PROFILES OF MINDSET-BASED MEANING SYSTEMS

Same mindset, different goals and motivational frameworks:

Profiles of mindset-based meaning systems

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Acknowledgements: This work was supported by funding from the Cambridge Commonwealth, European and International Trust and the China Scholarship Council awarded to the first author. We are grateful to the students, teachers, and schools involved in the study and to Pia Kreijkes, Dave Putwain, Michelle Ellefson, and anonymous reviewers for helpful comments on earlier versions of this article.

Declarations of interest: none.

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Highlights

Profile analyses of mindset-related constructs yielded a four-profile solution.

Growth mindset was accompanied by either high mastery goals or high multiple goals.

Fixed mindset was accompanied by either high performance goals or low all goals.

Profiles with a growth mindset performed better on high-stakes exams.

Boys were more commonly found in profiles underpinned by a fixed mindset.

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Abstract

Growth and fixed mindsets have been linked to distinct effort beliefs, goals, and behaviours, creating a seemingly dichotomous pattern of motivation. Yet, students holding the same mindset are unlikely a homogenous group and may further differ in their motivational patterns. The current study employed a person-centred approach to investigate how mindsets and associated constructs naturally cohered and functioned together to influence student achievement. Data were collected from 535 English students (aged 14-16 years) on mindsets, effort beliefs, achievement goals, perseverance, and self-handicapping, along with their English and maths performance at the end of secondary school. Latent profile analyses revealed four distinct profiles. Across the profiles, students' mindset co-varied with effort beliefs, mastery goals, perseverance, and self-handicapping, but the relationship between mindsets and performance goals was less straightforward. Two profiles supported the classic growth mindset–mastery goal (*Growth-Focused*) and fixed mindset–performance goal pairings (*Ability-Focused*). The other two profiles, however, displayed alternative combinations of mindsets and goals that had not been acknowledged in the past. Specifically, some growth mindset students embraced performance goals alongside mastery goals (*Growth-Competitive*), and some fixed mindset students did not endorse performance goals (*Disengaged*). The two growth-oriented profiles consistently performed well, and *Growth-Competitive* students even outperformed *Growth-Focused* students in maths. Compared to girls, boys were more often found in *Ability-Focused* and *Disengaged* profiles. Overall, the results indicate a nuanced set of relations between mindsets and achievement goals, highlighting the dynamic integration of motivational beliefs and goals within individuals.

Keywords: implicit theories of intelligence; mindset; achievement goals; latent profile analysis; person-oriented approach; academic achievement; gender differences

Same mindset, different goals and motivational frameworks:

Profiles of mindset-based meaning systems

Students can think about the nature of their ability in two ways (Dweck & Leggett, 1988; Nicholls, 1984). Some have a fixed mindset or an entity theory—they view ability as a fixed trait, while others have a growth mindset or an incremental theory—they view ability as a malleable quality that can be developed (Dweck et al., 1995). Fixed and growth mindsets are systematically linked to students' beliefs about effort, achievement goals, and behaviours (Blackwell et al., 2007). As a result, mindsets can organise associated constructs into a coherent motivational framework or 'meaning system' (Molden & Dweck, 2000, 2006). Growth mindset students, on average, tend to view effort positively, pursue mastery goals to develop their competence, persist through challenges, and have better academic performance. In contrast, fixed mindset students tend to view effort negatively, pursue performance goals to demonstrate their competence, engage in self-defensive behaviours, and show worse performance over time (Dweck & Molden, 2017).

Despite these well-documented differences between growth and fixed mindset students (*between-mindset differences*), few studies have examined variations in motivation and achievement among students holding the same mindset (*within-mindset differences*). Yet, we argue that those with the same mindset are unlikely a homogenous group and may further differ in their goals, behaviour, and achievement. For example, since school environment becomes increasingly performance-focused when students progress through education (Eccles & Roeser, 2011), might some growth mindset students seek performance goals alongside mastery goals? If so, how does their academic performance compare to growth mindset students who endorse only mastery goals? Dweck and Leggett (1988) suggested that although growth mindset students tend to adopt mastery goals, some of them might be able to coordinate both mastery and performance goals (see also Molden & Dweck, 2000). Indeed,

research on achievement goal profiles often highlights a group of students who pursue mastery and performance goals simultaneously (Niemi-virta et al., 2019; Wormington & Linnenbrink-Garcia, 2017), but studies examining patterns of achievement goals alone have not yet considered these students' underlying mindset. The current study thus adopts a person-centred approach to examine how mindsets and associated motivational constructs naturally cohere and function together to influence student achievement. By profiling students based on a broader set of variables constituting the mindset-based meaning system (i.e., effort beliefs, achievement goals, perseverance, and self-handicapping; discussed further below), the current study may unveil more nuanced relationships between mindsets and other motivational constructs. In addition, given that motivation is domain-specific (Guay & Bureau, 2018) and that girls tend to display more adaptive patterns of school motivation (Butler & Hasenfratz, 2017), we aim to compare students' mindset-related profiles in English and maths and examine the gender compositions of these profiles.

In the following sections, we first summarise key findings from research examining between-mindset differences, before synthesising evidence for the possible within-mindset differences in motivational frameworks. Next, we review gender differences in mindset-related constructs before outlining the current study.

Different mindsets, different motivational frameworks

According to Dweck and colleagues (Dweck, 2002; Molden & Dweck, 2000), children's mindsets become increasingly linked to their beliefs about effort, achievement goals, and behavioural tendencies, forming a holistic meaning system that influences student achievement. Notably, experimental and longitudinal studies show that mindsets are causal antecedents of other components in the meaning system. First, mindsets can transform the meaning of effort. Students primed with a fixed mindset tend to view hard work as a sign of low ability, whereas those primed with a growth mindset tend to view effort as a tool to

increase ability (Hong et al., 1999). Second, mindsets can shape students' achievement goals or reasons for engaging in academic tasks. In a study of fifth and sixth graders, children were given some unsolvable puzzles before having a choice to work on other problems (Bempechat et al., 1991). After the initial failure, children primed with a fixed mindset preferred easier problems that would validate their ability (i.e., a performance goal), whereas children primed with a growth mindset preferred more challenging problems that would develop their ability (i.e., a mastery goal)¹. Third, mindsets can lead to different patterns of behaviour in achievement settings. Students with a growth mindset are more likely to persevere and try harder when encountering obstacles (Robins & Pals, 2002). In contrast, after receiving negative feedback, students primed with a fixed mindset tend to forgo the opportunity to improve the skills needed for success (Hong et al., 1999; Nussbaum & Dweck, 2008). This kind of behaviour is termed self-handicapping, which involves deliberately creating barriers to success so that potential failure is less indicative of one's ability (Török et al., 2018).

In early adolescence, mindsets, effort beliefs, goals, and behaviours begin to gain coherence and influence student achievement collectively (Molden & Dweck, 2006). In a longitudinal study following students from seventh to ninth grade, students holding a stronger growth mindset showed greater gains in maths achievement, and the relationship between mindsets and achievement was mediated by students' effort beliefs, achievement goals, and behavioural responses to setbacks (Blackwell et al., 2007). In light of the systematic associations between mindsets (growth versus fixed), beliefs about effort (useful versus futile in increasing ability), achievement goals (mastery versus performance), and behavioural

¹ Although subsequent research has introduced the approach-avoidance distinction to mastery and performance goals, a growth mindset is associated positively with mastery goals and negatively with performance goals, regardless of an approach or avoidance orientation (Burnette et al., 2013). Therefore, we focused on the primary mastery-performance distinction in our review of the literature.

tendencies (perseverance versus self-handicapping), the present study focused on these constructs as core components of the mindset-based meaning system.

