INSTRUCTOR BELIEFS: PRACTICE, MESSAGING AND OUTCOMES

MINDSET IN THE MARGINS: INSTRUCTOR BELIEFS AS PREDICTORS OF PRACTICE, MESSAGING AND STUDENT OUTCOMES

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TITLE: Mindset in the Margins: Instructor Beliefs as Predictors of Practice, Messaging, and Student Outcomes

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Lay Abstract

Instructor beliefs about student abilities and intelligence influence how they teach, communicate, and support students, which ultimately impacts student motivation and performance. In this study, I examined how instructors' beliefs predicted their teaching practices, messaging, and student outcomes. Instructors who believed intellectual abilities could be developed reported performing teaching behaviours and messaging in syllabi that communicated these beliefs more often. However, instructor and student reports of instructor beliefs and teaching behaviour frequency did not align. The results revealed that student perceptions were stronger and more consistent predictors of student motivation and engagement. Therefore, instructors need to ensure their pedagogical values are not just held privately, but clearly communicated and reinforced. Institutional efforts to train instructors in inclusive and growth-oriented practices should also emphasize this, as it is students' perceptions, not instructors' intentions, that ultimately drive motivation.

Abstract

Instructors play an important role beyond teaching course material in the classroom, they are central to shaping students' experiences. One way that instructors influence students' motivation and engagement stems from their own beliefs about students' intellectual abilities. Mindset beliefs refer to whether intellectual abilities can be developed over time (*growth*) or are innate (*fixed*). Universality beliefs refer to whether everyone (*universal*) or only some people (*nonuniversal*) have the potential to reach the highest level of success. Brilliance beliefs refer to whether an innate talent is required for success in a given field. These beliefs have all been previously tied to student performance, motivation, and engagement. Instructors and students from STEM fields were surveyed across both studies. In Study 1, I investigated whether these beliefs predicted instructor self-efficacy, behaviours, and messaging to students (n=28). Additionally, I examined whether beliefs differed by discipline or demographics. In Study 2, I examined whether instructor and student reports of instructor beliefs and behaviours aligned, and whether one was more significant in predicting student outcomes (n=140). Overall, the findings demonstrated that growth mindset and universal beliefs are positively associated with instructor self-efficacy and teaching practices that communicate these beliefs to students. Though instructor beliefs are important in predicting select student outcomes, it is students' perceptions of instructor beliefs that are stronger and more consistent in predicting student motivation overall. This suggests that while instructor beliefs are important, the key to enhancing student experiences may be to ensure that these beliefs are clearly communicated to students. This is particularly important in STEM classrooms where students generally perceive the courses to be more difficult and cite negative classroom experiences and diminished motivation as reasons for

leaving STEM. However, further research is needed to explore how institutional efforts can be designed to drive student motivation and engagement.

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ICC, intraclass correlation

M, mean

SD, standard deviation

Declaration of Academic Achievement

I, Veronica Cui, declare that I am the sole author of this thesis. I was responsible for conceptualizing the research questions and conducting data analyses.

Dr. Joseph A. Kim, Dr. Faria Sana, Dr. Elizabeth Canning, and Dr. Bruce Milliken contributed to the design of this study by providing valuable suggestions and feedback throughout the research process. Dr. Faria Sana also helped conceptualize statistical analyses for Study 2 and the interpretation of findings.

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Introduction

Instructors play an important role in the classroom—beyond teaching course content, they are central to shaping students' experiences. Their beliefs about student abilities and intelligence influence how they teach, communicate, and support students, which ultimately impacts student motivation and performance. STEM courses, which are generally perceived to be difficult and tied to field-specific abilities, have a significant dropout rate, in which a large proportion of students cite negative classroom experiences and diminished motivation as key factors. As such, the role of instructors is particularly important in science, technology, engineering, and math (STEM) classrooms (Hunter, 2019).

Moreover, students from historically underrepresented groups, such as racial/ethnic minority groups (Black, Hispanic/Latinx, and Indigenous students) and women, have been negatively stereotyped in STEM (Barger, 2019; Canning et al., 2019; Leslie et al., 2015). These groups of students can be subjected to negative biases which may manifest as situational cues in the classroom that reinforce these stereotypes which are believed to be associated with hindered academic performance and belonging (Canning et al., 2019; Dar-Nimrod & Heine, 2006; Muenks et al., 2020).

Instructor beliefs can be conceptualized through three distinct lay theories: mindset, universality, and brilliance. Mindset beliefs refer to the malleability of abilities and intelligence. While a growth mindset refers to the belief that one's abilities can be developed over time through effort (Yeager et al., 2019), a fixed mindset refers to the belief that these do not change over time. Universality beliefs refer to the distribution of potential in a population. A universal belief refers to the idea that everyone has the potential to reach the highest level of ability, whereas a nonuniversal belief refers to the idea that only some people have the potential to

succeed (Rattan, Savani, et al., 2012). Brilliance beliefs refer to the belief that success in a field requires innate talent (Leslie et al., 2015). Altogether, these belief systems influence how instructors teach, communicate expectations, and how students experience learning, affecting student performance and motivation.

Previously, these beliefs have been studied individually. However, growing research suggests that these theories are related but distinct constructs (Limeri et al., 2023). Studying the three theories in conjunction with one another can help better understand how each contributes uniquely to various student outcomes. Additionally, while research has established the positive outcomes of instructor growth mindsets, there is little research available studying the mechanisms through which instructors communicate mindset messages.

Altogether, this highlights a need to understand how these beliefs manifest in teaching behaviours and messaging, and how they are perceived by students. The present study aims to address this by examining how these beliefs predict teaching behaviours, messaging to students, and student outcomes. By understanding these relationships further, the study aims to provide insights for faculty development and provide a foundation for designing interventions which aim to improve student outcomes, and further narrow racial achievement gaps.

Literature Review

Brilliance Beliefs and Implications on Student Outcomes

Brilliance beliefs refer to the belief that an innate talent is required for success in a given field (Leslie et al., 2015). In contrast to general intelligence, which is the focus of mindset beliefs, brilliance beliefs specifically refer to exceptional intellectual abilities (Bian et al., 2018; Heyder et al., 2020). These beliefs are domain-specific and may vary across fields based on what

characteristics members of the discipline deem to be critical for success, otherwise known as field-specific ability beliefs (Bian et al., 2018).

