



Antecedents and trajectories of achievement goals: A self-determination theory perspective

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Background. Research has shown that both achievement goal theory and self-determination theory (SDT) are quite useful in explaining student motivation and success in academic contexts. However, little is known about how the two theories relate to each other.

Aim. The current research used SDT as a framework to understand why students enter classes with particular achievement goal profiles, and also, how those profiles may change over time.

Sample. One hundred and eighty-four undergraduate preservice teachers in a required domain course agreed to participate in the study.

Method. Data were collected at three time points during the semester, and both path modelling and multi-level longitudinal modelling techniques were used.

Results. Path modelling techniques with 169 students, results indicated that students' autonomy and relatedness need satisfaction in life predict their initial self-determined class motivation, which in turn predicts initial mastery-approach and -avoidance goals. Multi-level longitudinal modelling with 108 students found that perceived teacher autonomy support buffered against the general decline in students' mastery-approach goals over the course of the semester.

Conclusions. Data provide a promising integration of SDT and achievement goal theory, posing a host of potentially fruitful future research questions regarding goal adoption and trajectories.

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Achievement goal theory provides a framework for understanding the conscious goals and intentions that guide student behaviour (Dweck & Elliott, 1983), and also the standards they use to evaluate their success (Pintrich, 2000a). Achievement goal theorists have proposed various conceptual distinctions such as ego versus task goals, performance versus learning goals, and performance versus mastery goals (Ames, 1992; Dweck & Leggett, 1988). These constructs are organized by the 2×2 achievement goal framework, in which students are said to adopt mastery-approach goals (i.e., wanting to develop competence and learn), mastery-avoidance goals (i.e., aim to avoid not mastering a task), performance-approach goals (i.e., showing others they are competent), or performance-avoidance goals (i.e., avoiding looking incompetent to others) when pursuing academic tasks (Elliot, 1999; Elliot & Church, 1997). Students can pursue more than one goal at a time, and thus varying goal profiles are possible.

Self-determination theory (SDT) is concerned with the perceived locus of causality (PLOC) of the motivation that people have when engaging in motivated behaviour (Deci & Ryan, 2000); do they feel themselves to be the source of the motivation (internal PLOC), or do they instead feel compelled against their will (external PLOC)? According to SDT, internal motivations tend to result when people have gotten their basic psychological needs met – that is, when they come into a context feeling autonomous, competent, and related in life. In this case, students have the inner resources needed to fully engage with the new context. Also, contexts which support autonomy and internal PLOC tend to promote greater engagement over time.

Research has shown that both achievement goal theory (Cury, Elliot, Da Fonseca, & Moller, 2006; Elliot & Church, 1997; Elliot & Harackiewicz, 1996; Elliot & McGregor, 2001; Pintrich, 2000a–c) and SDT (Grolnick & Ryan, 1987; Koestner, Ryan, Bernieri, & Holt, 1984; Reeve, Deci, & Ryan, 2004; Vallerand, Fortier, & Guay, 1997; Vansteenkiste, Simmons, Lens, Sheldon, & Deci, 2004) are quite useful in explaining student motivation and success in academic contexts. However, little is known about how the two theories relate to each other (Deci & Ryan, 2000; Urdan, 2000). In this research, we used SDT to ask: (a) why do people start out with certain types of goals in an educational setting?, and (b) what factors help students to maintain or move towards more adaptive goals, over time? Marrying the two theories could benefit achievement goal theorists by helping them to understand the dynamic precursors and later modifiers of achievement goals, and could help benefit self-determination theorists by giving them more insight into how broad precursor states (one's level of need satisfaction in life, at the time the course is started) give rise to broad motivational orientations (i.e., having an internal or an external PLOC for being in the class) which then instantiate themselves as more specific goals within a more particular life domain or context (Elliot & Church, 1997; Vallerand *et al.*, 1997). Additionally, we were interested in how features of the academic context (i.e., teacher autonomy support) may facilitate change in students' achievement goals over the course of a semester. Below, we discuss the existing literature on achievement goal precursors and trajectories, and then explain how SDT may be used to consolidate the existing findings.

Achievement goal theory

Achievement goal theory provides a framework to understand students' goals and motivation by highlighting various purposes or reasons (i.e., performance or mastery) and standards of evaluation (i.e., other-referential or self-referential) that a student might have for pursuing particular academic tasks (Pintrich, 2000a). In this area,

various learning-focused achievement goals have been proposed including learning, task, task-involved, and mastery goals. Also, various performance-focused goals have been proposed including performance, ego-involved, and normatively focused goals (Dweck & Leggett, 1988; Elliot & Church, 1997; Pintrich, 2000a). Initially, performance goals were found to predict generally negative classroom outcomes, and mastery goals were found to predict generally positive classroom outcomes.

More recently, researchers have proposed that learners' underlying approach and avoidance motives need to be considered in achievement goal theory (Elliot, 1999; Elliot & Church, 1997; Elliot & Harackiewicz, 1996), implying a four-fold achievement goal typology: performance approach, in which the student approaches success compared to others; performance avoidance, in which the student tries to avoid doing poorly compared to others; mastery approach, in which the student tries to increase his or her own skill level; and mastery avoidance, in which the student strives to avoid learning less than what is possible and/or an incomplete understanding of the course material. However, originally the mastery-avoidance construct was ignored, leading to a trichotomous achievement goal framework. Research utilizing this framework has found that not all performance goals are problematic: although performance-avoidance goals are associated with negative outcomes, performance-approach goals have been associated with both positive and negative outcomes for learners; thus on balance, it appears that performance-approach goals can be seen as at least somewhat adaptive in the educational context (Elliot & Church, 1997; Elliot & Harackiewicz, 1996; Pintrich, 2000a,b).

