



Perceived autonomy support and autonomous motivation toward mathematics activities in educational and out-of-school contexts is related to mathematics homework behavior and attainment

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ABSTRACT

We adopted a trans-contextual model of motivation to examine the processes by which school students' perceived autonomy support (defined as students' perceptions that their teachers' support their autonomous or *self-determined* motivation) and autonomous forms of motivation (defined as motivation to act out of a sense of choice, ownership, and personal agency) toward mathematics activities in an educational context predict autonomous motivation and intentions toward mathematics homework, and actual mathematics homework behavior and attainment, as measured by homework grades, in an out-of-school context. A three-wave prospective study design was adopted. High-school students ($N = 216$) completed self-report measures of perceived autonomy support and autonomous forms of motivation toward mathematics activities in school in the first wave of data collection. One-week later, participants completed measures of autonomous forms of motivation, attitudes, subjective norms, perceived behavioral control, and intentions with respect to mathematics homework outside school. Students' self-reported homework behavior and homework grades from students' class teachers were collected 5-weeks later. A structural equation model supported model hypotheses. Perceived autonomy support and autonomous forms of motivation toward mathematics activities in school were related to autonomous forms of motivation toward mathematics homework outside of school. Autonomous forms of motivation toward mathematics homework predicted intentions to do mathematics homework mediated by attitudes, subjective norms and perceived behavioral control. Intentions predicted self-reported mathematics homework behavior and mathematics homework grades. Perceived autonomy support and autonomous forms of motivation toward mathematics in school had statistically significant indirect effects on mathematics homework intentions mediated by the motivational sequence of the model. Results provide preliminary support for the model and evidence that autonomous motivation toward mathematics activities in the classroom is linked with autonomous motivation, intention, behavior and actual attainment in mathematics homework outside of school.

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1. Introduction

1.1. Homework and educational outcomes

An important question for any school educator is whether his or her instruction will affect students outside the school environment. Setting homework is a key means by which educators can evaluate whether in-class learning is adopted and applied by students

beyond the classroom. Homework, therefore, is an important activity to promote further development of skills learned in school. Research has consistently demonstrated that school students who do homework have consistently higher academic attainment compared with those who do not (Cooper, Robinson, & Patall, 2006; Trautwein, 2007; Trautwein, Köller, Schmitz, & Baumert, 2002). Despite strong support for the relation between homework and academic attainment, there is evidence that students do not always complete their assignments or fail to invest sufficient effort in completing them. Research demonstrates that a substantial proportion of school students fail to adequately complete set homework, which could potentially limit learning and adversely affect long-term academic attainment (Markow, Kim, & Lieberman, 2007). There is also evidence that the degree of effort that students invest in completing their homework assignments is related to more effective learning

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and better grades (Trautwein, 2007; Trautwein, Ludtke, Kastens, & Koller, 2006). Educators and teachers are, therefore, interested in identifying the motivational factors associated with school students' completion of, and effort invested in, homework assignments. Of particular interest are the antecedents of *self-regulation* of homework behavior, such that students complete set homework independently with minimal external prompting or reinforcement.

A key factor related to the self-regulation of behavior in educational contexts is self-determined or *autonomous* motivation. Autonomous motivation reflects doing tasks and behaviors out of a sense of choice, ownership, and personal agency. Research has indicated that autonomously-motivated children acting in school contexts are more likely to pay attention and invest more effort in class and demonstrate adaptive educational outcomes such as better overall grades (Deci, Ryan, & Williams, 1996; Deci, Vallerand, Pelletier, & Ryan, 1991; Ntoumanis, 2005; Pintrich & Degroot, 1990; Wong, Wiest, & Cusick, 2002). The mechanism by which autonomous motivation leads to adaptive educational outcomes is through greater interest, effort and application toward instruction, and, particularly, greater involvement in self-directed study outside of the class (Reeve, 2002; Skinner & Belmont, 1993). Means to promote greater autonomous motivation has traditionally been through autonomy-supportive techniques and behaviors demonstrated by teachers in the classroom (Reeve, Bolt, & Cai, 1999; Reeve & Jang, 2006; Su & Reeve, 2011). Research has shown that teachers that provide choice, acknowledge conflicts, allow students to adopt an exploratory or questioning approach, provide encouragement and positive, task-related feedback, and avoid using controlling, didactic language foster greater autonomous motivation in their students compared with those who do not (Reeve et al., 1999; Reeve & Jang, 2006; Chatzisarantis, Hagger, & Smith, 2007). A mathematics teacher may, for example, structure his or her lessons accordingly to promote autonomy by providing a clear rationale for solving particular problems or equations (e.g., showing how they might apply to real-world contexts), allow students to investigate those applications in pairs or groups, providing hints, but not answers, as the students continue, and accompanying progress and success with positive feedback.