The field-specific ability beliefs model hypothesizes that the brilliance beliefs and messages associated with a field, in combination with the gender-brilliance stereotype, can explain gaps in representation in STEM fields (Bian et al., 2018; Meyer et al., 2015). This is because innate talent is typically seen as a requirement for success, and pervasive cultural stereotypes tend to associate men, rather than women, with raw innate talent. Furthermore, this gender-brilliance stereotype is instilled in children as young as 6 years old, and has subsequent effects on children's interests and beliefs (Bian et al., 2017; Wang et al., 2025).

Across 30 academic disciplines, fields that endorsed giftedness consistently had lower proportions of female Ph.D. holders. Further research suggests that this finding extends to lay people; lower female representation is found in disciplines believed to require more raw talent. In addition, members of disciplines that emphasized raw talent also assessed their field to be less welcoming to women and that women were less suited for higher-level work in academia than men, suggesting that field-specific ability beliefs may be fostering these beliefs (Leslie et al., 2015). The biases that exist in brilliance-centred disciplines are critical components that influence students' likelihood of pursuing further studies and careers in the field. When examining psychological variables in a high school sample of students in STEM courses, social belonging was the only significant predictor associated with female students' intentions to persist in STEM (Ito & McPherson, 2018), underscoring the implications that brilliance beliefs may have on student belonging and, ultimately, career choice.

The issue of under-representation in disciplines that emphasize giftedness persists in other minority groups within academia. Widespread stereotypes perpetuate the notion that White

and Asian individuals possess greater innate abilities than Black, Hispanic/Latinx, and Indigenous students in STEM fields. Similar to the pattern observed with female representation across disciplines, African American representation was negatively associated with disciplines emphasizing innate talent as a requirement for success. In contrast, among Asian Americans, a group that does not experience the same intellectual stereotypes, representation is not predicted by field-specific ability beliefs (Leslie et al., 2015). Taken together, these findings suggest that field-specific ability beliefs may lead to minority groups internalizing these stereotypes about innate talent, ultimately leading to gaps in representation at higher levels of academia.

Messages tying brilliance and success together have important implications on psychological outcomes. An experimental study by Bian et al. (2018) revealed that brilliance belief messaging undermined women's interest across a range of educational and professional opportunities, supporting Leslie et al.'s (2015) findings that female involvement in academia is associated with field-specific ability beliefs. In addition to influencing interest-value in opportunities, women who received brilliance messaging also reported feeling higher levels of anxiety and reduced sense of belonging. Additionally, the association of brilliance with success led to early-career academics experiencing heightened impostor feelings that were related to lower sense of belonging and self-efficacy (Muradoglu et al., 2022). Considering the role that parents, educators, and community members play in the development of children, messages about ability beliefs may play a critical role in determining students' career choices and long-term career success, particularly for traditionally underrepresented groups in academia (Meyer et al., 2015; Muradoglu et al., 2022).

In classrooms, instructor brilliance beliefs have important implications on student motivational outcomes, especially for low achieving students. For instance, when teachers

endorsed the belief that math required an innate ability, low achieving students who were performing half a grade unit or more below class average reported lower intrinsic motivation (Heyder et al., 2020). In contrast, high-performing students' intrinsic motivation was not associated with their instructor's math-specific ability beliefs. Instructors who subscribe to brilliance beliefs may be communicating the idea that success (or high grades) requires an innate level of talent. This may lead to low achieving students viewing their poor performance as a sign of incompetence and undermining their motivation (Heyder et al., 2020). Instructor beliefs may also further influence students' sense of autonomy and belonging.

Further research about the role instructors' brilliance beliefs play in influencing student outcomes should be conducted to better understand how student learning experience can be enhanced. This research may also have important implications in addressing underrepresentation across fields.

Universality Beliefs and Implications on Student Outcomes

While brilliance and mindset beliefs focus on observed intelligence and abilities, universality beliefs refer to the distribution of potential across a population. A universal belief refers to the notion that everyone has the potential to reach the highest level of ability, whereas a nonuniversal belief refers to the idea that only some people have the potential to reach the highest level of ability (Rattan et al., 2018; Rattan, Savani, et al., 2012).

Despite its relatively recent proposal as a lay theory, emerging research suggests that beliefs about the distribution of potential may vary across cultural groups. In a series of studies comparing American and Indian universality beliefs, Rattan et al. (2012) found that while both universal and nonuniversal beliefs were present in both groups, Americans held fewer universal beliefs and were more likely to endorse that only some people had the potential for high

intelligence. Notably, this cultural difference was specific to beliefs about intelligence and was not explained by general cultural differences, nor did it extend to other domains such as musical talent or athletic abilities (Rattan, Savani, et al., 2012).

Universality beliefs may also have further implications on individuals' beliefs regarding educational policy and resource allocation. For instance, individuals who possess universal mindsets are more likely to see education as a fundamental human right (Savani et al., 2017). This is consistent with a universal belief—that anyone can succeed if they receive the right education. Conversely, this may also be explained by the idea that individuals with nonuniversal views may view education to be a fundamental right, but only for individuals who demonstrate high potential. Furthermore, when exposed to universal beliefs or the idea that everyone has the potential to become highly intelligent in a biased questionnaire task, participants were more likely to support policies that focused on investing in educational resources for all students, as well as reallocating resources more equally between high- and low-income communities, compared to those who were exposed to nonuniversal beliefs (Rattan, Savani, et al., 2012). One possible explanation is that individuals who hold nonuniversal beliefs may interpret underperformance as evidence of lack of potential, which in turn leads them to question the value of investing in or reallocating educational resources. Thus, these individuals may be more likely to support policies that reflect an unequal distribution of resources.

In classrooms, universality beliefs may help in predicting student outcomes. In a sample of undergraduate students, the overall universality beliefs were related to students' psychological outcomes, including students' sense of belonging and intent to persist in STEM (Limeri et al., 2023). More specifically, endorsing universal beliefs predicted a greater sense of belonging and a stronger intent to persist in STEM. Conversely, nonuniversal beliefs predicted a lower sense of

belonging and a weaker intent to persist in STEM. Interestingly, nonuniversal beliefs also predicted students' evaluative concern—concern at being negatively evaluated following a mistake—while universal beliefs did not (Limeri et al., 2023).

