



## Motivation belief profiles in science: Links to classroom goal structures and achievement



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### ABSTRACT

Using a person-centered approach, this study examined science motivation belief (achievement goals and self-efficacy) profiles among middle school students ( $N = 1443$ ). Three profiles were identified across grades: *confidently mastery*, *high all*, and *low confidence/low mastery*. For grades 6 ( $n = 520$ ) and 7 ( $n = 307$ ), a fourth profile, *indifferent*, and for grade 8 ( $n = 613$ ), two new profiles, *low all* and *performance-driven*, were identified at the end of the school year. Results from latent transition analyses showed relatively stable profile membership; 42–89% of students remained in the same profile between time points. Classroom goal structures predicted profile membership and were aligned to students' personal goal endorsements. Evidence was also found for the association between profile and science achievement. *Confidently mastery* students demonstrated the highest science achievement, whereas performance was lower for all other profiles, with *low confidence/low mastery* students generally demonstrating the lowest science achievement.

### 1. Introduction

Students' motivation towards academic goals (i.e., achievement goals) and beliefs in their ability to successfully complete tasks in school (i.e., self-efficacy) are fundamental to their science achievement (Cerasoli, Nicklin, & Ford, 2014; Usher & Pajares, 2006; Valentine, Dubois, & Cooper, 2004). Increasingly, scholars are calling for a deeper examination of students' achievement goal orientation and self-efficacy in science classrooms, by exploring how these forms of motivation co-exist within individuals. Person-centered approaches are well-suited for this line of inquiry, as they allow for the identification of subgroups of individuals characterized by distinct configurations of motivation factors and self-efficacy beliefs (Marsh, Lüdtke, Trautwein, & Morin, 2009). Findings from existing person-centered studies indicate that students endorse distinct combinations of achievement goals (see Wormington & Linnenbrink-Garcia, 2017 for review), and few studies have examined related profiles of students' self-efficacy beliefs (e.g., Chen, 2012; Conley, 2012; Roeser, Strobel, & Quihuis, 2002). Different student profiles that reflect unique combinations of achievement goals and/or self-efficacy have direct implications for learning behaviors and academic outcomes (e.g., Chen, 2012; Conley, 2012; Lo, Chen, & Lin, 2017; Mar Ferradás, Freire, & Núñez, 2017; Schwinger & Wild, 2012). However, the small body of literature on motivation profiles in science, technology, engineering, and mathematics (STEM) fields among middle

school students are primarily focused on math (e.g., Lo et al., 2017; Luo, Paris, Hogan, & Luo, 2011; Schwinger & Wild, 2012). Exceptions include studies in middle school science (e.g., Chen, 2012; Chen & Usher, 2013; Roeser et al., 2002); however, these studies examined profiles in regards to implicit theories, epistemic beliefs, distress, and/or sources of self-efficacy. Thus, the present study adds to the existing body of literature by using latent profile analysis (LPA) to examine the co-occurrence of achievement goals and self-efficacy beliefs among diverse middle school students in science (referred hereafter as 'motivation belief' profiles).

Additionally, examining the longitudinal stability of motivation belief profiles is needed to inform efforts aimed to support persistence in STEM, particularly among students who traditionally opt out of advanced studies in these fields (Morgan, Farkas, Hillemeier, & Maczuga, 2016; Quinn & Cooc, 2015). Middle school is an important period to examine, as significant drops in students' science motivation, interest, and achievement have been documented during this time (Anderman, Maehr, & Midgley, 1999; Britner & Pajares, 2006; Shim, Ryan, & Anderson, 2008; Wang & Holcombe, 2010). Findings from recent studies examining the stability of students' motivation profiles are mixed (e.g., Gillet, Morin, & Reeve, 2017; Gonçalves, Niemivirta, & Lemos, 2017; Jansen In De Wal, Hornstra, Prins, Peetsma, & Van Der Veen, 2016; Lee, Wormington, Linnenbrink-Garcia, & Roseth, 2017; Lo et al., 2017; Shim & Finch, 2014) and no study to date has examined the

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stability of motivation belief profiles among middle school students in science. By applying latent transition analysis (LTA), we address this gap to provide a more detailed account of the potential shifts in students' profile membership over the school year.

Finally, no study to date has taken a person-centered approach to examine important context-related predictors of students' motivation profiles. However, scholars have increasingly noted the need to account for classroom goal structures in person-centered studies of student motivation (Lo et al., 2017; Schwinger, Steinmayr, & Spinath, 2016; Shim & Finch, 2014). This study addresses this call by examining science classroom goal structures (including students' perceptions of mastery, performance-approach, and performance-avoid oriented teaching practices), as well as grade-specific science achievement in relation to students' profiles. Taken together, this study aims to fill several gaps in the literature by examining a) science motivation belief profiles among a diverse sample of middle school students, b) patterns of stability and change in students' profile membership over the school year, and c) the relationships among students' motivation belief profiles, classroom goal structures, and science achievement.