A key assumption of self-determination theory applied to educational contexts is that if teachers and instructors adopt autonomy-supportive techniques and behaviors in their lessons, students' will perceive their teachers to be supportive of their autonomy. Students who perceive their teachers to be autonomy-supportive are more likely to report autonomous motivation and adaptive educational outcomes (Jang, Kim, & Reeve, 2012). Although one of the assumed pathways by which the promotion of autonomous motivation in the classroom leads to distal adaptive educational outcomes (e.g., better grades) is through greater self-directed learning outside of the classroom (e.g., increased motivation toward, and effort invested in, completing homework assignments), there is relatively little research testing this pathway relative to research examining in-class autonomous motivation and participation in educational activities (Hagger & Chatzisarantis, 2012; Vallerand, 1991; Wang, 2012).

Recently, researchers have begun to examine the process by which autonomous motivation in the classroom leads to autonomous motivation toward educational activities outside of formal educational contexts. Adopting a trans-contextual model motivation, an integrated theoretical model adopting hypotheses from theories of autonomous motivation and social cognition, Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski (2005), Hagger, Chatzisarantis, Culverhouse, & Biddle (2003), and Hagger et al. (2009) demonstrated that autonomous motivation toward activities in an educational context was strongly associated with autonomous motivation toward related activities outside of the school context. Furthermore, students' perceptions that their teacher supported their autonomy were also associated with autonomous motivation in the

extra-mural context, mediated by autonomous motivation in the educational context. To date, research adopting the trans-contextual model has tested motivational transfer in physical education and leisure-time physical activity contexts (Hagger & Chatzisarantis, 2012). The model has not been applied to the promotion of self-directed learning activities in other academic subjects outside of school, such as doing mathematics homework, but has considerable potential to guide research on the transfer of motivation across classroom and out-of-school contexts.

The purpose of the current research was to adopt the trans-contextual model to examine the effects of school students' perceived autonomy support and autonomous motivation toward mathematics activities in the classroom on their autonomous motivation toward mathematics homework outside of school, a key self-directed learning activity. The research will make a unique contribution to understanding the extent to which motivation toward learning activities in educational contexts is related to motivation toward similar activities (e.g., homework) in an out-of-school context. It will also demonstrate how the motivational transfer across contexts is related to important education-related outcomes such as doing homework and actual homework attainment. We expect results to have important implications for educational practice by demonstrating how the fostering of autonomous motivation in class may affect students' behavior toward learning activities outside of school.

1.2. Why focus on mathematics?

Our focus on mathematics education is in response to governmental and economic organizations' call to address the mathematical skills 'gap' in the workforce and their advocacy of high-quality education in multiple science, technology, engineering, and mathematics (STEM) subjects as a driver of economic growth (Hanushek & Woessmann, 2007; House of Lords, 2012). STEM subjects have been recognized as those in which there is a significant shortfall in expertise and where there is a substantial need for a highly-educated workforce. Promoting better skills, learning, and attainment in mathematics is important given the prominent role of mathematics competency in STEM subjects (Wang, 2013). Given evidence that students with low mathematics attainment during the early secondary school years are less likely to move on to study and gain employment in STEM-related subjects and professions (Anlezark, Lim, Semo, & Nguyen, 2008; Boe, Henriksen, Lyons, & Schreiner, 2011; Krogh & Andersen, 2013), identifying the motivational factors related to adaptive outcomes in in-class and out-of-school learning activities in mathematics may help inform interventions to improve mathematics competency (Steinmayr, Dinger, & Spinath, 2012).

1.3. The trans-contextual model

The trans-contextual model is an integrated theoretical model that outlines the process by which students' perceptions of their teachers' support for autonomous motivation in educational contexts relates to autonomous motivation for learning activities in class (e.g., solving mathematics problems) and, importantly, autonomous motivation toward related learning activities in out-of-school contexts (e.g., doing homework). The model also provides an indication of the links between autonomous motivation and future participation in educational activities in out-of-school contexts (Hagger & Chatzisarantis, 2009; Hagger et al., 2003, 2005, 2009). Model hypotheses are based on three prominent theories that have been applied to understand intentional, motivated behavior in numerous contexts: self-determination theory (Deci & Ryan, 1985), Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation, and the theory of planned behavior (Ajzen, 1991).

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