Similarly, students' perceptions of their faculty's universality beliefs are significant in predicting student motivational outcomes. In a survey among Ph.D. candidates in STEM fields, women who perceived their instructors to hold greater universal beliefs also reported feeling a greater sense of belonging in their field (Rattan et al., 2018). Interestingly, this relationship was not found for male candidates, despite men and women having similar perceptions of universality beliefs. Self-reported universality beliefs did not explain this finding either, although participants' perceptions of instructor beliefs aligned with participants' self-reported universality beliefs. The results were further replicated in a challenging introductory science course. When underrepresented students reported they perceived their instructor to hold universal beliefs, they tend to report a greater sense of belonging to their major (Rattan et al., 2018). A greater sense of belonging also explained why students who perceived their instructor to endorse universal beliefs outperformed those who perceived their instructor to endorse nonuniversal beliefs. Taken together, these results suggest that instructors' universality beliefs may have significant implications on students' sense of belonging in STEM courses, which ultimately influence other student outcomes, especially for underrepresented minority groups.

Individuals from groups which are negatively stereotyped are more aware of situational cues that may reflect these stereotypes. Perceiving situational cues, such as their instructor indicating that they do not have the potential to succeed, reflects these beliefs, which are ultimately related to decreased motivation, engagement, and achievement (Murphy et al., 2007). In a series of experimental studies where participants were exposed to hypothetical scenarios

describing instructors with either universal or nonuniversal beliefs, there was a significant majority-minority gap in students' perceptions of the course (Rattan et al., 2018). This held true for both racial and gender minorities. European American undergraduate students were significantly more likely to report feeling more inclined to take the course than African American students. Similarly, when exposed to nonuniversal messaging, females felt a lower sense of belonging to the course when compared to men, along with more social identity threat and a greater agreement that their instructor endorsed negative stereotypes. However, when exposed to universal messaging, these gaps—both in race and gender—were eliminated. These findings suggest that students' perceptions of instructor universality beliefs may be particularly influential for underrepresented minorities.

Further research about the role instructors' universality beliefs play in influencing student outcomes, particularly their sense of belonging, is necessary to better understand how to optimize student learning experiences. This research may also have important implications in addressing underrepresentation across fields.

Mindset Beliefs and Implications on Student Outcomes

Mindset beliefs refer to an individual's implicit theory on the nature of intelligence. Specifically, a growth mindset refers to the belief that intelligence can be developed and improved over time, whereas a fixed mindset refers to the belief that intelligence is innate (Dweck & Leggett, 1988).

The majority of the research investigating mindset beliefs in classrooms have focused on students' mindsets and how they influence student outcomes. Previous research has linked student mindset to course achievement. Adolescents who endorsed more growth mindset beliefs demonstrated an increase in course performance over the course of two years, as opposed to

students with fixed mindsets who did not experience any improvement (Blackwell et al., 2007). Even in students as young as first or second grade, those who endorsed growth mindset beliefs performed better on a standardized math test than those who endorsed fixed mindset beliefs (Park et al., 2016). These findings suggest that mindset beliefs are relatively stable throughout a lifetime and can predict academic performance even from a young age.

In addition to academic performance, mindsets have also been linked to student motivation and psychological outcomes, which may explain the link between mindset and performance. Individuals who hold growth mindsets hold more positive outlooks about putting in effort, viewing effort as an opportunity to learn (Blackwell et al., 2007; Rubin et al., 2019). Though self-reported beliefs are important predictors of student motivation, experimental studies in which students are exposed to growth mindset theory through interventions show increased motivation when compared to a control group (Blackwell et al., 2007). In STEM courses specifically, students who hold greater levels of growth mindset also self-report higher sources of science self-efficacy and interest in pursuing science (Marriott et al., 2019). Student mindset has also been linked to maladaptive behaviours, such as procrastinating or being unprepared for tests (Limeri et al., 2023). Those with fixed mindsets typically engage in these behaviours more, whereas those with growth mindsets are negatively associated with these behaviours. Theoretically, this may be explained by the fact that students would be able to attribute poor performance to these behaviours rather than their performance, which would signal low intelligence or abilities (Limeri et al., 2023). These findings illustrate the impact that student mindsets can have on outcomes that ultimately influence student motivation and behaviours.

Student mindsets are also predictive of student achievement goal orientation. When students set goals in a course, those who hold growth mindset beliefs are more likely to adopt

mastery goal orientations, which emphasize developing competence, whereas those with fixed mindsets adopt performance goal orientations, which emphasize demonstrating competence. For example, children with fixed mindsets tended to focus on performance goal orientations by completing easier activities in order to demonstrate their competence to their peers (Muradoglu et al., 2025). These findings show how children interpret effortful tasks. When presented with difficult tasks, students who endorsed fixed mindsets were more likely to associate higher levels of effort with lower comprehension and less mastery (Miele et al., 2013). These findings demonstrate that the way which students perceive competence and set goals in classrooms can be predicted by their mindsets. This holds true even from a young age, where motivations greatly influence behaviour.

While students' own mindset beliefs are key factors in performance and motivation outcomes, emerging research suggests that instructor beliefs are equally important to student experiences. Faculty theories about their own intelligence or their students' intelligence do not differ (Rubin et al., 2019). For instance, an instructor who believed that their own intelligence could develop over time was also more likely to endorse that their students could develop their intellectual abilities over time as well. Moreover, recent research suggests that instructor demographics, such as age, gender, and academic discipline, do not predict instructor mindsets (Canning et al., 2019; Rubin et al., 2019). More research should be done to investigate instructor mindset differences, given that Rubin et al. (2019) found that teaching-track instructors were more likely than tenure-track professors to endorse growth mindsets. Understanding faculties' beliefs about mindset and any mindset differences is important to developing better insight into how student experiences can be enhanced.

This is of particular importance, given that instructor mindset beliefs are linked to student achievement and motivation. When students were taught by instructors who endorsed fixed mindset beliefs, students reported less motivation and more negative experiences in the course (Canning et al., 2019). These findings highlight the role that instructor mindset beliefs can play in student experiences and achievement.