Although path analysis has demonstrated that mindsets form a network with other beliefs, goals, and behaviours, a person-centred approach may be more appropriate for testing the meaning system hypothesis directly. A person-centred approach identifies groups of individuals who are similar to each other on a set of variables (Collins & Lanza, 2010). In the current study, a focus on the patterns of variables will enable us to understand how mindsets, effort beliefs, goals, and behaviours naturally cohere into a larger motivational framework. In fact, a recent study has applied a person-centred perspective to study some key elements of the mindset-based meaning system. Chen and Tutwiler (2017) classified sixth and tenth graders into distinct subgroups based on their mindsets and achievement goals. Consistent with the meaning system hypothesis, they found a growth-oriented profile where students reported a growth mindset alongside dominant mastery goals. However, they did not find a profile combining a fixed mindset with dominant performance goals. This discrepant finding suggests that additional person-centred research is needed to understand the natural combinations of mindsets and achievement goals within individuals.

Same mindset, different motivational frameworks

Research reviewed thus far focuses on between-mindset differences and implies a dichotomous pattern of motivation stemming from two opposing mindsets. Nevertheless, we argue that the relationships between mindsets and associated constructs may be more complex than assumed. While people holding distinct mindsets show a preference for either mastery or performance goals when the two goals are pitted against each other, growth mindset is only weakly correlated with mastery and performance goals ($r_s = .19$ and $-.15$; for a meta-analysis, see Burnette et al., 2013). This suggests that the straightforward relation between mindsets and achievement goals may not hold for a subset of the population, and

that people may combine their mindsets and goals in a more nuanced manner than what might be expected from current theorising. Additionally, studies have identified several common patterns of achievement goals, including (1) dominant mastery goals, (2) dominant performance goals, (3) high mastery/high performance goals, and (4) moderate-low mastery/moderate-low performance goals (for reviews, see Niemivirta et al., 2019; Wormington & Linnenbrink-Garcia, 2017). Although the first two profiles correspond well to students with a growth or fixed mindset, it is unclear what type of mindset might underlie the latter two patterns of goal endorsement.

Might the high-mastery/high-performance goal profile represent a group of growth mindset students who embrace performance goals? Or are they fixed mindset students who endorse mastery goals? Empirical studies investigating these possibilities found mixed evidence. For example, Stone (1999; also described in Dweck, 1999) assessed fifth graders' mindsets before giving them tasks that were framed as either performance- or mastery-oriented. On the performance task, growth mindset students showed no reluctance to adopt a performance goal: they were as likely as the fixed mindset students to express a desire to outperform others, and were even more likely to agree that the task would reveal their current ability. Students with a fixed mindset, however, agreed more strongly that the performance task was also a measure of their permanent and global ability. When directed towards the mastery task, fixed mindset students initially valued gains in learning as much as growth mindset students. However, fixed mindset students were soon overwhelmed by their own performance concerns even in a mastery context. These findings suggest that fixed mindset students may have difficulty in sustaining a mastery goal, but growth mindset students can coordinate mastery and performance goals simultaneously. In contrast, Schwinger et al. (2016) found the opposite pattern in a longitudinal study of primary school children in Germany. They showed that fixed mindset children had a greater likelihood of being in the

high-mastery/high-performance goal profile relative to the mastery goal profile, but this result was observed in only one out of five time points. Given the conflicting findings in past studies, additional research is needed to clarify the type of mindset underlying the high-mastery/high-performance goal profile.

In addition, what type of mindset might underlie the moderate-low mastery/moderate-low performance goal profile? It is worth noting that students with low to moderate levels of mastery and performance goals tend to show the lowest levels of academic engagement and achievement (Niemivirta et al., 2019). Consequently, researchers have called for more studies to understand these disengaged students (Wormington & Linnenbrink-Garcia, 2017). Based on previous studies, it is plausible that a fixed mindset might underlie the moderate-low mastery/moderate-low performance goal profile and partially account for its maladaptive consequences. Schwinger et al. (2016) found that fixed mindset students had an increased likelihood of belonging to the moderate and low multiple goal profiles. In addition, studies in sport psychology show that motivational profiles with low mastery and performance goals are further characterized by a fixed mindset and high amotivation (Chian & Wang, 2008; Wang et al., 2002). These results suggest that when students perceive their ability in a domain as fixed and lacking, they may fail to see the purpose of engaging in domain-related activities, thereby falling into a state of indifference.

In summary, although variable-centred research paints a straightforward, one-to-one correspondence between mindsets and achievement goals, the link between the two may be less straightforward than is commonly assumed. Studies reviewed above suggest that not all growth mindset students dismiss performance goals, and not all fixed mindset students are preoccupied with performance goals. By employing a person-centred approach, the present study may reveal complex combinations of mindsets and achievement goals (especially performance goals) within individuals.

Gendered motivational frameworks

In her review of gender differences in motivation, Butler (2014; Butler & Hasenfratz, 2017) proposed a tendency for boys to ‘prove and protect’ their abilities and for girls to ‘try and improve’ their abilities. These gendered tendencies have striking parallels with motivational frameworks underpinned by a fixed or growth mindset. Therefore, one might wonder if boys and girls would be differentially represented in distinct mindset-related profiles. If so, this holds implications for understanding boys’ relative underachievement in school (Voyer & Voyer, 2014).

When examining mindsets alone, most studies observe no meaningful gender differences (Ahmavaara & Houston, 2007; Tucker-Drob et al., 2016). This includes a recent study employing a nationally representative sample of 10th graders in the US, which found that boys and girls were equally likely to hold a growth mindset in maths (Hwang et al., 2019). Although single studies sometimes reveal a stronger growth mindset among either boys (Chen & Pajares, 2010; Diseth et al., 2014) or girls (Spinath et al., 2003; Tempelaar et al., 2015), there appear to be no systematic gender differences across studies.

Regarding achievement goals, however, small but consistent gender differences have been found, and the pattern of gender variations are tied to specific subject domains (Wirthwein et al., 2020). When goals are assessed regarding a verbal domain or school motivation in general, girls tend to report more mastery goals (Martin, 2004; Peterson & Kaplan, 2016), but this tendency often diminishes or disappears in maths-related domains (Butler, 2008; Friedel et al., 2007). In contrast, boys tend to prioritise the goals of validating competence or avoiding displays of incompetence (i.e., performance-approach and -avoidance goals; Peterson & Kaplan, 2016; Yu & McLellan, 2019). Studies on goal profiles similarly show that girls are overrepresented in profiles with dominant mastery goals,

whereas boys are overrepresented in profiles with dominant performance goals (Luo et al., 2011; Schwinger et al., 2016).

Gendered tendencies towards ‘proving and protecting’ versus ‘trying and improving’ (Butler, 2014) can also be inferred from boys’ and girls’ effort beliefs, perseverance, and use of self-handicapping strategies. Girls generally place a higher value on effort and believe more strongly that effort leads to improved performance (McCrea et al., 2008; Tempelaar et al., 2015). In addition, girls on average tend to persist longer when facing challenges (Schnell et al., 2015), and this finding holds across self-report and behavioural measures (Gilmore et al., 2003; Vermeer et al., 2000). In contrast, when encountering difficulties, boys tend to protect their self-worth by employing self-handicapping strategies to discount low ability as the cause of failure (McCrea et al., 2008; Yu & McLellan, 2019).

Overall, variable-centred studies have found small but consistent gender differences in many components of the mindset-based meaning system. Although boys and girls both *believe in their potential to grow*, gender differences in effort beliefs, goals, and behaviours suggest that girls place greater importance on *working towards growth*. The present study extended prior research to investigate the proving versus improving motivational tendencies from an integrative, person-centred perspective. Based on past research, girls were expected to be found more often in growth-oriented motivational profiles, particularly in school subjects that are perceived as congruent with their gender identity (Wirthwein et al., 2020).

Study overview and hypotheses

The current study adopted a person-centred approach to examine the various ways mindsets and associated motivational constructs cohered and functioned together as a meaning system. Specifically, it addressed three research questions. First, what are the emergent patterns of mindset-based meaning systems in English and maths? We focused on mindsets, effort beliefs, achievement goals, perseverance, and self-handicapping as core

components of the system because these constructs are systematically linked to each other and exert influence on student achievement collectively (Blackwell et al., 2007; Robins & Pals, 2002). Based on prior variable-centred research, we expected to first identify two profiles reflecting between-mindset differences in motivational frameworks (*Hypothesis 1*):

- a *Growth-Focused* profile, evidenced by a growth mindset, positive effort beliefs, dominant mastery goals, high perseverance, and low self-handicapping; and
- an *Ability-Focused* profile, evidenced by a fixed mindset, negative effort beliefs, dominant performance goals, low perseverance, and frequent use of self-handicapping strategies.