A current trend in the achievement goal theory literature has been to examine the initially ignored mastery-avoidance construct. Mastery-avoidance goals are seen as striving to avoid not mastering a task or striving to avoid not learning all there is to learn (Elliot & Murayama, 2008). This avoidance of incompetence is made in reference to the absolute performance on a task or in reference to individual past performances on a task (Elliot, 1999). According to Pintrich (2000b), mastery-avoidance goals can be hard to conceptualize. Examples such as a perfectionist not wanting to be wrong, a basketball player not wanting to miss a free throw, a person not wanting to leave a puzzle incomplete, and a student not wanting to learn something the wrong way have helped to explain ways in which mastery-avoidance goals may be different from mastery-approach or performance-approach goals (Elliot & McGregor, 2001; Pintrich, 2000b).

Research on mastery-avoidance goals has found a mixed positive and negative pattern of correlates, similar to the performance-approach construct. Mastery-avoidance predicts worse performance on multiple choice and essay exams (Hulleman, Trinastic, & Harackiewicz, 2006), and also more anxiety and worry (Elliot & McGregor, 2001). In other studies, mastery avoidance has also been positively related to a need for achievement and unrelated to exam performance (Elliot & Murayama, 2008), positively related to perceived competence, enjoyment, effort, and physical activity (Wang, Biddle, & Elliot, 2007), and perceptions of an enjoyable learning climate (Morris & Kavussanu, 2008). Thus, it appears that like performance-approach goals, mastery-avoidance goals have at least some adaptive characteristics.

Goal antecedents and trajectories

In the 2×2 goal framework, a goal can be defined as an 'aim that one is committed to that serves as a guide for future behavior' (Elliot & Murayama, 2008, p. 614). Much of the research in achievement goal theory has focused on the emotion and

achievement outcomes associated with students adopting certain achievement goals (Kaplan, Middleton, Urdan, & Midgley, 2002). Limited to date are studies that explain *why* students enter a class with a particular achievement goal, or goals. In one of the few such studies (Elliot, 1999), Elliot and colleagues have shown that the motive dispositions of fear of failure and need for achievement underlie avoidance and approach goal adoption, respectively (Elliot & Church, 1997). Dweck and colleagues (Chiu, Hong, & Dweck, 1997; Dweck, Chiu, & Hong, 1995) have examined lay theory predictors of achievement goal adoption, finding that those with entity theories of ability (ability is unchanging, so one must try to show one already has it) gravitate towards performance goals, and those with incremental theories (ability can be changed, so one must try to get more) gravitate towards mastery goals. Notably, both the Elliot and Dweck lines of research explain achievement goal adoption with conceptually similar antecedent constructs: fear of failure predicts avoidance, entity theory predicts performance. What other non-achievement-related personality states or characteristics might explain achievement goals?

Research examining trajectories of change in students' achievement goals is also somewhat scarce (see Fryer & Elliot, 2007). Most existing studies have targeted school transitions, peer relationships, classroom activities, concrete performance feedback, or concrete teacher practices in order to predict changes in goals (e.g., Anderman, 1999; Anderman & Anderman, 1999; Senko & Harackiewicz, 2005). Very few studies have focused on teacher's interpersonal demeanour and teacher's way of communicating with students, which are potentially important factors since they are likely to be under the control of the teacher. Does the teacher seem to respect the student's spontaneous learning impulses and general sense of self, or is the teacher controlling and dictatorial? The studies that do exist show students generally experience an array of positive outcomes when their teachers can create a supportive learning environments (Patrick, Turner, Meyer, & Midgley, 2003; Turner & Patrick, 2004). However, the relationship between supportive instructional patterns and students' achievement goals, and goal trajectories, has not been determined. Below, we highlight SDT as a possible framework to address this gap in the achievement goal literature, focusing on three aspects of SDT: basic need satisfaction, motivation within the context, and autonomy support by authorities within the context.

Self-determination theory

Again, SDT makes a distinction between internal and external PLOC for behaviour – does the behaviour seem to emanate from the self, or from non-internalized or self-alien factors? According to SDT, motivation can range from fully internal, to partially internalized, to partially external, to completely external (Ryan & Connell, 1989). Intrinsic motivation involves acting for the enjoyment of the activity, and the experience is the reward. Identified motivation involves seeing the importance in an activity, even when it may not be pleasurable. In contrast, introjected motivation is the drive to engage in behaviour in order to alleviate an unpleasant internal state such as guilt or anxiety; the person feels split, so that one part of the self has to compel the other part. External motivation is a controlled state in which one is acting because she or he is compelled to do so by an outside source. Having autonomous (internalized), as opposed to controlled (non-internalized), reasons for engaging in learning activities is associated with increased effort, persistence, achievement, and learning (Boiche, Sarrazin, Grouzet, Pelletier, & Chanal, 2008; Gottfried, 1990; Hardré & Reeve, 2003; Ryan & Connell,

1989; Vansteenkiste, Zhou, Lens, & Soenens, 2005). Identified, introjected, and external regulation are all extrinsic forms of motivation. However, these motives become more self-determined as they move from external to identified.

Psychological need satisfaction

What produces internal PLOC? SDT suggests that peoples' ability to internalize what they are doing is affected by the degree to which they experience satisfaction of their innate psychological needs of autonomy, competence, and relatedness (Deci & Ryan, 2000; Williams & Deci, 1996). The need for autonomy relates to a person wanting to feel control and ownership over their behaviours, the need for competence is related to feelings of effectance and efficacy, and the need for relatedness are associated with feelings of closeness and connectedness with others (Deci & Ryan, 1985, 1990). When people enter a new context with these needs met, they are more likely to fully engage with the challenges within that context, that is, to experience internal causation of their behaviour (Deci & Ryan, 2000; Ryan & Deci, 2000).