Another emerging area of research has focused on connecting student perceptions of instructor mindset beliefs with student outcomes. Students who perceive their instructor to endorse growth mindset beliefs report increased engagement, social connectedness, and emotional well-being (Wang et al., 2025). This is only true for student perceptions, not instructors' self-reported beliefs. Even when an instructor self-reports low levels of fixed mindset, students who perceive their instructor to hold fixed mindset beliefs consistently report feeling a lower sense of belonging, more evaluative concerns, a greater sense of impostor syndrome, and heightened negative affect (LaCosse et al., 2021; Muenks et al., 2020). These outcomes are linked to an overall greater sense of psychological vulnerability and thus explain students' reduced engagement, interest, and performance (Muenks et al., 2020). Interestingly, the relationship between student perceptions of instructor mindset and student outcomes was still significant after controlling for students' own beliefs. Again, this demonstrates that student perception of instructor mindset is key in determining achievement, engagement, and motivation.

The importance of self-reported and student perceptions of instructor beliefs may also be crucial for increasing the representation of minority groups in STEM. Though all students reported decreased engagement and motivation when they perceived their instructors to believe intelligence was fixed, as opposed to instructors who believed intelligence could be improved, the effects of students' perceptions of mindset beliefs were much larger across all outcomes

among female students than male students (LaCosse et al., 2021). In the Canning et al. (2019) study examining the influence of instructor beliefs on student outcomes, the effect of instructors with fixed mindsets on student motivation and achievement was larger for underrepresented minorities. In fact, the racial achievement gap between underrepresented minorities and non-underrepresented minorities was nearly twice as large in courses taught by instructors with fixed mindsets than when taught by instructors who held growth mindsets (Canning et al., 2019). These findings align with an identity threat framework, which suggests that individuals from groups which are negatively stereotyped are more aware of situational cues that indicate that their identity may result in stigma. These situational cues may then lead to psychological concerns, which lead to decreased motivation, engagement, and achievement, as described by the cues hypothesis (Murphy et al., 2007).

There has also been concern that warm teaching behaviours and mindset are confounded constructs, with some evidence associating a growth mindset with warm behaviours and fixed mindsets with cold behaviours. However, research still suggests that these constructs are conceptually distinct. For instance, when students were asked to categorize teaching behaviours as growth mindset signalling or fixed mindset signalling, warmth only sometimes influenced categorization. (Kroeper, Fried, et al., 2022). This suggests that while students may be influenced by the warmth or coldness of a behaviour, it is not the only factor that students use when evaluating instructor mindset. Additionally, in an experimental study, when students were asked about their perception of an instructors' beliefs based on feedback received after a low mark on a test, those who received comforting feedback perceived their professor to endorse stronger fixed mindset beliefs, than those who received strategy-based feedback providing concrete suggestions for improvement, and a control condition (Rattan, Good, et al., 2012). Although the comfort

feedback was phrased positively, students perceived the statements of consolation for low ability as fixed mindset oriented, supporting the idea that warmth and friendliness do not always dictate students' perceptions of instructor behaviour. Though a warm demeanor may be beneficial to student outcomes, the benefits of receiving growth mindset messaging persist, even with a cold demeanor. When students were exposed to instructor messaging with both warm and cold demeanors, students who received growth mindset messaging still experienced better outcomes, including a greater sense of belonging, less impostor feelings and evaluative concern, along with higher anticipated effort and course performance than those who received fixed mindset messaging (White et al., 2024). Further, in the fixed mindset condition, having an instructor with a warm demeanor only led to a greater sense of belonging, suggesting that perception of instructor warmth does not negate the effects of fixed mindset messaging. Thus, although instructors with a growth mindset are typically perceived as warmer and friendlier, the benefits of growth mindset messaging are not all accounted for by instructor warmth.

Given the implications of student, instructor, and student perceptions of instructors' mindset beliefs on student performance, motivation, and engagement, further research should be conducted to better understand how these three factors influence student outcomes. This is of particular importance given that fixed mindsets seem to have greater negative effects for underrepresented minorities in STEM.

Distinct Yet Related: Comparing Mindset, Universality, and Brilliance Beliefs

Mindset, universality, and brilliance beliefs are all distinct concepts that offer unique predictive value in understanding student outcomes (Bian et al., 2018; Limeri et al., 2023; Muradoglu et al., 2025; Rattan, Savani, et al., 2012). Though much of the research focusing on mindset, universality, and brilliance beliefs have focused on a single belief dimension, recent

research has begun to look at these beliefs in conjunction, which represent separate underlying dimensions. Even among children between the ages of 5 and 11, these constructs are distinct from one another (Muradoglu et al., 2025).

Previous research has found significant, but small correlations, between mindset and universality beliefs, indicating that they are related but distinct constructs (Limeri et al., 2023; Muradoglu et al., 2025; Rattan, Savani, et al., 2012). While it is predictable that growth mindset is associated with universal beliefs and fixed mindset is associated with nonuniversal beliefs, given the valence of each belief, there may also be individuals who hold growth-nonuniversal or fixed-universal beliefs. For instance, while one might believe that intelligence is malleable and can improve over time, they may simultaneously believe some people have more potential for improvement to reach a high level of intelligence. Conversely, they may believe that intelligence is innate and simultaneously believe that everyone is already at a high level of intelligence. Additionally, these constructs both provide explanations for student outcomes. While some of these explanations overlap, others are distinct. For example, student sense of belonging in STEM is associated with perception of instructors' universality beliefs but cannot be accounted for through perceptions of instructor mindset (Rattan et al., 2018). Thus, it is important to think of the mindset and universality as distinct but related constructs.

Previous research has also suggested that mindset and brilliance beliefs are related in some ways (Limeri et al., 2023; Muradoglu et al., 2025; Porter & Cimpian, 2023). While students may view intelligence to be a fixed trait, they may also simultaneously hold the belief that only those with innate abilities can achieve success in their field (fixed-brilliance beliefs). On the other hand, while students may believe that field-specific abilities are required to succeed in a given field, they may also believe that intelligence and abilities are something that can

change and improve (growth-brilliance beliefs). Though the endorsement of brilliance beliefs is typically positively correlated with fixed mindset beliefs and negatively correlated with growth mindsets, the correlations are still weak to moderate enough to consider them distinct constructs (Limeri et al., 2023; Porter & Cimpian, 2023). Additionally, factor analysis across studies supports this claim. Finally, both brilliance and mindset beliefs offer unique contributions in understanding student outcomes (Bian et al., 2018; Limeri et al., 2023; Porter & Cimpian, 2023). For instance, students' math performances were predicted by their outlook on whether field-specific ability beliefs were required for success, rather than whether they endorsed fixed or growth mindset beliefs.