Furthermore, we argue that there may be individual differences in the ways mindsets are combined with other factors, which have been rendered invisible in previous variable-centred research. As a result, we expected to identify profiles showing alternative combinations of mindsets, effort beliefs, goals, and behaviour. Given the dearth of research testing the meaning system hypothesis from a person-centred perspective, we took an exploratory approach and did not specify the pattern of these alternative profiles. In addition, we compared students' profile memberships in English and maths to examine the domain-specificity of motivational frameworks.

Second, how do profiles of mindset-based meaning systems predict students' subsequent achievement in English and maths? Previous research suggests that mindsets form the core of meaning systems—they are causal antecedents of other constructs and can change the meaning of goals and behaviour (Hong et al., 1999; Stone, 1999). It was thus predicted that regardless of the configurations of factors, profiles with a growth mindset would show better achievement over time, whereas profiles with a fixed mindset would show worse achievement (*Hypothesis 2*).

Third, how does students' gender relate to their profile memberships? In light of the gendered motivational tendencies (Butler, 2014), girls were expected to be found more often in growth-oriented profiles, indicated by a growth mindset, positive effort beliefs, mastery goals, and perseverance (*Hypothesis 3*). This gender difference was expected to be larger in English, a domain that is viewed as stereotypically compatible with girls' gender identity.

Method

To increase the transparency and openness of research, we have made the measures and analysis code available on the Open Science Framework (OSF) at <https://osf.io/p34n6/>.

Participants and procedure

The sample comprised 535 students (295 girls, aged 14-16 years) from four state-funded secondary schools in England. Students were in the last two years of secondary education (Year 10: $n = 319$; Year 11: $n = 216$) and were working towards the national General Certificate of Secondary Education (GCSE) exams taken at the end of Year 11. This sample was chosen because past studies suggest that mindset-based meaning systems may be most impactful when students encounter academic challenges (e.g., Blackwell et al., 2007). The average level of student achievement was diverse across participating schools: the proportion of students obtaining a pass grade in GCSE English and maths ranged from 23% to 69%. Participants were predominantly White (79.1%) and Asian (12.3%), with the remaining identified as mixed race (5.4%) and Black (1.9%). Nine per cent of the students spoke English as an additional language (EAL), and 10.3% received free school meals (FSM) due to low family income.

The study was approved by the departmental ethics committee. Prior to data collection, parents were informed of the study and were given the opportunity to withdraw their child. Students also provided assent to participate. Questionnaires assessing key motivational constructs were group administered to students during regular school hours in

spring term. Teachers responsible for administering the questionnaire were provided with an instruction sheet containing the purpose, ethics, and procedures of the study. Students were told that participation was completely voluntary and that their responses would not be seen by anyone at home or school. Students subsequently took the GCSE exams at the end of Year 11, and their achieved grades were obtained from school records. The time lag between assessments of motivation and achievement was introduced to examine the potential impact of mindset-based meaning systems on student performance.

Measures

The current study used well-validated scales from previous research. Motivational constructs were assessed with respect to the domains of English and maths. All items were rated on a Likert scale ranging from 1 (*disagree a lot*) to 6 (*agree a lot*).

Mindset. Students' mindset was assessed with a three-item scale adapted from De Castella and Byrne (2015). The items measured a fixed mindset (e.g., 'My ability in ... is something that I can't change very much') and were reverse scored so that higher scores indicated a stronger growth mindset. Only negatively worded items were used because both our pilot and previous studies found that positively worded items are extremely compelling and prone to social desirability responses (e.g., Dweck et al., 1995). The reliability of the scale, as indicated by Cronbach's alpha (α), was .77 for English and .78 for maths.

Effort beliefs. Items assessing beliefs about effort were adapted from the study by Blackwell et al. (2007). Again only negatively phrased items were used (5 items; e.g., 'If I'm bad at ..., working hard won't make me better at it') and were reverse scored so that higher scores reflected a stronger belief about the utility of effort in increasing ability. The scale displayed good internal reliability ($\alpha = .81$ for English and .83 for maths).

Achievement goals. Mastery, performance-approach, and performance-avoidance goals were measured using items adapted from the revised Patterns of Adaptive Learning

Scales (PALS; Midgley et al., 2000). Mastery goal items assessed a focus on developing academic competence (5 items, $\alpha = .89$ for English and $.86$ for maths; e.g., ‘One of my goals in ... is to learn as much as I can’). Items tapping performance goals focused on ability validation and self-worth concerns. Performance-approach goal items evaluated a focus on demonstrating competence relative to others and gaining favourable judgment (5 items, $\alpha = .92$ for both English and maths; e.g., ‘One of my goals is to show others that I’m good at ...’). Performance-avoidance goal items assessed a focus on avoiding negative judgement or displays of incompetence relative to others (4 items, $\alpha = .79$ for English and $.80$ for maths; e.g., ‘It’s important to me that I don’t look stupid in my ... class’).

Perseverance. Four items were used to assess the extent to which students persevere when facing challenges. These items were borrowed from the study conducted by Elliot, McGregor, and Gable (1999) and measured one’s tendency to maintain effort when the tasks became difficult or boring (e.g., ‘If a particular topic or problem confuses me in my ... lesson, I go back and try to figure it out’). Cronbach’s alpha coefficients were $.82$ for English and $.83$ for maths.

Self-handicapping. Academic self-handicapping was measured using a six-item scale adapted from the PALS (Midgley et al., 2000). These items assessed intentional effort withdrawal prior to evaluations to generate excuses for potential poor performance. An example item is ‘I sometimes put off doing my maths homework until the last minute so I have an excuse if I don’t do so well’. This scale showed good internal reliability ($\alpha = .83$ for English and $.86$ for maths).

Achievement. Academic achievement was operationalised as English and maths grades in national GCSE exams taken by all students at the end of compulsory secondary education. These exam results are high-stakes for both students and schools because they are crucial for educational progression and are used to rank schools in league tables. GCSE

exams were recently reformed and participants in this study were among the first to sit the more challenging exams. Students' performance was graded on a scale from 1 (the lowest) to 9 (the highest) and was standardised before analyses to ease interpretation.

Covariates. Students' background characteristics and prior achievement can influence subsequent performance and the probability of belonging to a given latent profile. The current study thus included a number of covariates to investigate the unique effect of latent profiles on achievement as well as the independent effect of gender on profile membership. These covariates included ethnicity, language background, and free school meal status—all of which were self-reported by participants at the end of the questionnaire. In addition, students' English and maths performance on the National Curriculum Tests (NCT) was gathered from schools to indicate prior achievement. These tests are taken by all students at the end of primary school in England and represent the only national test data available prior to GCSE. NCT scores were standardised before analyses.

Analytic strategy

Data analysis proceeded in three steps. First, we verified the factor structure of motivational variables in measurement models. Next, latent profile analysis (LPA) was conducted based on factor scores saved from the measurement models to identify subgroups of students with distinct mindset-based meaning systems. Lastly, once the optimal profile solution was determined, outcomes and predictors of profile membership were incorporated into the final LPA model. All analyses were conducted in Mplus Version 8 (Muthén & Muthén, 1998-2017) using the maximum likelihood estimation with robust standard errors (MLR). Missing values were handled by the full information maximum likelihood procedure (FIML) in Mplus.

Measurement models. We verified the factor structure of motivation measures using exploratory structural equation modelling (ESEM; Asparouhov & Muthén, 2009). A

confirmatory approach to ESEM was adopted so that items were specified to load on their respective factors and cross-loadings were freely estimated but targeted to be as close to zero as possible. Recent research has illustrated the merits of ESEM when small cross-loadings can be expected among various motivation measures (Guay et al., 2015). This is the case in the present investigation where conceptual and empirical overlap has been reported among some variables (e.g., performance-approach and performance-avoidance goals; Linnenbrink-Garcia et al., 2012).

