*the continuum argument has muddled the description of the different regulations, such that they are alternatively described as different in kind or as varying in terms of their level of self-determination*" (p. 576). In other words, they point out that the definition that Ryan and Connell (1989) gave to the simplex actually merged the concepts of kind and degree as being one and the same thing. Indeed, contrary to autonomous actions, which are initiated by a sense of choice and personal volition, or controlled actions, which are regulated by external or internal pressures (Taylor et al., 2014), amotivation refers to the absence of contingency between actions and outcomes. More specifically, when people are more or less autonomously motivated, they perceive why they do what they do, whereas in the case of amotivation, they cannot find the reasons for engaging in an activity. For example, Chemolli and Gagné (2014) pointed out that in SDT, only the different types of internalization (i.e., intrinsic, identified, introjected and external) differ in the degree to which they are autonomously regulated. This conceptual difference would imply that one cannot contrast amotivation to other forms of motivational regulation insofar as amotivation would be a qualitatively different construct from the other regulations. Other researchers using analytical methods to verify factorial structures, such as CFA, have not found a single dimension, but have rather showed that items from the amotivation subscale and items from the other subscales load on separate factors (Fernet, Senécal, Guay, Marsh, & Dowson, 2008; Gagné et al., 2013; Guay, Vallerand, & Blanchard, 2000; Millette & Gagné, 2008; Tremblay, Blanchard, Taylor, Pelletier, & Villeneuve, 2009; Vallerand & Bissonnette, 1992; Vallerand, Blais, Brière, & Pelletier, 1989; Vallerand et al., 1992, 1993). This was furthermore supported by Rasch analysis, which showed that evidence for the continuum is actually quite weak (Chemolli & Gagné, 2014). A final argument against the continuum is that the different regulations produce different affective, cognitive, and behavioral consequences (Koestner & Losier, 2002). These seemingly qualitatively different types of regulation led researchers to assert that the simplex pattern does not provide sufficient evidence for a continuum. Chemolli and Gagné (2014) advocate that the simplex pattern cannot be described using a continuum but rather using the concept of contiguum. In other words, as motivation types do not only vary in degree of autonomy but also in quality, they should not be described as falling along a continuum of autonomy but rather as a succession of adjacent constructs.

1.3. Motivation as a predictor of academic adjustment

The vast array of literature on what motivates students in the classroom has repeatedly demonstrated the benefits of self-determined regulations in the academic setting from childhood through adolescence (e.g., Broussard & Garrison, 2004; Elliot & Dweck, 2005; Gottfried, 1985, 1990; Harter & Connell, 1984; Henderlong & Lepper, 1997, April; Lloyd & Barenblatt, 1984). Autonomous types of motivation are associated with positive academic (Gottfried, Fleming, & Gottfried, 1994; Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007; Steinmayr & Spinath, 2009), behavioral, cognitive and emotional consequences (e.g., Vallerand, 1997). Students who show higher intrinsic motivation report more interest in school (Vallerand et al., 1989) and are less likely to drop