Universality and brilliance beliefs are newer constructs that have not been typically studied in conjunction with one another. However, emerging studies have demonstrated that universality and brilliance also exist as distinct lay theories, though nonuniversal beliefs are typically moderately correlated with brilliance beliefs (Limeri et al., 2023; Muradoglu et al., 2025). While universality focuses on distribution of potential, the brilliance belief holds that exceptional intellectual abilities are required to succeed in a given field. Thus, while someone may believe that everyone has the potential to reach the highest level of ability, they may also simultaneously believe that one must demonstrate exceptional abilities to achieve success in a field (universal-brilliance beliefs). Contrarily, one might believe that only some individuals have the potential to reach the highest level of ability, and these are the same individuals who can demonstrate the abilities required to be successful in a field (nonuniversal-brilliance beliefs).

While research has established mindset, universality, and brilliance beliefs to be distinct constructs, they have also suggested that even fixed/growth and universal/nonuniversal beliefs are distinct constructs. Although these have previously been thought to exist at opposite ends of a

spectrum, there are typically weak to moderate correlations between fixed/growth and universal/nonuniversal beliefs, which suggests that they may not be complete opposites (Limeri et al., 2023; Scherer & Campos, 2022). Instead, it may be that individuals hold both fixed/growth or universal/nonuniversal beliefs simultaneously. Similar to the sections above, these four beliefs have been found to have unique explanatory value in understanding student outcomes. For instance, Limeri et al. (2023) found that students' course performance was significantly predicted by growth and universal beliefs but not fixed or nonuniversal beliefs. Taken together, these findings highlight more nuanced relationships between different lay theories.

Overall, the body of evidence suggests that research investigating student outcomes should consider using five lay theories given their unique predictive power.

Communicating Ability Beliefs: Instructor Messaging and Student Interpretation

Students' perceptions of instructor beliefs about their ability are critical in predicting student outcomes and behaviours. Given that instructors interact with students in many settings through one-on-one interactions, lectures, and course materials, students have many opportunities to make inferences from their instructors' behaviours to interpret their beliefs. While previous research has shown the efficacy of manipulating students' perceptions of brilliance, universality, and mindset beliefs through experimental interventions to improve student outcomes, most of the research focused on identifying teaching behaviours that signal beliefs has concentrated on the mindset literature.

With respect to mindset perception, research suggests that students use a multitude of cues to interpret instructor mindset, including explicit messages, teaching practices, and course policies or assessments that indicate that student abilities are either innate or can be improved over time (Kroeper, Fried, et al., 2022; Kroeper, Muenks, et al., 2022; Muenks et al., 2024; Sun,

2018, 2019). For instance, some teaching practices that indicate a growth mindset include providing various opportunities for practice and feedback along with providing extra help to students in need, signalling that students may use these opportunities and guidance to improve their abilities (Muenks et al., 2024). Further, there is a moderate association between student perceptions of instructors' growth mindset and their growth mindset behaviours. This suggests that students evaluate their instructors' mindsets using these different aspects of behaviour.

Recent research also suggests that students' perceptions of instructor behaviours are more important in predicting student perceptions and outcomes, rather than instructors' self-reported teaching behaviours. Muenks et al. (2024) found student perceptions of instructor behaviour to be the strongest predictor of how they perceived their instructors' mindsets, whereas instructor self-reported beliefs and behaviours were not significantly associated with how students perceived their mindset. The researchers also found that while there seemed to be an association between instructors' self-reported mindset beliefs and student perceptions, there was no alignment between mindset-relevant teaching behaviour reports (Muenks et al., 2024). Previous research investigating teachers' motivational beliefs, such as their sense of self-efficacy, revealed that teacher beliefs were a significant predictor of their endorsement of teaching practices that support student autonomy, along with student perceptions of those teaching practices (Lauermann & Berger, 2021). However, it was student perceptions of autonomy support that emerged as a powerful predictor of student engagement, whereas instructor beliefs were not directly associated with student engagement. Together, these results suggest that it may be student perceptions of beliefs and behaviours that may be most important in understanding student outcomes, rather than instructors' self-reported beliefs.

One instructor behaviour that may lead to differing student perceptions is autonomy-supportive teaching. Autonomy-supportive teaching, which has previously been associated with higher teacher sense of self-efficacy and instructor responsibility for student outcomes (Lauermann & Berger, 2021), has also been associated with instructor mindset beliefs (Leroy et al., 2007). Instructors who endorsed fixed mindsets were less likely to use autonomy-supportive teaching practices in their classrooms. Conversely, instructor growth mindset and autonomy-supportive teaching practices were positively associated, a relationship mediated by instructor self-efficacy. These align with mindset beliefs since instructors who believe that intellectual abilities can be improved may lead to them believing that they have the ability to guide students to improve (Leroy et al., 2007). Thus, they may be more inclined to implement teaching practices that aim to foster student motivation. This suggests that the beliefs that instructors hold about students' abilities lead to them engaging in different teaching behaviours that indicate their beliefs to students.

Growth mindset signalling behaviours can broadly be categorized into four categories: (i) messages about success, (ii) provision of opportunities, (iii) response to struggle, and (iv) value placement (Kroeper, Fried, et al., 2022; Kroeper, Muenks, et al., 2022). Messages about success refer to the verbal or non-verbal messages that instructors may communicate to students about what it takes to succeed (Kroeper, Muenks, et al., 2022). For instance, an instructor who believes that intelligence can be improved may tell students that hard work and perseverance are required to succeed in their course. Conversely, an instructor who believes intelligence is fixed may tell students that natural talent is required for success (e.g., "If you are not good at coding, this course may not be for you"). Provision of opportunities refers to the quantity and quality of opportunities for practice or feedback that instructors provide (Kroeper, Muenks, et al., 2022). A

growth mindset is typically associated with more opportunities for practice and feedback (Kroeper, Fried, et al., 2022). However, the content of the feedback is crucial in how students interpret the message. For instance, although instructors may comfort students after receiving a bad grade, if the underlying message focuses on the students' inability to succeed, students will interpret this as a fixed mindset behaviour (Rattan, Good, et al., 2012). Response to struggle encompasses instructors' responses to students struggling (Kroeper, Muenks, et al., 2022). This may be conveyed through messages to the student or policies that the instructor implements in response. For example, they may either respond by offering more strategies and opportunities to help students improve or tell students that improvement is not possible. Value placement refers to behaviours which indicate what an instructor communicates to students is important in the course. For instance, instructors who endorse growth mindset beliefs may tell students that showing improvement is important in their course, whereas instructors who endorse fixed mindset beliefs may place an emphasis on exceptional performances that demonstrate high levels of innate abilities.