Model fit was assessed using the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardised root mean square residual (SRMR). Good model fit is indicated by a CFI value close to 0.95 or above, a RMSEA value close to 0.06 or below, and SRMR close to 0.08 or below (Hu & Bentler, 1999).

Latent profile analyses. Students responding similarly on the motivation measures were classified into distinct subgroups using LPA. Factor scores saved from the ESEM models were used as latent profile indicators because they assigned more weight to items with higher loadings, thereby partially controlling for measurement errors (Morin et al., 2016). Furthermore, factor scores are estimated in standardized units ($M = 0$, $SD = 1$) and can be readily interpreted as deviations from the sample mean.

Models with two to six profiles were estimated and the optimal number of profiles to retain was initially guided by several statistical indicators (Nylund et al., 2007). These included the Akaike information criteria (AIC), the consistent AIC (CAIC), the Bayesian information criteria (BIC), the sample-size adjusted BIC (SABIC), and the bootstrap likelihood ratio test (BLRT). A lower value on AIC, CAIC, BIC, and SABIC indicates a better fitting model, and a non-significant BLRT test supports a model with one less profile. To further facilitate model selection, information criteria were plotted to identify the elbow point after which the improvement in fit became minimal (Petrus & Masyn, 2010), and

theoretical interpretability of the profiles were also considered. Moreover, a solution with one less profile was preferred when additional profiles did not differ qualitatively from existing profiles (Morin et al., 2016). Finally, we relied on the entropy (ranging from 0 to 1) to describe the accuracy of the final solution, with higher values representing greater classification precision (Celeux & Soromenho, 1996). Once the optimal profile solution was selected, post hoc analyses were performed to examine how profiles differed from one another on each indicator.

Outcomes and predictors of latent profiles. To examine profile differences in student achievement, we used the BCH method introduced by Bolck, Croon, and Hagenaars (2004), which is equivalent to a weighted ANOVA and outperforms alternative approaches in simulation studies (Bakk & Vermunt, 2016). Specifically, a manual BCH was performed to examine differences in academic achievement among profiles while controlling for the effect of socio-demographic and achievement covariates (Asparouhov & Muthén, 2014b). Profile-specific means were compared using the MODEL CONSTRAINT command and can be interpreted as the independent influence of latent profiles on student achievement.

Finally, to investigate the effect of gender on profile memberships, the R3STEP command was used to perform multinomial logistic regressions while controlling for other covariates (Asparouhov & Muthén, 2014a). Specifically, the latent class variable was regressed on all predictors simultaneously so the coefficients for gender represented its unique contribution adjusting for all other effects in the model.

Results

Preliminary analyses

ESEM models with target rotation showed excellent fit to data in English and maths according to the CFI (.968 and .981), RMSEA (.037 and .029), and SRMR (.018 and .018), supporting the underlying factor structure of the motivational constructs. Means and standard

deviations of observed variables are reported in Table 1 separately for each gender. Boys and girls scored similarly on the majority of measures but there were some exceptions. In English, girls reported higher levels of mastery goals ($d = 0.42$), perseverance ($d = 0.44$), and achieved better grades than boys ($d = 0.39$). In maths, girls again reported more mastery goals ($d = 0.21$) and greater perseverance ($d = 0.27$), but the size of gender differences was attenuated. In addition, boys adopted more performance-approach goals ($d = -0.22$) and outperformed girls in maths ($d = -0.19$).

Table 1

Means and standard deviations for observed variables by gender

Variable	English			Maths		
	Girls	Boys	Cohen's d	Girls	Boys	Cohen's d
Growth mindset	4.23 (1.08)	4.18 (1.09)	0.05	4.37 (1.14)	4.42 (1.04)	-0.04
Positive effort beliefs	4.54 (1.02)	4.48 (0.98)	0.06	4.55 (1.09)	4.67 (0.92)	-0.11
Mastery goals	4.58 (0.94)	4.16 (1.06)	0.42***	4.60 (0.97)	4.39 (0.98)	0.21*
PAP goals	2.72 (1.29)	2.64 (1.18)	0.06	2.63 (1.26)	2.92 (1.30)	-0.22*
PAV goals	2.95 (1.21)	2.85 (1.09)	0.09	2.96 (1.28)	2.88 (1.15)	0.07
Perseverance	4.25 (1.00)	3.81 (0.99)	0.44***	4.29 (1.07)	4.01 (1.02)	0.27**
Self-handicapping	2.01 (0.88)	2.13 (0.89)	-0.13	2.08 (1.02)	2.17 (0.96)	-0.09
Academic achievement	5.49 (1.84)	4.79 (1.77)	0.39***	4.92 (1.98)	5.32 (2.13)	-0.19*

Note. PAP = performance-approach, PAV = performance-avoidance. Positive Cohen's d values indicate higher scores for girls. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Intercorrelations among variables are shown in Table 2. Theoretically consistent patterns of correlations were observed. Growth mindset was associated positively with positive effort beliefs ($r_s = .75$ and $.73$ in English and maths), mastery goals ($r_s = .47$ and $.43$), and perseverance ($r_s = .39$ and $.46$), but negatively with performance-avoidance goals ($r_s = -.23$ and $-.23$) and self-handicapping ($r_s = -.37$ and $-.44$). Interestingly, growth mindset and performance-approach goals were nearly uncorrelated ($r_s = -.07$ and $-.14$). In addition, students' English and maths achievement related positively to growth mindset ($r_s = .14$ and $.21$), positive effort beliefs ($r_s = .18$ and $.23$), and perseverance ($r_s = .12$ and $.19$), but negatively to self-handicapping ($r_s = -.25$ and $-.28$).

Table 2

Intercorrelations between observed variables in English and maths

Variable	1	2	3	4	5	6	7	8
1. Growth mindset		.73	.43	-.14	-.23	.46	-.44	.21
2. Positive effort beliefs	.75		.46	-.12	-.33	.51	-.61	.23
3. Mastery goals	.47	.50		.19	.10	.76	-.33	.10
4. PAp goals	-.07 ^a	-.16	.18		.78	.13	.34	.02 ^a
5. PAv goals	-.23	-.34	.04 ^a	.74		.04 ^a	.42	-.01 ^a
6. Perseverance	.39	.48	.72	.11	-.03 ^a		-.36	.19
7. Self-handicapping	-.37	-.57	-.26	.33	.41	-.32		-.28
8. Academic achievement	.14	.18	.02 ^a	-.09	-.07 ^a	.12	-.25	

Note. Values below diagonal correspond to variables in English; values above diagonal correspond to variables in maths.

^a Nonsignificant correlation, $p > .05$.

Profiles of mindset-based meaning systems

Fit indices for LPA solutions with two to six profiles in English and maths are reported in Supplementary Appendix 1. The AIC, CAIC, BIC, and SABIC values continued to decrease with the addition of profiles, and BLRT remained significant for all the solutions. The values of the information criteria are also graphically presented as elbow plots (see Supplementary Appendix 2). These plots suggest that the improvement in fit flattened around four profiles in English, but the pattern was more ambiguous in maths and both three and four profiles seemed plausible. Careful examination of the four-profile solutions in conjunction with the three- and five-profile solutions suggested that adding a fourth profile resulted in a theoretically interpretable and qualitatively distinct profile in both subjects, whereas the five-profile solution split an existing profile into two identical profiles. Thus, based on fit indices and theoretical significance of the profiles, the four-profile solution was retained in both subjects, with a reasonably high level of classification accuracy (entropy = .85 for both English and maths).

The same four profiles consistently emerged across the two subjects, labelled as (1) *Growth-Focused*, (2) *Ability-Focused*, (3) *Growth-Competitive*, and (4) *Disengaged*. These profiles in English and maths are illustrated in Figures 1 and 2, while the profile-specific

means of all indicator variables are reported in Supplementary Appendix 3. In line with *Hypothesis 1*, we identified two profiles illustrating the between-mindset differences widely documented in variable-centred research. In both subjects, students in the *Growth-Focused* profile (Profile 1) believed that ability can be improved through hard work, prioritised mastery goals over performance goals, reported high levels of perseverance, and refrained from self-handicapping. In contrast, students in the *Ability-Focused* profile (Profile 2) displayed the exact opposite pattern of motivation. They held a fixed mindset, viewed effort to develop ability as futile, and gave up easily when facing challenges; meanwhile, they adopted goals and behaviours concerned with proving and protecting their self-worth. Together, Profiles 1 and 2 were the most common profiles in both subjects, comprising approximately two thirds of the students (62% in English and 69% in maths).