Teacher autonomy support

The above paragraph described the ideal precursor state when entering a new life context (i.e., any achievement situation): strong feelings of need satisfaction, which produce positive initial motivation. However, classes last weeks or months. What contextual factors can influence motivation after the class begins? According to SDT, teacher autonomy support is a crucial social-contextual variable for promoting quality student motivation (Deci & Ryan, 1987; Filak & Sheldon, 2003; Ryan & Grolnick, 1986). Autonomy-supportive teachers provide their students as much choice as possible within the situation. The goal is to help students connect their sense of self to the activity, so that they can do it with a sense of ownership and volition, rather than feeling controlled and coerced. When choice cannot be provided, autonomy-supportive teachers can take their students' perspective ('I know you may not be crazy about doing this') and also provide a meaningful rationale for the activity ('but here's why it is essential for your career goals'). As a result, students are helped (over time) to internalize it by identifying the activity with their sense of self, even if the activity is not enjoyable (Ciani, Summers, Easter, & Sheldon, 2008; Reeve, 2006; Ryan, Connell, & Grolnick, 1992; Stefanou, Perencevich, DiCintio, & Turner, 2004).

In sum, SDT may help to explain both the origins and the trajectories of achievement goals. What is already known about relations between SDT and achievement goal constructs? Urdan (2000) noted the theoretical similarities between intrinsic motivation (SDT) and mastery-approach goals (achievement goal theory), and between external motivation (SDT) and performance goals (achievement goal theory). Supporting this, Duda, Chi, Newton, Walling, and Catley (1995) found a positive relationship between mastery-approach goals and intrinsic motivation and Elliot and Church (1997) found a negative relationship between performance-avoidance and intrinsic motivation. Elliot and McGregor (2001) found that students' self-determined motivation was positively related to mastery-approach goals, and unrelated to performance-approach goals. Barkoukis, Ntoumanis, and Nikitaras (2007) found that mastery-approach goals were positively correlated with intrinsic and identified motivation and negatively correlated with external motivation.

Which causal order is preferable – SDT motivations predicting subsequent achievement goal adoption, or achievement goal adoption predicting subsequent SDT motivations? Although the ordering might go either way, depending on how and when constructs are measured, we suggest that students' general context motivation serves as a source for specific achievement goals (Carver & Scheier, 1981; Vallerand *et al.*, 1997). This hypothesis is based on numerous theoretical and empirical articles showing that broader motive dispositions are profitably conceptualized as antecedents of peoples' specific action objectives (Moller, Elliot, & Friedman, 2008; Sheldon & Elliot, 1998, 1999; Thrash & Elliot, 2001; Urdan, 2000; Urdan & Mestas, 2006); broader goals (such as 'I take this class because I think it is important for my career goals') provide the motivational energy underlying specific goals (such as 'my goal is to master this class material').

We tested three primary hypotheses: (1) general relatedness, competence, and autonomy need satisfaction in life would predict internalized course motivation. Those who experience quality relationships, feel successful, and feel themselves to be the origin of their behaviour in this current phase of their life should report internalized motivation for the class. (2a) Internalized course motivation would predict greater mastery-approach goals. Those who have internalized motivation to take the class should be interested in approaching greater skill in that class; this hypothesis devolves from the conceptual similarity between intrinsic motivation and mastery-approach goals (Urdan, 2000). In simple terms, both constructs involve approaching task mastery for its own sake, rather than for the sake or appeasing or pleasing an external entity or observer. In the current model, we propose that initial global motivation for taking the class affects the specific type of goals adopted for the class, in line with Vallerand's (1997) hierarchical model of motivation which outlines the top-down effects of global motivation upon more contextual motivation. (2b) Internalized class motivation would predict lesser performance-avoidance goal adoption, as has been found in some past research. Those who identify with and expect to enjoy the class should not be prematurely anxious about failing compared to others. Given the scarcity of previous research, no explicit hypotheses were made regarding the strength or direction of the effect of internalized motivation on mastery-avoidance or performance-approach goals, as these two goal types involve a mixture of one beneficial and one problematic foci, from the perspective of the two theories (Figure 1 consolidates Hypotheses 1 and 2 into a single path model). (3) The perceived autonomy supportiveness of the teacher during the class should predict positive changes in mastery-approach motivation over time. Those who feel that the teacher cares about their perspective and gives them choice should become more learning-focused over time. This hypothesis devolves from past SDT research showing that autonomy-support increases intrinsic motivation, and the conceptual overlap between intrinsic motivation and mastery-approach goals. However, we also examined whether teacher autonomy support predicts changes in the other three achievement goals.

Method

Participants and procedure

Data were collected from 184 undergraduate students at a large research university in the Midwest region of the USA. All students were teacher education majors and enrolled in a required educational psychology course. The course is taken mostly by sophomores in the second year of the teacher education programme. Students were surveyed at three