Although these four categories cover a large portion of mindset-signalling behaviours, these are not all encompassing. For instance, when students reported that their instructors used more elaborative active learning practices (e.g., hands-on activities, real-world projects, interactive discussions), they were also more likely to perceive their instructor to hold stronger growth mindset beliefs, regardless of how satisfied students were with instruction in the course (Muenks et al., 2021). However, this did not hold true for all types of active learning. Student perceptions of other active learning practices, such as practicing data skills or communication skills, were not significantly associated with their perception of their instructors' mindset.

Together, these results suggest that there are a wide variety of behaviours that instructors communicate, leading to students drawing conclusions about their mindset.

Beyond in-class interactions, instructor beliefs may also be communicated to students through written course materials, such as course syllabi. In an experimental study, students read syllabi with either fixed or growth mindset cues communicated through course policies, including the course grading structure, attendance policies, and exam grading schemes, along with messaging that differentiated between what stronger and weaker students may need embedded (Canning et al., 2021). Students exposed to fixed mindset cues were less likely to feel like they belonged and were more likely to believe that the instructor would endorse gender stereotypes. Consistent with previous findings on the stereotype threat hypothesis, women performed worse than men when they believed their instructor held fixed mindset beliefs, but this performance gap was reduced in the growth mindset condition. Emerging research also suggests that it may not be the policies themselves but the rationale that instructors provide for implementing certain policies. In an experimental study, participants were shown syllabi that contained the same course policies which differed in rationale. For example, when explaining office hour policies, a high-quality fixed mindset rationale may communicate that it is an important opportunity for smart students to demonstrate their abilities and discuss the material more in-depth, whereas a high-quality growth mindset would frame it as an opportunity for all students to ask questions and discuss the material. Students who received high-quality fixed mindset rationale were less likely to feel like they belonged, show interest in the course, and were more likely to believe the instructor endorsed gender stereotypes (Ozier, 2023). This suggests that while behaviours and policies can be salient cues for students, understanding instructors' intentions may be a more significant predictor. Taken together, these results suggest

that students interpret instructor mindset through course materials such as syllabi, which ultimately influences their psychological outcomes.

Taken together, the emerging literature examining how student perceptions of instructor beliefs influence psychological outcomes highlights the importance of understanding how instructor beliefs are communicated to students and what influences student perception. This information is crucial in better understanding how to improve student learning experiences and psychological outcomes.

The Present Studies

Although there has been extensive research focused on mindset beliefs, the current literature has only recently shifted to examining the role that instructor mindsets and student perceptions of those mindsets play in influencing student outcomes. Universality and brilliance beliefs are also relatively newer constructs, and more research needs to be done to fully understand the scope of their impact on student outcomes. Previous research suggests that all three lay theories have significant impacts on student motivation and engagement, particularly for underrepresented minority groups. However, these beliefs have not typically been studied in conjunction with one another. Thus, in the present studies, I aim to understand how instructor beliefs influence (i) their teaching practices (Study 1a), (ii) messaging to students (Study 1b), and (iii) student outcomes (Study 2). Study 2 also aimed to address whether student perceptions and instructor self-reports aligned across beliefs and teaching practices, and which were more powerful predictors of student motivation and engagement.

In Study 1a, I investigated whether the five dimensions of instructor beliefs (brilliance, fixed, growth, nonuniversal, and universal) were associated with their sense of teacher self-efficacy and the frequency they perform mindset-relevant behaviours. I also examined whether

instructor characteristics and STEM disciplines predicted the five dimensions of instructor beliefs. Instructors from the faculties of science, health sciences, and engineering were recruited to complete a survey with these measures.

In Study 1b, I investigated how a professor's syllabi may convey their mindset beliefs to students. Course syllabi were collected from instructors in the survey and analyzed for various mindset-relevant behaviours. I then explored whether coders' perceptions of instructor mindset beliefs aligned with professors' self-reported beliefs, and whether this relationship would be mediated by coders' perception of instructor friendliness and warmth.

In Study 2, I addressed two main questions: (1) Do instructor and student reports of instructor beliefs and mindset-signalling teaching practices align? and (2) Are instructor self-reports or student perceptions of instructor beliefs more predictive of student motivational and engagement outcomes? Students were recruited through the instructors from Study 1 who indicated that they would be willing to help with a follow-up study. Students were asked to report their perception of their instructors' beliefs and behaviours.

Implications

Understanding how instructor beliefs influence their teaching practices is crucial given the impact of teaching practices and instructor self-efficacy on student outcomes. Further, if beliefs are clustered among various social groups or STEM disciplines, this provides insight on where interventions may best be targeted. By examining real course syllabi, this study adds to the growing body of literature investigating whether syllabi are effective tools for instructors to communicate mindset messaging, and whether one can accurately predict an instructors' mindset through their course materials. This area of research will provide insights on whether discrepancies between instructors' behaviours and beliefs exist, which could provide

recommendations for professors to adjust their behaviours to clearly communicate their beliefs to students.

Previous research has outlined the important roles that instructor beliefs and student perceptions play in influencing student psychological outcomes. This research will contribute to the growing literature examining this research question and expand the scope of the question to include universality and brilliance beliefs. The findings of this research have important implications on how interventions may be designed depending on whether instructor beliefs or student perceptions are more critical in predicting student outcomes.

Also, this study examines universality, brilliance, and mindset beliefs in conjunction with one another whereas most of the previous research has examined each lay theory in isolation. Additionally, fixed and growth mindset, and nonuniversal and universal beliefs will be studied independently to further understand the nuanced relationships between instructor beliefs and implications on their teaching practices, messaging, and student outcomes.

The results will contribute to the growing literature on instructor beliefs about student abilities and their impact on instructor teaching practices, messaging, and student outcomes. This research will also help inform educators and policy makers on how to best structure teaching practices and interventions to enhance student learning experiences.