Figure 1

Final profile solution in English

Figure 2

Final profile solution in maths

The other two profiles, however, displayed alternative patterns of mindset-based meaning systems. Students in the *Growth-Competitive* profile (Profile 3) were similar to the *Growth-Focused* students in terms of reporting a growth mindset, positive effort beliefs, and high perseverance. Yet, *Growth-Competitive* students could be distinguished from all other groups by their joint pursuit of mastery and performance goals. In English, *Growth-Competitive* students were as mastery-oriented as the *Growth-Focused* students, and were equally performance-oriented as the *Ability-Focused* students. In maths, *Growth-Competitive* students were even more mastery-oriented than the *Growth-Focused* students and significantly more performance-oriented than the *Ability-Focused* students. This elevated level of performance goal pursuit, however, was accompanied by a moderate level of self-handicapping. Importantly, the *Growth-Competitive* profile was not a group of students who simply agreed with every statement, as some scales were negatively worded and reverse scored. This profile was the third largest group in the study, comprising about one fifth of the students (20% in English and 23% in maths).

Finally, we observed a small group of students who were similar to the *Ability-Focused* students in terms of holding a fixed mindset and negative effort beliefs, but were further characterised by very low scores on other dimensions of motivation (except for self-handicapping). Notably, this profile reported the lowest level of mastery goals and perseverance. Due to their lack of motives to engage and lack of willingness to persist on academic tasks, we labelled this the *Disengaged* profile (Profile 4). The size of this profile was larger in English (18%) than in maths (9%). This was somewhat surprising and, as will be explained, was a result of boys moving into or out of the *Disengaged* profile across subjects.

Students' profile memberships in English and maths are compared in Supplementary Appendix 4. There was some evidence supporting the domain specificity of students' motivational frameworks. Only 64% of students remained in the same profile across the two subjects. Students in the *Growth-Focused* profile, unencumbered by self-worth concerns (i.e., low performance goals and low self-handicapping), largely maintained their growth orientation across subjects, whereas membership of other profiles seemed to be more subject-dependent.

In sum, our findings not only supported the between-mindset differences theorised by Dweck, but also revealed nuanced within-mindset differences in students' motivational frameworks. Contrary to popular assumptions, some fixed mindset students reported only low levels of performance goals (*Disengaged*), whereas some growth mindset students did not shy away from pursuing performance goals (*Growth-Competitive*).

Outcomes and predictors of mindset-based meaning systems

Our next aim was to investigate differences in academic achievement across the four profiles while controlling for prior achievement, gender, ethnicity, language background, and free school meal status. Profile-specific means for English and maths achievement are shown

in Table 3. Regarding English achievement, an omnibus test for an overall difference across the profiles was significant, $\chi^2(3) = 8.68, p = .034$, suggesting that profile membership was associated with students' subsequent exam performance. Pairwise comparisons showed that *Growth-Competitive* and *Growth-Focused* profiles obtained the highest scores in English and did not differ from one another. The *Growth-Focused* profile also scored higher than the *Ability-Focused* profile, and showed a trend towards better performance than the *Disengaged* profile ($p = .052$). The *Ability-Focused* and *Disengaged* profiles scored the lowest and did not differ from each other.

Table 3

Differences in English and maths achievement across profiles

Variable	<i>Growth-Focused</i>	<i>Ability-Focused</i>	<i>Growth-Competitive</i>	<i>Disengaged</i>
English achievement	-0.02 _{ab} (.08)	-0.25 _c (.09)	0.04 _a (.10)	-0.20 _{bc} (.09)
Maths achievement	0.10 _b (.05)	-0.16 _c (.06)	0.28 _a (.09)	0.00 _{bc} (.11)

Note. Means are z-standardized and values in parentheses represent standard errors. Values with different subscripts in the same row are significantly different at $p < .05$.

Regarding maths achievement, an omnibus test for an overall difference across the profiles was also significant, $\chi^2(3) = 24.75, p < .001$. The *Growth-Competitive* profile scored the highest in maths, followed by the *Growth-Focused* profile. The *Ability-Focused* profile again scored the lowest. The *Disengaged* profile fell in between the *Growth-Focused* and *Ability-Focused* profiles but these differences did not reach statistical significance.

Overall, the results indicated that mindset-based meaning systems influenced students' academic performance beyond the effects of prior achievement, gender, ethnicity, language background, and socioeconomic status. Consistent with *Hypothesis 2*, the two profiles with a growth mindset consistently performed better than the two profiles with a fixed mindset (between-mindset differences). The findings further showed that in maths, the *Growth-Competitive* profile outperformed the *Growth-Focused* profile, and the *Disengaged*

profile appeared to be less detrimental than the *Ability-Focused* profile (within-mindset differences).

Finally, we examined whether gender was a significant predictor of students' profile membership. Tables 4 and 5 show the effect of gender on a student's likelihood of belonging to a given profile in English and maths, while holding all other sociodemographic and achievement covariates constant. Gender was dummy coded and boys served as the reference category. A significant positive coefficient plus an odds ratio (*OR*) > 1 suggested that, compared to boys, girls had an increased likelihood of belonging to the target profile (vs. the comparison profile). In line with *Hypothesis 3*, girls were more commonly found in growth-oriented profiles than boys. In both subjects, girls were more likely to belong to the *Growth-Focused profile* (Profile 1), relative to the *Ability-Focused* and *Disengaged* profiles (Profiles 2 & 4), *ORs* = 1.78 to 2.85. Put differently, boys were more often found in the *Ability-Focused* and *Disengaged* profiles relative to the *Growth-Focused* profile. Furthermore, in English only, girls were also more likely than boys to be in the *Growth-Competitive profile* (Profile 3), relative to the *Ability-Focused* and *Disengaged* profiles (Profiles 2 & 4), *ORs* = 1.98 to 2.75.

Table 6 compares the gender distribution of each profile across the two subjects based on students' most likely profile membership. The proportion of girls in each profile was largely stable across subjects, with approximately 70% of them belonging to the *Growth-Focused* and *Growth-Competitive* profiles. In contrast, the percentage of boys in each profile varied more as a function of the subject. The proportion of boys in the *Disengaged* profile increased from 10% in maths to 24% in English, whereas the proportion of boys in the two growth-oriented profiles dropped from 64% in maths to 49% in English.

Although not the focus of the present study, interesting main effects were also observed for other covariates (see Tables 4 and 5). For instance, students from Asian

backgrounds were more likely to be in the *Growth-Competitive* profile (Profile 3) relative to all other profiles, *ORs* = 3.41 to 8.20. Students with higher prior achievement were more commonly found in the *Growth-Focused* (Profile 1) and *Growth-Competitive* profiles (Profile 3) relative to the *Ability-Focused* profile (Profile 2), *ORs* = 1.32 to 2.00. In maths only, students who received free school meals had an increased likelihood of being in the *Ability-Focused* and *Disengaged* profiles (Profiles 2 and 4), relative to the *Growth-Focused* profile (Profile 1), *ORs* = 1.32 to 1.49.