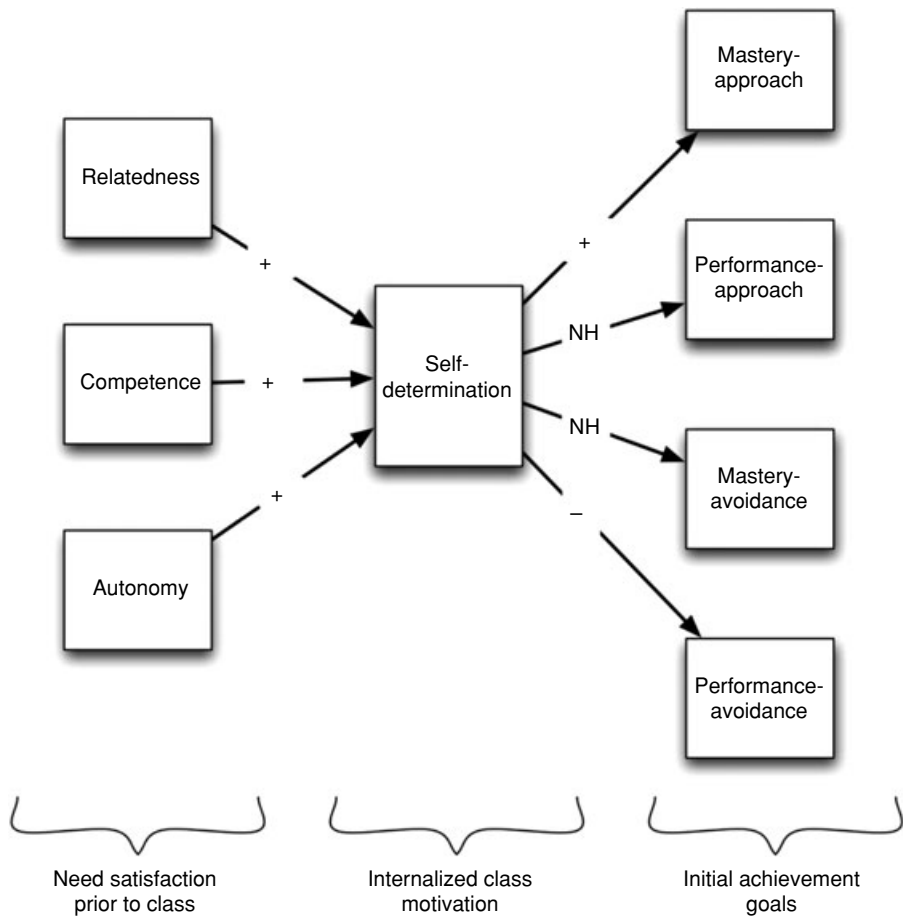


Figure 1. Hypothesized path model. Note. Plus sign indicated a hypothesized positive relationship. NH = no explicit hypothesis was made regarding the direction of the path. Hypothesized correlations among psychological needs and among achievement goal error terms are not central to our study, and are not displayed in this model.

time points during the semester: during the first week of class, at the mid-point of the semester, and the week before the final exam. Data were collected from the fall 2007 and spring 2008 sections of the class, and later aggregated. The two sections of the course were taught by the same instructor and followed an identical curriculum. Participating students were mostly White (92%), sophomore status (85%), woman (74%), and had an average age of 20 years. Participants received a \$5 gift card to the university bookstore after completing the survey at each time point (three gift cards), and were entered into a raffle for a \$100 gift card if they completed the survey at all three time points. Over 95% of students in the class participated in the study. The first research question required complete cases at Time 1, resulting in 169 cases. The second and third research questions required complete cases on the predictor variable at level 2 (i.e., autonomy support), resulting in 108 cases.

Measures

Students' achievement goals

The 12-item 2×2 achievement goal scale from Cury *et al.* (2006) was used to measure: (a) mastery approach (three items; e.g., My goal is to completely master the material presented in this class); (b) mastery avoidance (three items; e.g., My goal is to avoid learning less than I possibly could); (c) performance approach (three items; e.g., My goal is to perform better than the other students); and (d) e.g., performance avoidance (three items; e.g., It is important for me to avoid doing poorly compared to other students) at three time points during the semester. Students rated their goals on a seven-point Likert-type scale ranging from 1 *strongly disagree* to 7 *strongly agree* scale. In the first analysis with a sample size of 169, Cronbach's alphas were .84 for mastery approach, .68 for mastery avoidance, .79 for performance approach, and .80 for performance avoidance. In the second analysis with a sample size of 108, Cronbach's alphas were as follows by time point: mastery approach (Time 1: .87, Time 2: .86, Time 3: .90), mastery avoidance (Time 1: .60, Time 2: .77, Time 3: .77), performance approach (Time 1: .82, Time 2: .86, Time 3: .93), and performance avoidance (Time 1: .84, Time 2: .93, Time 3: .93).

The revised version of the Achievement Goal Questionnaire used in this study was selected over previous versions (e.g., Elliot & McGregor, 2001) that suffered from numerous limitations (see Elliot & Murayama, 2008, for a complete description). One notable modification to the revised scale is the removal of motive from the goal items (e.g., 'My fear of performing poorly in this class is often what motivates me' has been replaced with the revised item 'I am striving to avoid performing worse than others'). Elliot and colleagues have argued that achievement goals are separate from the reasons why they are pursued (Elliot & Murayama, 2008; Elliot & Thrash, 2001), and this particular revision is important to the current research as we strive to assess the reasons behind students' initial achievement goals and goal trajectories.

Students' psychological need satisfaction

Autonomy, competence, and relatedness were each measured with six items, with three negatively worded items that were reversed prior to analysis (Sheldon & Gunz, 2009). The 18-item need satisfaction scale was administered once during the first week of class, and instructed students to rate the items 'bearing in mind your feelings during the last three months or so'. Thus, the measure could be used to assess students general need satisfaction prior to beginning the course, as a precursor to early achievement goal adoption. Students rated the items on a seven-point Likert-type scale ranging from 1 *strongly disagree* to 7 *strongly agree* scale. Cronbach's alpha for the autonomy subscale (e.g., I was free to do things my own way) was .73, .65 for the competence subscale (e.g., I took on and mastered hard challenges), and .63 for relatedness (e.g., I felt appreciated by one or more important people).

Students self-determined motivation

Students' self-determined motivation was measured at a single time point during the first week of class. The Behavioural Regulation in Exercise Questionnaire (BREQ-2; Markland & Tobin, 2004) was used and modified to fit the education context. Students' intrinsic, identified, interjected, and external motivation was each measured to create a relative autonomy index (RAI). Instead of asking students 'why do you engage in exercise', the instructions were modified from 'why do you engage in exercise' to 'why do you try

to do well in this class'. Any mention of exercise in the items was removed, and one item for intrinsic motivation was changed from 'because I get pleasure and satisfaction' to 'because it's interesting'. Four items measured intrinsic motivation (e.g., because it's interesting; $\alpha = .88$ in first analysis, .90 in the second), three items measured identified motivation (e.g., because it's important to me; $\alpha = .66$ in the first analysis, .68 in the second), four items measured introjected motivation (e.g., because I will feel guilty if I don't; $\alpha = .81$ in the first analysis, .77 in the second), and four items measured external motivation (e.g., because others will not be pleased if I don't; $\alpha = .86$ in the first analysis, .86 in the second). For the purpose of the current study, we aggregated the four subscales to create a single indicator of students' self-determined motivation with the RAI equation. This method and equation is common in self-determination research (Levesque, Zuehlke, Stanek, & Ryan, 2004; Ommundsen & Kvalø, 2007), and was computed as intrinsic + identified – external – introjected.