Study 1

In Study 1, I examined the relationship between instructor beliefs and teaching practices and messaging. In Study 1a, I investigated the relationship between a professor's mindset belief and their mindset-relevant behaviours. In addition, I also investigated whether instructor beliefs differed based on instructor characteristics and STEM discipline. In Study 1b, I explored how a professor's syllabi may convey their beliefs to students. Instructors' syllabi were coded to

determine the frequency of messaging communicating each belief. I then investigated whether instructor beliefs predicted the frequency of messages in their syllabi. I also examined whether coders were able to accurately predict instructor beliefs after reading the syllabi and whether perception of instructor friendliness or warmth mediated this relationship.

Study 1a

Methods

The study was conducted using Limesurvey, an online survey platform. Participants were instructors from the faculties of science, health sciences, and engineering at McMaster University who were invited to complete a 10 to 15 minute survey regarding their teaching behaviours and beliefs. Participants answered questions regarding their demographics, frequency of teaching behaviours, beliefs about student abilities, sense of teacher self-efficacy, and perception of student failure and blame. Instructors were also invited to upload their course syllabi. Ethics clearance from the McMaster Ethics Research Board was given for all aspects of the study (MREB #6851).

Participants

28 instructors from the faculties of science, health sciences, and engineering were recruited from McMaster University (Ontario, Canada). Participants were awarded a $25 Starbucks gift card upon completion of the survey. All questions in the survey were optional, and participants were given a gift card regardless of how many questions they answered. All participants provided informed consent (study approved by McMaster Research Ethics Board, #6851).

Materials

Survey. The survey was conducted using LimeSurvey and was provided to participants through the recruitment email they received. The survey consisted of 75 questions (see Appendix A). Participants were asked to report their age, years of teaching experience, gender, and race/ethnicity. They were also given an opportunity to upload their course syllabi. There was no limit on how many syllabi instructors could upload. Instructors were also asked about the frequency of various teaching behaviours thought to act as cues of instructor mindset, along with their mindset, universality, and brilliance beliefs. Additionally, instructor perception of student blame and failure and teacher sense of efficacy across three domains: student engagement, instructional practice, and classroom management were measured.

Measures

Mindset-Relevant Behaviours. Instructors were asked to self-report the frequency to which they performed various behaviours that act as situational cues to students about their mindset based on previous research (Kroeper, Muenks, et al., 2022; Ozier, 2023). Of the 20 items used to assess mindset-relevant behaviours, two measured opportunities for office hours (e.g., “How often do you mention and remind your class about office hours?”; $\alpha = .64$), two items measured instructors commenting on grades with one item about voicing displeasure (e.g., “How often do you verbally express displeasure in grades if they are below your standards?”) and one item regarding voicing pleasure. Five items reflected instances where instructors encouraged engagement (e.g., “How often do you explicitly encourage students to come to class?; $\alpha = .44$), nine items reflected providing opportunities for feedback (e.g., “How often do you encourage students to seek professor or TA feedback before turning in an assignment?”; $\alpha = .63$), and two items measured communicating explicit messages about the value of effort in

course achievement (e.g., “How often do you tell students that anyone can do well in your class if they put in effort?”; α = .82). All items were measured using a 6-point Likert scale with 1 indicating never and 6 indicating very often.

Instructor Beliefs. Instructor beliefs about student abilities were measured using an instructor-adapted version of the ULTrA survey designed to measure mindset, universality, and brilliance beliefs in undergraduate students (Limeri et al., 2023; Limeri & Muenks, unpublished). There were a total of 25 items assessing beliefs about student abilities, with five questions assessing each belief: brilliance (e.g., “People who are highly successful in my field have a natural talent for it”; α = .87), fixed (e.g., “In general, how well my students learn is something that they cannot change very much”; α = .82), growth (e.g., If they want to, a typical student in my class can become as effective at applying knowledge as experts in my field; α = .93), nonuniversal (e.g., “Some of my students will always be less effective at learning than those who have a natural talent for it”; α = .81), and universal (e.g., “Any of my students who try could become as good at applying knowledge as experts in my field”; α = .89). Each item was assessed using a 5-point Likert scale 1 (strongly disagree) to 5 (strongly agree). Higher scores reflected greater self-reported beliefs.

Teacher Sense of Efficacy. Teacher sense of efficacy was measured using the teacher sense of efficacy scale (Fives & Looney, 2009). It included 15 items that assessed efficacy across three domains. Out of the 15 items, six items measured efficacy for student engagement (e.g., “How much can you do to motivate students who show low interest in course work?”; α = .87), six items reflected the efficacy of instructional practices (e.g., “How much can you gauge student comprehension of what you have taught?”; α = .91), and three items measured classroom management efficacy (e.g., “How much can you do to control disruptive behavior in the

classroom?"; α = .62). Scores were Instructors answered each item using a 9-point Likert scale from 1 (nothing/not at all) to 9 (a great deal).

Results

Demographics

The average age of participants was 40.93 years (SD = 7.89), and STEM teaching experience was 8.61 years (SD = 6.75). The percentage of female and URM faculty were 35.7% and 14.3% respectively. Participants from nine different STEM disciplines participated. A total of 28 participants' data were used in the analysis.

Beliefs

Five beliefs were measured on a scale from 1 indicating a strong disagreement with the belief and 5 indicating a strong agreeance with the belief for brilliance (M = 1.94, SD = 0.72), fixed (M = 1.74, SD = 0.76), growth (M = 4.02, SD = 1.02), nonuniversal (M = 2.15, SD = 0.87), and universal (M = 3.75, SD = 0.99) beliefs. Scores for each belief were calculated by averaging instructor responses to the corresponding five questions for each belief on the instructor-adapted version of the ULTrA survey. A boxplot displaying the distribution of responses for each belief can be found in Figure 1.