Table 4

Multinomial logistic regressions for the effects of predictors on profile membership in English

Predictor	Profile 1 vs. 2		Profile 1 vs. 4		Profile 3 vs. 1		Profile 3 vs. 2		Profile 3 vs. 4		Profile 2 vs. 4	
	Coef.	OR	Coef.	OR	Coef.	OR	Coef.	OR	Coef.	OR	Coef.	OR
Female	0.72**	2.06	1.05**	2.85	-0.04	0.96	0.68*	1.98	1.01**	2.75	0.33	1.39
Asian	0.04	1.04	0.88	2.40	1.23**	3.41	1.27**	3.55	2.11**	8.20	0.84	2.31
Mixed race	0.00	1.00	0.23	1.25	0.06	1.06	0.06	1.06	0.28	1.33	0.23	1.25
EAL	0.40	1.49	0.34	1.41	-0.11	0.89	0.29	1.33	0.23	1.26	-0.06	0.94
FSM	-0.61	0.55	-0.17	0.85	0.11	1.11	-0.50	0.61	-0.06	0.94	0.44	1.55
Prior achievement	0.40**	1.49	-0.18	0.84	-0.01	0.99	0.39*	1.48	-0.19	0.83	-0.58**	0.56

Note. The coefficients and ORs reflect the effects of predictors on the likelihood of membership into the first listed profile relative to the second listed profile. Profile 1 = Growth-Focused; Profile 2 = Ability-Focused; Profile 3 = Growth-Competitive; Profile 4 = Disengaged. EAL = English as an additional language; FSM = free school meal; Coef. = coefficient; OR = odds ratio. The black ethnic group was too small in numbers to be included as a reliable predictor. * $p < .05$, ** $p < .01$.

Table 5

Multinomial logistic regressions for the effects of predictors on profile membership in maths

Predictor	Profile 1 vs. 2		Profile 1 vs. 4		Profile 3 vs. 1		Profile 3 vs. 2		Profile 3 vs. 4		Profile 2 vs. 4	
	Coef.	OR	Coef.	OR	Coef.	OR	Coef.	OR	Coef.	OR	Coef.	OR
Female	0.58**	1.78	0.68*	1.97	-0.37	0.69	0.21	1.23	0.31	1.36	0.10	1.10
Asian	0.15	1.16	0.64	1.89	1.25**	3.47	1.39**	4.01	1.88**	6.55	0.49	1.63
Mixed race	-0.21	0.81	1.24	3.44	0.45	1.57	0.24	1.27	1.68	5.39	1.44	4.23
EAL	0.31	1.37	0.13	1.14	0.55	1.73	0.86	2.36	0.68	1.97	-0.18	0.84
FSM	-1.32**	0.27	-1.49**	0.23	0.97*	2.65	-0.34	0.71	-0.52	0.60	-0.18	0.84
Prior achievement	0.28**	1.32	0.21	1.24	0.42**	1.52	0.69**	2.00	0.63**	1.87	-0.06	0.94

Note. The coefficients and ORs reflect the effects of predictors on the likelihood of membership into the first listed profile relative to the second listed profile. Profile 1 = Growth-Focused; Profile 2 = Ability-Focused; Profile 3 = Growth-Competitive; Profile 4 = Disengaged. EAL = English as an additional language; FSM = free school meal; Coef. = coefficient; OR = odds ratio. The black ethnic group was too small in numbers to be included as a reliable predictor. * $p < .05$, ** $p < .01$.

Table 6

Gender distribution across English and maths profiles

Profile	% Girls		% Boys	
	English	Maths	English	Maths
Growth-Focused	45	50	32	39
Ability-Focused	20	22	27	27
Growth-Competitive	23	21	17	25
Disengaged	13	8	24	10

Discussion

Existing mindset research focuses almost exclusively on between-mindset differences in motivation and achievement. Numerous studies have shown that, on average, a growth mindset orients students towards positive effort beliefs, mastery goals, and mastery-oriented behaviours, whereas a fixed mindset predisposes students towards negative effort beliefs, performance goals, and helpless behaviours in achievement settings (Blackwell et al., 2007; Burnette et al., 2013). Nevertheless, this straightforward, one-to-one mapping may not fully capture the complex relationships between mindsets and related motivational constructs, obscuring other possible combinations of these variables within individuals. Consequently, the current study adopted a person-centred approach to investigate how mindsets, effort beliefs, goals, and behaviour naturally integrated into meaning systems. The same four mindset-related profiles emerged across two subjects, with predictable relations to students' background characteristics and academic performance. In this section, we discuss the complex relations between mindsets, goals, and achievement, as well as the differences in profile membership as a function of students' background characteristics.

Mindsets, meaning systems, and achievement

The meaning system framework proposed by Dweck and colleagues (Hong et al., 1999; Molden & Dweck, 2000) addresses the complexity of motivation by considering how mindsets and the corresponding effort beliefs, goals, and behaviour function together as a coherent motivational framework. Although the interconnection among this network of

factors has been supported by path analysis, we contend that a person-centred approach aligns more closely with the notion that mindsets, effort beliefs, goals, and behaviour operate together as a system, and can provide compelling evidence for this hypothesis. The results show that two thirds of the students belonged to the *Growth-Focused* and *Ability-Focused* profiles. These profiles conceptually replicate past variable-centred studies and indicate that for the majority of students, fixed and growth mindsets may orient them to interpret effort differently, to prioritise either performance or mastery goals, and to behave in either a helpless or mastery-oriented manner. In addition, we identified two additional ways that mindsets and associated constructs linked together. The *Disengaged* profile suggests that some students may see little purpose in engaging or trying if they are not naturally talented. Even in the *Growth-Competitive* profile, which might appear somewhat theoretically inconsistent in the first instance, growth mindset was still linked to positive effort beliefs, mastery goals, and high perseverance. Overall, the findings are broadly in line with the idea that mindsets and associated constructs form coherent motivational meaning systems.

Across the four profiles, students' mindsets co-varied with effort beliefs, mastery goals, perseverance, and self-handicapping, but there was an interesting disconnect between mindsets and performance goals. Specifically, not all growth mindset students set only mastery goals: some of them embraced performance goals alongside mastery goals. In addition, not all fixed mindset students engaged in performance goals and self-defensive behaviours: some of them lacked any achievement goal and became disengaged. These different combinations of mindsets and performance goals may explain the modest correlations between these constructs in the current and previous studies (Burgoyne et al., 2020; Burnette et al., 2013; Payne et al., 2007).

Since growth mindset and performance goals are often viewed as incompatible with each other, the consistent emergence of a *Growth-Competitive* profile raises the question of

how students integrate these factors into a coherent motivational framework. Although performance goals are traditionally defined in terms of a focus on demonstrating one's ability, people have multiple ways of conceptualising ability (Dweck & Leggett, 1988; Nicholls, 1984). When students view ability as fixed and inversely related to effort, performance goals involve putting their global and permanent ability on display, and failure or mere exertion of effort can call into question their enduring quality and thus become threatening. Indeed, *Ability-Focused* students reported low perseverance and high self-handicapping, suggesting that these fixed mindset students were willing to forgo effort to avoid the implications of low ability. In contrast, when students view ability as malleable and positively related to effort, performance goals involve demonstrating their current level of ability on the task—a quality that they have strived to develop and can be improved further. Since effort is what enables them to reach their current ability, *Growth-Competitive* students showed sustained effort and perseverance when operating under performance goals. Within a meaning system where only current, improvable ability is at stake in evaluative situations, failure to achieve performance goals may not be as debilitating and may even provide valuable information about one's current skill level on academic tasks. Overall, students' mindsets might systematically alter how performance goals are interpreted and regulated, and individual differences in goal meaning might partly contribute to the mixed effects of performance-approach goals in the literature (Molden & Dweck, 2000; Stone, 1999).

In addition, we found a group of fixed mindset students who lacked any achievement goal. Compared to other profiles, this group of students reported the lowest levels of mastery goals and perseverance. This is consistent with past research linking fixed mindset to work avoidance goals among adolescents (King & McInerney, 2014). Moreover, a recent study found that students with moderate/low goal profiles also had lower self-efficacy

(Linnenbrink-Garcia et al., 2018). Collectively, these findings suggest that perceiving one's ability as being low and unchanging may lead to a lack of purpose and motivation.