Teacher autonomy support

Student perceptions of teacher autonomy support was assessed on two separate occasions, first at the mid-point of the semester with respect to the first half of the class (Time 2 data collection) and again at the end of the semester with respect to the second half of the class (Time 3 data collection). We computed a single aggregate rating of autonomy support that encompassed the whole period of the class. Teacher autonomy support was not assessed at the beginning of the class as students had not had adequate time to experience the instructor's practices. On each occasion, students were asked to rate the degree to which they felt their instructors engaged in autonomy-supportive behaviours. The six-item, short-form version of the Learning Climate Questionnaire was used (Black & Deci, 2000; Williams & Deci, 1996). Students rated the items (e.g., The teacher of this course conveys confidence in my ability to do well in class) on a seven-point Likert-type scale ranging from 1 *strongly disagree* to 7 *strongly agree* scale. Cronbach's alpha in the current study was .91 at Time 2, and .90 at Time 3.

Analyses and results

Path analysis

Descriptive statistics and correlations

Descriptive statistics for the 169 cases used in the path model were computed (see Table 1, for correlations, means, and standard deviations). Assumption checking revealed that one variable, mastery-approach goals, was negatively skewed ($M = 6.18$; skewness of -2.00). This was not surprising as the sample is comprised of teacher education majors in a required education course, and it is not out of the ordinary for students to have a learning goal in their desired field. Tabachnick and Fidell (2007a,b) suggest that analyses on moderately skewed data can be improved with log transformations, which can decrease the likelihood of spurious findings when data have been measured on an arbitrary scale where transformation does not hinder interpretation (i.e., Likert scales). Based on these authors' recommendations, mastery approach was transformed with a log transformation. A log transformation is a simple change that transforms a variable back to

Table 1. Correlations among variables used in the path model ($N = 169$)

	1	2	3	4	5	6	7	M	SD
1. Relatedness	1.00							5.38	0.88
2. Competence	.40**	1.00						4.93	0.90
3. Autonomy	.44**	.44**	1.00					4.90	1.01
4. Self-determination	.32**	.21**	.36**	1.00				2.29	2.81
5. Mastery approach	.43**	.18*	.24**	.47**	1.00			6.18	0.85
6. Performance approach	.11	.11	-.05	-.04	.23**	1.00		5.26	1.20
7. Mastery avoidance	.27**	.12	.23**	.28**	.40**	.05	1.00	5.08	1.25
8. Performance avoidance	.06	.06	-.03	-.07	.21**	.70**	.19*	5.18	1.30

Note. Self-determination = Intrinsic + Identified – Introjected – External; higher levels of self-determination indicate more autonomous motivation; * $p < .05$; ** $p < .01$.

normality so that test assumptions are less likely to be violated.¹ Subsequent correlations among our variables supported the hypothesized relationships presented in Figure 1. All three of the need satisfaction variables were significantly and positively correlated with self-determined motivation. Self-determination was significantly and positively correlated with students' initial mastery-approach and -avoidance goals. Self-determination was unrelated to students' initial performance-approach and -avoidance goals.

Model specification

Structural equation modelling software (Bentler, 1995) was used to examine the fit of our data to the hypothesized path model (see Figure 1). To assess the fit of the model, we used the chi-square test as well as the comparative fit index (CFI) and the root mean square error of approximation (RMSEA; Hu & Bentler, 1999). Data are presumed to be consistent with the model if the fit indices meet established cut-off criteria and if the chi-square test is non-significant. Byrne (2006), however, points out that the chi-square test can be overly sensitive. Evaluation of multiple global fit indices is often used as an effective alternative to the chi-square test (Bollen, 1989; Bollen & Long, 1993; Hu & Bentler, 1999). We followed Hu, Bentler, and Kano's (1992) recommendation of .90 for the CFI cut-off value and MacCallum, Browne, and Sugawara's (1996) recommendation of .10 for the RMSEA cut-off value to assess model fit. We also chose to examine other global fit indices to draw a reasonable conclusion about the plausibility of the model (Kline, 2005).

Model fit

A recursive path model was constructed to examine the multivariate relationship among the study variables (see Figure 1, for hypothesized model). For the characteristics of our sample, results indicated that the data provided an acceptable fit to the path model (Byrne, 2006): $\chi^2(12) = 27.55$, $p < .05$, CFI = .95, RMSEA = .08. Alternative global fit

¹Skew statistics approaching 2.0 or -2.0 are considered to be moderately skewed. Transformation of the data helped to decrease the likelihood of error. Results from both the path model and HLM analyses were slightly improved when using the transformed versus untransformed mastery-approach variable, yet both the untransformed and transformed analyses met conventional cut-off requirements in the path model and significance/results of the HLM analyses were nearly identical.