### 1.1. Achievement goals and self-efficacy in middle school science

A large body of work points to achievement goals as one of the most influential motivation constructs related to a host of desired student outcomes (see Linnenbrink-Garcia et al., 2012; Midgley, Kaplan, & Middleton, 2001; Senko, Hulleman, & Harackiewicz, 2011 for reviews). The trichotomous achievement goal theory proposes that students hold three qualitatively distinct goals that drive their approach to learning: 1) *mastery* goals focused on developing competence, 2) *performance-approach* goals focused on demonstrating competence, and 3) *performance-avoidance* goals focused on avoiding failure or appearing incompetent (Ames, 1992; Dweck & Leggett, 1988; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Midgley et al., 2001; Pintrich, 2000; Weiner, 2000). Although we used the common trichotomous goal theory in this study, a  $2 \times 2$  achievement goal framework that differentiates mastery-approach from mastery-avoidance goals (goals focused on avoiding performing worse than one has done before) has also been proposed (DeShon & Gillespie, 2005; Elliot & McGregor, 2001; Madjar, Kaplan, & Weinstock, 2011; Van Yperen, Elliot, & Anseel, 2009). Finally, a construct central to science learning, self-efficacy (the beliefs students hold about their academic abilities) is also examined (Bandura, 2001, 2006). In science, self-efficacy has been linked to perseverance on challenging academic tasks, science achievement, and continuation in science-related majors and careers (Britner & Pajares, 2006; Chen & Usher, 2013; Gwilliam & Betz, 2001; Lau & Roeser, 2010; Lee, Hayes, Seitz, DiStefano, & O'Connor, 2016). As discussed next, there is strong evidence to show that achievement goals and self-efficacy are closely related constructs highly predictive of students' propensity to learn and achieve in science.

### 1.2. Achievement goal and self-efficacy profiles: A person-centered approach

#### 1.2.1. A person-centered approach

A person-centered approach focuses on identifying naturally occurring combinations of variables at the individual level (Bergman & Trost, 2006; Pastor, Barron, Miller, & Davis, 2007). Latent profile analysis is an analytic method used to identify different profiles of individuals with similar indicator variable responses (Masyn, 2013; Nylund, Asparouhov, & Muthén, 2007; Pastor et al., 2007; Wingate & Tomes, 2017). Advantages of person-centered approaches include the ability to statistically estimate a model for group membership and fit, allowing for the examination of complex interactions and dynamics among motivation and belief variables (Hagenaars & McCutcheon, 2002; Nylund et al., 2007). Person-centered analytic techniques also allow researchers to examine the relationships of student profiles to key

predictors and academic outcomes. Further, latent transition analysis (LTA) provides the added benefit of modeling change in individual's profile configurations over time (Collins & Lanza, 2013).

A large number of studies related to achievement goal profiles have emerged in recent years. A meta-analytic review of these studies showed that profiles characterized by high mastery goals, as well as high approach goals, are linked to positive outcomes such as adaptive learning processes (e.g., self-regulation strategies, engaging in school tasks) and outcomes (e.g., grades), whereas the reverse is true for profiles characterized by average to low goal endorsement (Wormington & Linnenbrink-Garcia, 2017). Another notable finding was that the relationship between profiles and outcomes vary as a function of school level and the number of achievement goals assessed (trichotomous vs.  $2 \times 2$  goal theory). Thus, to inform the present work, studies using the same trichotomous achievement goal model and/or self-efficacy, as well as similar school level population (middle school or secondary students) are reviewed in more detail next.

#### 1.2.2. Achievement goal profiles

Previous studies of achievement goal profiles in middle school have identified between three to seven profiles, and consistently find that high endorsement of mastery and/or performance-approach goals are associated with positive academic outcomes (Conley, 2012; Lo et al., 2017; Luo, Paris, et al., 2011; Shim & Finch, 2014). For example, Shim and Finch (2014) conducted a study of academic achievement goals (also including social achievement goals) among middle school students in the United States, and identified six profiles that ranged from high, moderate, and low endorsements of academic and social goals. Mastery-oriented academic and social profiles were linked with higher levels of positive learning behaviors. Studies of achievement goal profiles among middle school students in other countries also identified profiles characterized by high mastery and/or performance-approach (and low performance-avoid) goals and moderate endorsement of all goals. For example, Luo, Paris, et al. (2011) examined achievement goal profiles in math among secondary students in Singapore using cluster analysis, and more recently, Lo et al. (2017) examined the stability of achievement goal profiles in math, among Taiwanese students in grades 7 and 8. In both of these studies, the profile characterized by high mastery and performance-approach goals were linked to positive academic outcomes (e.g., self-efficacy, self-concept, engagement, time management, self-regulation), whereas moderate endorsement of achievement goals (e.g., diffuse, indifferent) and high endorsement of avoidance goals were found to be maladaptive (Lo et al., 2017; Luo, Paris, et al., 2011).

Conley (2012) examined patterns of motivation profiles among 7th grade students in mathematics, that included achievement goals as well as expectancy-value perspectives and self-efficacy beliefs. A seven-profile solution was identified, including a low profile (low on all motivational indices), three average clusters (average ratings with an emphasis on mastery, cost, or across motivational indices), and 3 high clusters (high ratings on competence beliefs, cost, or high across motivational indices) (Conley, 2012). The profiles characterized by average endorsement on the achievement goal, task value, and self-efficacy belief factors were associated with higher academic achievement and positive affect (Conley, 2012). Of note, a high mastery oriented profile commonly found in other person-centered studies was not identified (e.g., Jang & Liu, 2012; Tuominen-Soini, Salmela-Aro, & Niemivirta, 2011). Possible explanations for this discrepancy include the domain of study (mathematics) and developmental stage of participants (middle school) that together is associated with lower levels of mastery goals (Conley, 2012). Therefore, when making comparisons across motivation profile studies, in addition to the achievement goal model and grade level, the role of content domain may also be an important feature to consider. In fact, several scholars have argued that attention to subject area in person-centered studies is particularly relevant during the secondary years when subjects become more

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