Our findings also provide insights into the underlying mindset of different goal profiles. The four profiles identified in this study correspond well to the commonly found goal profiles in previous research (Niemi-virta et al., 2019; Wormington & Linnenbrink-Garcia, 2017). The *Growth-Focused* and *Ability-Focused* profiles indicate that profiles with dominant mastery goals may be rooted in a growth mindset, whereas profiles with dominant performance goals may stem from a fixed mindset. In line with previous studies (Chian & Wang, 2008; Wang et al., 2002), the *Disengaged* profile indicates that students with low all goals may hold a fixed mindset. Most importantly, the results clarify the type of mindset held by those who pursue multiple goals. Profiles with a fixed mindset consistently failed to facilitate mastery goal pursuit (*Ability-Focused* and *Disengaged*), whereas a growth mindset posed no problem for adopting mastery and performance goals at once (*Growth-Competitive*). The findings thus support the proposal that growth mindset students may be more able to coordinate performance and mastery goals simultaneously (Molden & Dweck, 2000; Stone, 1999).

Of additional importance is the finding that profiles with dominant mastery goals and multiple goals were both underpinned by a growth mindset. This result informs our thinking about the mastery goal versus multiple goal debate within the achievement goal literature. Although mastery goal and multiple goal pursuits are often positioned as distinct motivational pathways, our results suggest that these two goal patterns may be more similar than different: they represent variations in goal deployment among those who already hold a growth mindset. Instead of following distinct learning trajectories, students with a mastery goal or multiple goal orientation may be travelling in two lanes of the same growth-oriented path.

Finally, mindset-based meaning systems predicted students' performance on high-stakes exams beyond the effects of prior achievement and sociodemographic characteristics. Consistent with the idea that mindsets are core beliefs in the meaning system, the two profiles with a growth mindset performed better than the two profiles with a fixed mindset. Although recent meta-analyses indicate only a modest correlation between mindsets and academic achievement (Costa & Faria, 2018; Sisk et al., 2018), we argue that this might be a conservative estimate because our results show that mindsets activated a network of interconnected beliefs, goals, and behaviour, all of which operated interdependently to influence student achievement. As a result, mindset-based meaning system could be viewed as a gestalt, and the components of this system may interact to produce a joint effect that is greater than the sum of its parts.

In addition to the striking between-mindset differences, there are small but interesting within-mindset differences in student achievement. Among students with a fixed mindset, the *Ability-Focused* profile appeared to be more detrimental than the *Disengaged* profile for maths performance. This might be partly explained by the higher levels of self-handicapping among the *Ability-Focused* students. Furthermore, this result is in line with research on self-determination theory showing that the quality of motivation matters (Vansteenkiste et al., 2009). In the current study, students who reported a greater amount of poor-quality motivation (*Ability-Focused*) fared no better or even worse than those with low levels of motivation (*Disengaged*). Among students with a growth mindset, the *Growth-Competitive* profile outperformed the *Growth-Focused* profile in maths. This might be explained by *Growth-Competitive* students' higher levels of mastery goals and perseverance in maths, and does not necessarily indicate any added benefit of endorsing performance goals. An alternative possibility is that there might be a mismatch between the study approach favoured by *Growth-Focused* students and the way knowledge is assessed in maths. Purely mastery-

oriented students tend to focus on personally interesting material when studying, sometimes at the expense of other important material (Senko & Miles, 2008). This interest-based studying approach is associated with worse achievement when exams include more closed-ended questions (such as those in maths), but not when exams include more open-ended questions that require short answers or essays (such as those in English; Senko, 2019).

Gender and other predictors of meaning systems

From a variable-centred perspective, boys and girls showed little difference in the majority of variables examined in this study (see Table 1). When differences did emerge, they were small to moderate in magnitude depending on the subject domain. Nevertheless, small differences in individual variables can add up to global differences in motivational patterns depending on how these variables are correlated and combined together (Giudice et al., 2012). Synthesising the evidence on gender differences in motivational constructs, Butler (2014) proposed a general tendency for boys to prove and protect their abilities and for girls to try and improve their abilities. Supporting and extending this proposal, the current study observed a pattern of *male proving or disengaging* versus *female striving and improving* from a person-centred perspective. Results from multinomial logistic regressions indicate that boys were more likely than girls to belong to *Ability-Focused* and *Disengaged* profiles relative to the *Growth-Focused* profile, especially in English. These findings echo person-centred studies guided by other motivational theories, which show that girls tend to display more adaptive patterns of motivation than boys (Litalien et al., 2017; Schwinger et al., 2016; Vansteenkiste et al., 2009).

Gendered motivational tendencies documented in this study might contribute to boys' relative underachievement in schools. In England, boys make less academic progress during secondary school when compared to girls with the same prior achievement (Burgess et al., 2004). The present study found that, compared to girls, boys were more often found in

Ability-Focused and *Disengaged* subgroups, and membership in these profiles hindered students' subsequent performance even after accounting for a range of covariates, including prior achievement. Therefore, the gendered tendency towards proving versus improving might partially account for the gender achievement gap in favour of girls in school. Nevertheless, girls' stronger orientation towards effortful learning might play a role in their underrepresentation in maths-related fields. In contexts where success is believed to require fixed and innate talent, female students tend to misinterpret their hard work as a sign that they are less able and do not belong (Smith et al., 2013; Stout & Blaney, 2017). Overall, thinking in terms of male proving or disengaging versus female striving and improving may deepen our understanding of the educational gender gaps on both sides.

In addition, our exploratory analyses indicate that compared to White students, those from Asian backgrounds showed a much higher likelihood of belonging to the *Growth-Competitive* profile. This orientation towards growth is consistent with research showing that Asian students are more motivated by self-improvement, and believe more strongly in the malleability of abilities (Heine et al., 2001). Interestingly, students from Asian backgrounds only had an increased likelihood of being in the *Growth-Competitive* profile. In other words, they were more likely to pursue multiple goals (versus mastery goals) when operating under a growth mindset. This result is in line with the stronger correlation between mastery and performance-approach goals ($r = 0.43$) as well as the more positive link between mastery and performance-avoidance goals ($r = 0.12$) observed in studies using Asian samples (for a meta-analysis, see Hulleman et al., 2010). As argued earlier, growth mindset might alter the meaning and outcome of performance goals. In support of this idea, performance-approach and -avoidance goals have been found to promote deep learning strategies, intrinsic motivation, and better performance in Asian contexts (Hulleman et al., 2010; King, 2016; King et al., 2012), presumably because these goals are motivated by self-improvement.

Future research could test these claims by comparing students' reasons for pursuing performance goals in different cultural contexts.

Finally, there appears to be a reciprocal relationship between mindset-based meaning systems and achievement. Although the four profiles incrementally predicted students' exam performance beyond prior achievement, students with lower prior achievement were more commonly found in the *Ability-Focused* profile. Several longitudinal studies of primary school children similarly show that low achievers tend to develop a stronger fixed mindset over time, but a fixed mindset does not yet predict subsequent performance in primary school years, indicating a unidirectional relationship (Gonida et al., 2006; Gunderson et al., 2018; Pomerantz & Saxon, 2001). Perhaps younger students begin to form beliefs about the nature of ability by observing their own performance, and persistent low achievement can engender a more pessimistic view about the utility of effort in increasing ability. Once beliefs about ability, effort, and goals unify into a coherent framework, this mindset-based meaning system may start to influence achievement more consistently. Cross-lagged studies that follow students over a longer period may be able to pinpoint when the relation between mindset and achievement becomes reciprocal.

In sum, the present study is among the first to map out students' mindset-based meaning systems using a person-centred approach. Although more research is needed, there is good reason to be optimistic about the generalisability of the profiles. First, they are replicable across two distinct subjects. Second, even the smallest profile consists of around 10% of the students and is unlikely an artefact of our chosen profile solution. Third, the four profiles match findings from previous research on mindsets and achievement goals. Fourth, they show predictable associations with students' background characteristics and subsequent academic achievement. Therefore, the four profiles may capture important individual

differences in how people organise their mindset and associated constructs into a coherent motivational framework.

Implications for practice

Our study suggests that performance goals concerned with competence demonstration are maladaptive when combined with a fixed mindset, but can lead to beneficial outcomes when pursued alongside mastery goals and a growth mindset. This has practical implications because students' motivation typically decline as they progress through education, in part due to the increasingly performance-focused motivational climate (Scherrer & Preckel, 2019). Although high-stakes testing and social comparison are common in secondary schools, nurturing a growth mindset among students has the potential to ameliorate the effects of performance goals and help buffer against the decline in motivation and performance (see Blackwell et al., 2007).