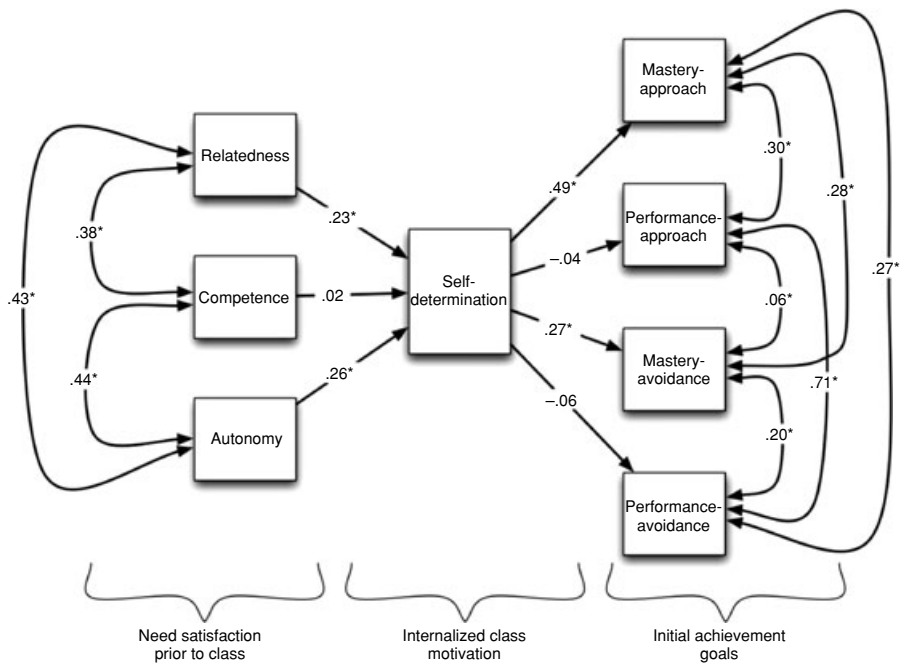


Figure 2. Path model results. Note. * $p < .01$.

indices also proved satisfactory (normed fit index = .92; non-normed fit index = .89; incremental fit index = .96; goodness-of-fit index = .96).

Parameters

In the model (see Figure 2), 17.8% of the variance in self-determination was accounted for by the combination of the psychological need satisfaction variables, and 23.9% of the variance in mastery approach and 7.5% of the variance in mastery avoidance was accounted for by self-determination. Results revealed that two of the three psychological needs were positive and significant predictors of students' self-determined motivation (autonomy, $\beta = 0.26$, $p < .01$; relatedness, $\beta = 0.23$, $p < .01$). Competence was unrelated to students' self-determined motivation. Self-determination was a positive and significant predictor of students' entering mastery-approach goals ($\beta = 0.49$, $p < .001$) and mastery-avoidance goals ($\beta = 0.27$, $p < .001$), while being unrelated to performance-approach and -avoidance goals.

As a whole, findings from the path model provide some support for the hypothesized model. Specifically, when the psychological needs of students (i.e., autonomy and relatedness) are met in the months leading up to the beginning of a course they are more likely to report self-determined reasons for trying to do well in that course, which leads to high reports of mastery goals.

Multi-level longitudinal modelling

Descriptive statistics and correlations

Descriptive statistics for the 108 cases used in the multi-level longitudinal models were computed and inspected for normality (see Table 2). Inspection of the means

Table 2. Descriptive statistics and correlations for multi-level longitudinal analysis (N = 108)

Achievement goal	Time	1	2	3	4	5	6	7	8	9	10	11	12	M	SD
1. Mastery approach	1	1.00												6.19	0.84
2. Mastery approach	2	.59**	1.00											5.93	0.92
3. Mastery approach	3	.57**	.66**	1.00										5.80	1.02
4. Performance approach	1	.17	.10	.01	1.00									5.19	1.25
5. Performance approach	2	.15	.18	.07	.68**	1.00								5.01	1.23
6. Performance approach	3	.21*	.16	.31**	.68**	.79**	1.00							4.98	1.41
7. Mastery avoidance	1	.27**	.18	.29**	.04	-.03	-.06	1.00						5.19	1.12
8. Mastery avoidance	2	.51**	.57**	.49**	.08	.13	.14	.42**	1.00					5.19	1.23
9. Mastery avoidance	3	.41**	.46**	.71**	.00	.02	.21*	.33**	.60**	1.00				5.22	1.26
10. Performance avoidance	1	.10	.05	.03	.75**	.59**	.59**	.03	.11	.06	1.00			5.12	1.38
11. Performance avoidance	2	.15	.25*	.14	.57**	.84**	.75**	-.09	.28**	.14	.53**	1.00		4.92	1.39
12. Performance avoidance	3	.15	.17	.27**	.59**	.73**	.88**	-.06	.21*	.25**	.61**	.70**	1.00	5.02	1.46
13. Autonomy-support	1	.38**	.37**	.33**	.11	.17	.16	.14	.27**	.20*	.08	.23*	.22*	4.95	1.07

Note. (Time 2 + Time 3)/2; means and standard deviations from untransformed variables; mastery-approach correlations conducted with transformed data; *p < .05; **p < .01.

indicated that mastery-approach and performance-approach goals declined, whereas mastery- and performance-avoidance goals remained stable. This linear trend was tested formally, below. Assumptions checking revealed that student responses to mastery approach at Time 1 was negatively skewed ($M = 6.19$; skewness of -2.39). In line with recommendations for multi-level longitudinal data, mastery approach at Times 2 and 3 were also transformed using a log transformation to allow for an accurate examination of change over time (Hox, 2002; Singer & Willett, 2003). Correlation coefficients for the multi-level longitudinal models are displayed in Table 2.

Unconditional growth models

Using hierarchical linear modelling (HLM) software (Raudenbush, Bryk, & Congdon, 2004), unconditional growth models were generated to estimate the per cent of total variation in achievement goals attributable to differences within participants. That is, this analysis provided information about how much variance there was in self-reported achievement goals over time that could be modelled with other predictor variables such as perceived teacher autonomy support. An unconditional growth model for each achievement goal was generated, and results indicated that 9% of the variance in mastery-approach goals ($p < .001$), and 1% of the variance in performance-approach goals ($p < .05$) was associated with linear time. None of the variance in mastery-avoidance or performance-avoidance goals was associated with linear time, indicating that these goals did not significantly change during the semester.

Multi-level longitudinal models

Based on the results of unconditional models, multi-level longitudinal models were constructed to examine the relationship between change in students' mastery-approach goals and their perceived teacher autonomy support, and change in students' performance-approach goals and their perceived teacher autonomy support (see Figure 3, for a visual depiction of the rate of change). Two separate analyses were conducted, one for each goal. Mastery-approach and performance-approach goals were entered at level 1, and perceived teacher autonomy support was entered at level 2 to predict change

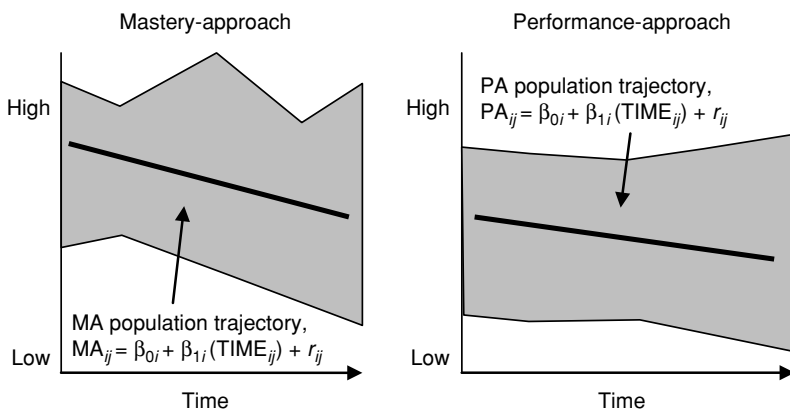


Figure 3. Change in mastery- and performance-approach goals over the semester.

in goals during the semester. The following equation was used for both multi-level longitudinal models.

Level 1 model:

$$\text{GOAL}_{ij} = \beta_{0i} + \beta_{1i}(\text{TIME}_{ij}) + r_{ij}$$

Level 2 model:

$$\begin{aligned}\beta_{0i} &= \gamma_{00} + u_{0i} \\ \beta_{1i} &= \gamma_{10} + \gamma_{11}(\text{AUTSUP}) + u_{1i}\end{aligned}$$

Results indicated that perceived teacher autonomy support was a significant and positive predictor of the change in mastery-approach goals ($p < .01$; see Table 3). The difference in the deviance statistics between the unconditional growth model (deviance = 803.09) and the multi-level longitudinal model with autonomy support as a predictor of change in mastery-approach goals (deviance = 794.97) indicated improved fit: $\Delta\text{deviance} = 8.12$ (1 *df*; $p < .01$). Perceived teacher autonomy support accounted for a 17.1% proportional reduction in within-person variance between the unconditional growth model and the multi-level longitudinal model. Perceived teacher autonomy support was not a significant predictor of the significant decline in performance-approach goals ($p > .05$).

Table 3. Multi-level longitudinal model predicting change in mastery-approach goals with autonomy support

Mastery-approach goals	Coeff	SE	t ratio	df	p
Intercept β_0					
Intercept γ_{00}	0.41	0.11	3.62	107	.001
Time slope β_1					
Intercept γ_{10}	-0.20	0.04	-4.75	321	.000
AutSup γ_{11}	0.12	0.03	3.53	321	.001
		SD	Variance	χ^2	p
Intercept u_0		0.70	0.49	501.64	.000
Level-1 r		0.63	0.39		

Note. Mastery-approach deviance = 794.97; AutSup = Autonomy support.

Results from the multi-level longitudinal modelling analyses indicated that students who perceived their teacher as controlling experienced a significant decrease in mastery-approach goals over the course of the semester (see Table 3), whereas those who perceived their teacher as autonomy-supportive were buffered against the sample-wide decline in mastery-approach motivation. Teacher autonomy support was unrelated to the decline in performance-approach goals, and mastery- and performance-avoidance goals did not change. It is important to note that the p value for the variance in rate of change for mastery-approach goals remained significant, indicating that there was still a significant amount of variance that could be explained by other variables.

Discussion

Results of the current study lend support for our suggestion that SDT constructs can help us to understand both initial achievement goal profiles and changing profiles of goals over time. Concerning initial profiles, students who felt more autonomy need satisfaction in the 3 months prior to a required class reported more self-determined reasons for taking that class. In addition, baseline relatedness need satisfaction also predicted self-determined class motivation. The need for competence did not have an effect on students' self-determined motivation. However, it should be noted that competence had a positive and significant bivariate correlation with self-determined class motivation. It was only when controlling for the other two psychological needs in the path model that the significance of the relationship between competence satisfaction and self-determined motivation dropped out. Further research will be required to determine if this is a stable pattern. However, one substantive interpretation of the finding is that the more 'human-centred' needs (autonomy and relatedness, involving quality personal and interpersonal experience) are more important for predicting motivational internalization, since the internalization (self-determination) measure is about the balance of internal and external motivation, not about expected competence.

The positive relationships between general autonomy and relatedness need satisfaction in the months prior to the class and initial self-determined motivation for the class highlights the psychological factors that affect the way different ways students orient to a new academic context, because baseline psychological need satisfaction in life predicted more self-determined reasons for engaging in the class. General psychological need satisfaction is beyond the control of the teacher, but nonetheless important to help researchers understand why students vary in their initial class motivation. We also found that more self-determined motives for the class predicted mastery-approach goals, as hypothesized. The path between self-determined motivation and mastery-approach goals was the strongest of any relationship in the path model. This finding is important for researchers interested in exploring and advancing the complementary nature of SDT and achievement goal theory in the educational domain. Understanding students' academic goals to learn and develop competence may be advanced by scrutinizing the reasons *why* they partake in the learning process.

Based on our results, students that understand the importance that a class may have on their future, or just the interest and fun involved in a particular class, may be more likely to adopt learning goals and less likely to be concerned about appearing competent or incompetent.