Furthermore, it may be possible to nudge students towards a stronger growth mindset by helping them to develop more adaptive goals and behaviours. From a meaning system perspective, individual components of a coherent motivational framework derive meaning from one another, and people may revise their beliefs about ability in keeping with changes in other motivational constructs (Barger & Linnenbrink-Garcia, 2017; Lou & Noels, 2019). For example, students in the *Disengaged* profile reported very low levels of mastery goals and perseverance in addition to a fixed mindset. Teachers can support these students by helping them to set mastery goals, persist in schoolwork, and reflect on their progress. Progress towards achieving their goals, in turn, may promote more adaptive motivation and beliefs about growth over time.

The results also have implications for raising boys' achievement in schools. Past research indicates that boys adopt more performance goals that aim at demonstrating competence, and this performance goal pursuit is associated with increased self-

handicapping, reduced persistence, and worse academic performance (Kenney-Benson et al., 2006; Yu & McLellan, 2019). Our findings suggest that the maladaptive nature of boys' performance goals might be explained, in part, by their tendency to combine performance goals with a fixed mindset. Instead of changing boys' preference for performance goals, instilling a growth mindset might help them move from an *Ability-Focused* profile into a *Growth-Competitive* profile, thereby facilitating their learning and achievement.

Limitations and future directions

There are several limitations to our study that could be addressed in the future. First, research could investigate additional predictors and outcomes of mindset-based meaning systems. For example, studies can include measures of anxiety and burnout to understand the relation between students' mindset-related profiles and wellbeing. Furthermore, our findings pose the intriguing question: what contributes to the within-mindset differences in motivational frameworks? Could fear of failure explain why some fixed mindset students adopt performance goals and self-handicapping, while others fall into a state of indifference? Similarly, could contingent self-worth explain why some growth mindset students pursue performance goals alongside mastery goals, while others remain purely mastery-oriented? Research examining both individual and contextual antecedents has the potential to enrich our understanding of the origins of these profiles.

In addition, although this study measured students' motivation and achievement in temporal sequence, the time lag between the assessment of motivation and achievement was over a year for students in Year 10. Given that there may be changes in students' motivation over time, it is impressive that a snapshot of students' motivational profiles subsequently predicted their academic achievement a year later. The association between motivational profiles and achievement might become even stronger if the two were measured closer in

time. That being said, future research should identify profiles across multiple time points and examine how students' meaning systems change over time.

Lastly, although we argue that there is reason to be optimistic about the generalisability of the profiles, our findings are still context- and sample-specific (i.e., 14-16 year olds from four state-funded English secondary schools). Future research should pay attention to the role of age and contexts in influencing the profile shape, size, and the relation between profiles and achievement. For example, the *Growth-Competitive* profile might be more common among younger children since they do not yet clearly distinguish between different types of achievement goals (Bong, 2009). In addition, other combinations of mindsets and achievement goals may exist. In settings where performance-approach and -avoidance goals are less strongly correlated, some students may score high on growth mindset, mastery and performance-approach goals, but low on performance-avoidance goals. Overall, whether the four profiles emerge and relate to academic achievement in the same manner across developmental stages and cultures warrant additional investigation.

Conclusion

Over the last few decades, research contrasting the effects of a growth versus a fixed mindset has been extremely generative. Numerous studies have shown that students with distinct mindsets, on average, set different goals and exhibit different patterns of behaviour. However, students holding the same mindset are unlikely a homogenous group and differing patterns of motivation may exist. Our findings show that not all growth mindset students set only mastery goals: some of them strive for mastery and performance goals simultaneously. In addition, not all fixed mindset students engage in performance goals and self-defensive behaviours: some of them simply lack any achievement goal and become disengaged. The findings highlight the promise of a person-centred approach for investigating the dynamic integration of motivational beliefs and goals within individuals. As illustrated, moving

beyond theoretical silos and profiling students based on a broader set of variables represents one avenue to unmask the complex relationships among major motivational constructs.

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Supplementary Materials

Appendix 1. Fit indices for latent profile analyses

Profile	LL	#fp	AIC	CAIC	BIC	SABIC	<i>p</i> BLRT	Entropy
<i>English</i>								
2	−4615.39	22	9274.78	9390.99	9368.99	9299.15	<.001	.84
3	−4450.98	30	8961.96	9120.43	9090.43	8995.20	<.001	.83
4	−4308.28	38	8692.57	8893.29	8855.29	8734.67	<.001	.85
5	−4231.70	46	8555.40	8798.38	8752.38	8606.36	<.001	.87
6	−4168.99	54	8445.98	8731.22	8677.22	8505.80	<.001	.85
<i>Maths</i>								
2	−4697.17	22	9438.35	9554.56	9532.56	9462.72	<.001	.80
3	−4520.55	30	9101.10	9259.57	9229.57	9134.34	<.001	.84
4	−4420.22	38	8916.44	9117.16	9079.16	8958.54	<.001	.85
5	−4352.65	46	8797.29	9040.27	8994.27	8848.26	<.001	.88
6	−4295.49	54	8698.98	8984.22	8930.22	8758.81	<.001	.88

Note. Values in bold indicate the selected model. LL = loglikelihood; #fp = number of free parameters; AIC = Akaike information criteria; CAIC = consistent AIC; BIC = Bayesian information criteria; SABIC = sample-size adjusted BIC; *p*BLRT = *p*-value for bootstrapped likelihood ratio test.

Appendix 2. Elbow plots for latent profile analyses

Appendix 3. Profile differences on motivational indicators

English

Variable	<i>Growth-Focused</i>	<i>Ability-Focused</i>	<i>Growth-Competitive</i>	<i>Disengaged</i>
Growth mindset	0.26 _a	-0.30 _b	0.23 _a	-0.47 _b
Positive effort beliefs	0.49 _a	-0.78 _b	0.41 _a	-0.58 _b
Mastery goals	0.50 _a	-0.42 _b	0.66 _a	-1.33 _c
PAP goals	-0.65 _b	0.61 _a	1.08 _a	-0.64 _b
PAV goals	-0.70 _c	0.75 _a	0.80 _a	-0.38 _b
Perseverance	0.53 _a	-0.50 _b	0.53 _a	-1.14 _c
Self-handicapping	-0.63 _d	1.04 _a	-0.11 _c	0.21 _b

Note. Values are z-standardized. Values with different subscripts in the same row are significantly different at $p < .05$.

Maths

Variable	<i>Growth-Focused</i>	<i>Ability-Focused</i>	<i>Growth-Competitive</i>	<i>Disengaged</i>
Growth mindset	0.42 _a	-0.68 _b	0.26 _a	-0.86 _b
Positive effort beliefs	0.37 _a	-0.71 _b	0.25 _a	-0.56 _b
Mastery goals	0.22 _b	-0.49 _c	0.70 _a	-1.45 _d
PAP goals	-0.62 _c	0.48 _b	1.09 _a	-0.86 _c
PAV goals	-0.62 _c	0.49 _b	0.96 _a	-0.61 _c
Perseverance	0.35 _a	-0.58 _b	0.55 _a	-1.44 _c
Self-handicapping	-0.55 _c	1.09 _a	-0.13 _b	0.16 _b

Note. Values are z-standardized. Values with different subscripts in the same row are significantly different at $p < .05$.

Appendix 4. Consistency of profile membership across subjects

	English Profile 1	English Profile 2	English Profile 3	English Profile 4	Total	% remain
Maths Profile 1	178	9	13	40	240	74
Maths Profile 2	6	74	27	21	128	58
Maths Profile 3	16	30	66	9	121	55
Maths Profile 4	9	9	2	26	46	57
Total	209	122	108	96		
% remain	85	61	61	27		

Note. Profile 1 = *Growth-Focused*; Profile 2 = *Ability-Focused*; Profile 3 = *Growth-Competitive*; Profile 4 = *Disengaged*. Overall consistency = 64%.