In the path model, self-determined motivation also predicted higher mastery-avoidance goals. Given the avoidance aspect of mastery-avoidance goals, this is somewhat puzzling. It appears that in case of this mixed-motive goal, the ostensibly negative feature of avoidance orientation was usurped by the ostensibly positive feature of mastery. It may be that the adaptive learning orientation of self-determined students expressed itself via the mastery part of the mixed mastery-avoidance measure, trumping the potential maladaptive avoidance aspect of the mastery-avoidance measure. Moreover, the characteristics of the class could have also lead self-determined students to be overly concerned with learning all that is possible in the course. Again, these students were mostly sophomores in the beginning of their teacher education programme, and the course may have seemed intimidating given their limited experience with the content. Yet another explanation is that students may have confused mastery-avoidance items with mastery-approach items. Recent research with athletes found that high Likert

scale ratings of mastery-avoidance items rarely matched the explanations students wrote concerning their high ratings; instead, participants often gave an incongruent response that seemed to translate mastery avoidance into mastery approach (Ciani & Sheldon, 2010). It is unknown if this phenomenon occurred in the current study, or whether self-determined motivation is a true antecedent of initial mastery-avoidance goal adoption. Notably, self-determined motivation was unrelated to students' initial performance goals, of both approach and avoidance varieties. Self-determined motivation is not about pleasing or appeasing others, providing a reasonable explanation for this null effect.

Buffering the decline in mastery-approach goals with autonomy support

In addition to examining students' psychological need satisfaction and self-determined motivation as antecedents to initial achievement goals in a class, the current research used multi-level longitudinal modelling to assess achievement goal trajectories over three time points in the semester. Results from four change models (one for each goal from the 2×2) revealed no significant change in mastery-avoidance or performance-avoidance goals; however, there was a significant decline in both mastery-approach and performance-approach goals significantly over the semester. Teacher autonomy support was modelled as a possible predictor of the change in both goals. Autonomy support did not influence the change in performance-approach goals, but did emerge as a significant and positive predictor of change in mastery approach. We hypothesized that autonomy support and mastery-approach goals would be significantly and positively related. Although this hypothesis was supported by our findings, the multi-level longitudinal analysis revealed the overall population trajectory for mastery-approach goals decreased over time, indicating that autonomy support served as a buffer to prevent the undermining of mastery-approach goals. Students who perceived their teachers as controlling were the ones whose mastery-approach goals were undermined. This corroborates past SDT work showing that intrinsic motivation can be undermined by controlling teachers (Grolnick & Ryan, 1987; Ryan & Grolnick, 1986).

Previous research has shown that mastery-approach goals tend to decline as students progress through their undergraduate programmes (Lieberman & Remedios, 2007; Remedios, Kiseleva, & Elliott, 2008). In these studies, samples of Russian and Scottish university students reported significantly less mastery-approach goals after their first year at the university. The researchers also found that both interest and enjoyment tended to decline along with the students' mastery-approach goals. The current study also shows a significant decline in mastery-approach goals over time among university students in the USA, but also provides some insight in how this decline can be buffered against with teacher autonomy support.

Unlike mastery-approach goals, teacher autonomy support did not affect the general decline in students' performance-approach goals. Indeed, SDT would not expect this, as performance goals tend to come with pressures and ego-involvements that should not necessarily be enhanced when a teacher is autonomy supportive. Finally, autonomy support was unrelated to change in either type of avoidance goals in the HLM analysis; feeling that the teacher encourages initiative did not cause either performance-avoidance or mastery-avoidance goals to decline. Thus, autonomy-support was related only to the type of achievement goal most similar to intrinsic motivation, which has received the majority of SDT research attention.

Limitations and future directions

A notable limitation to the current research is that only self-report measures were employed, which can increase the risk of method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). However, personal motivation is typically assessed by self-report. Another limitation is that we do not know the exact mechanisms underlying how perceived teacher autonomy-support affected change in mastery-approach goals. It may be that autonomy-supportive practices help to satisfy the classroom-specific needs of students, which in turn affect change in mastery-approach goals. More research is needed to test this assumption.

Additional, and related, limitations to the current research include the fit of the path model, the internal consistency of select measures, and the sample size. The path model provided acceptable fit based on criteria set forth by Hu *et al.* (1992) and MacCallum *et al.* (1996). However, more rigorous joint criteria (CFI > .96 and SRMR < .10 or RMSEA < .06 and SRMR < .10) required to retain a model have since been proposed by researchers (see Hu & Bentler, 1999). Less conservative criteria were selected in the current study given the following issues that can all affect model fit: (1) the novelty of the model being tested; (2) the modest sample size; and (3) the relatively low, but acceptable, internal consistency of some measures used in the path model. Though the fit of the model in the current study is useful for theory development, future research will be needed to replicate the model that we have proposed, with increased attention to measurement.

Another limitation, and thus an area for future research, is that we do not know the motivational profiles and career goals of the sample beyond this particular class. All students in the current study are teacher education majors in a required teacher preparation class. It would be interesting to know if the decrease in mastery-approach goals resulted in less favourable feelings about becoming a teacher. Relatedly, it is unclear if the changes in students' mastery-approach and performance-approach goals in this particular class would affect goal adoption in the next teacher preparation course. Would mastery and performance-approach goals return to the initial level within a new course, or would they stay at the depressed level found at the end of this course? Extrapolating from our results, we might expect that declines in approach motivation are associated with declines in general need satisfaction, which could predict further declines in mastery-approach motivation in the future; however, assessing students over two semesters would be necessary to address this question.

Another area for future research is to examine additional predictors of change in students' achievement goals. In the current study, a significant amount of variance in the rate of change for mastery-approach goals remained unexplained, even after accounting for autonomy support. Might this unexplained variance be accounted for by interpersonal experiences with other students in the class, or by graded performance during the class? Despite these limitations, still, we believe our data provide a promising initial integration of SDT and achievement goal theory, posing a host of potentially fruitful future research questions.

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