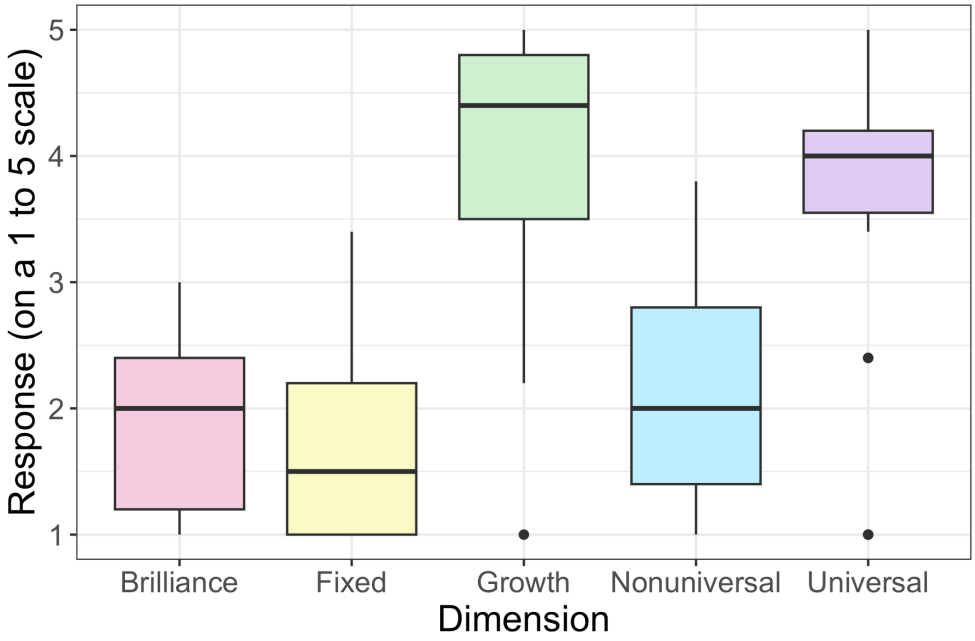

Figure 1

Boxplot displaying the distribution of responses for each belief with 1 indicating a lower belief and 5 indicating a higher belief.

A Pearson's bivariate correlation was completed for the following variables of interest: brilliance, fixed, growth, nonuniversal, and universal beliefs. Table 1 shows the correlation coefficients and p-values for each variable. There were significant positive correlations between fixed, brilliance, and nonuniversal beliefs. Additionally, there was a significantly positive correlation between growth and universal beliefs.

Consistent with previous findings (Limeri et al., 2023), the results support the notion that rather than existing as two opposite ends of the spectrum, nonuniversal and universal beliefs are distinct but correlated constructs, as evidenced by the low raw correlation coefficient (r = -.38). However, contrary to previous studies (Limeri et al., 2023; Scherer & Campos, 2022), growth and fixed mindset beliefs were not found to be correlated constructs.

Table 1

Pearson's r Correlation Coefficients (r) and P-Values (p) for Each Belief Measure

Measure		Brilliance	Fixed	Growth	Nonuniversal
Fixed	*r*	.49	—	—	—
	p	.009**	—	—	—
Growth	*r*	-.28	-.13	—	—
	p	.149	.517	—	—
Nonuniversal	*r*	.64	.38	-.26	—
	p	<.001***	.048*	.179	—
Universal	*r*	-.28	.09	.58	-.38
	p	.153	.665	.001**	.046*

Note: *p < .05; **p < .01; ***p < .001.

Instructor Beliefs and Mindset-Relevant Teaching Behaviours

Mindset-relevant teaching behaviour scores were calculated by averaging instructor responses from 1 (never) to 6 (very often) for six behaviours: providing office hours (M = 4.30, SD = 1.61), voicing displeasure (M = 1.57, SD = 1.07), voicing pleasure (M = 3.54, SD = 1.82), encouraging engagement (M = 4.89, SD = 0.76), providing opportunities for feedback (M = 4.30, SD = 0.90), and explicit messages about progress and success (M = 3.71, SD = 1.87).

A Pearson's bivariate correlation was completed between the five beliefs and the six mindset-relevant teaching behaviours of interest: providing office hours, voicing displeasure, voicing pleasure, encouraging engagement, providing opportunities for feedback, and using explicit messages about the value of effort in achieving success. Table 2 shows the correlation

coefficients and p-values for each variable. Having a growth mindset was significantly positively correlated with instructors' self-reported frequency of voicing pleasure, encouraging engagement, providing opportunities for feedback, and communicating explicit messages about progress and success. These findings suggest that instructors who self-report higher levels of growth mindset tend to perform a greater frequency of growth mindset related behaviours. Furthermore, although feedback was originally considered a growth mindset behavior, universal belief was significantly positively correlated with providing opportunities for feedback. This suggests that feedback may also be an indication of instructor universal belief.

Table 2

Pearson's r Correlation Coefficients (r) and P-Values (p) for Each Belief Measure and Teaching Behaviours of Interest

Measure		Brilliance	Fixed	Growth	Nonuniversal	Universal
Office Hours	*r*	.16	-.002	.33	.05	.28
	p	.410	.993	.084	.797	.149
Voicing Displeasure	*r*	.35	.17	-.09	.08	-.16
	p	.068	.402	.637	.687	.415
Voicing Pleasure	*r*	.11	.23	.41	.05	.23
	p	.587	.241	.030*	.817	.242
Encouraging Engagement	*r*	-.15	-.07	.47	-.04	.34
	p	.438	.707	.011*	.847	.080
Feedback	*r*	.01	.21	.47	.08	.48

	p	.970	.277	.012*	.702	.009**
Explicit Messages	*r*	-.17	.32	.52	-.04	.33
	p	.375	.093	.005**	.836	.090

Note: *p < .05; **p < .01; ***p < .001.

Instructor Beliefs and Teacher Sense of Efficacy

Teacher Sense of Efficacy was measured using the adapted teacher sense of efficacy scale (Fives & Looney, 2009). Three domains of efficacy were assessed on a scale from 1 (nothing/not at all) to 9 (a great deal): student engagement (M = 6.16, SD = 1.38), instructional practice (M = 7.28, SD = 1.27), and classroom management (M = 6.57, SD = 1.33). Scores for each domain were calculated by averaging instructor response for all respective questions.

A Pearson's bivariate correlation was completed between the five beliefs and the three subscales of teacher sense of efficacy: student engagement, instructional practice, and classroom management. Table 3 shows the correlation coefficients and p-values for each variable. Self-efficacy scores across all three dimensions were significantly positively correlated to growth and universal beliefs. This provides support for the notion that instructors who have higher levels of growth and universal beliefs are more confident in their abilities as a teacher.

Table 3

Pearson's r Correlation Coefficients (r) and P-Values (p) for Each Belief Measure and Teacher Sense of Efficacy Measure

Measure		Brilliance	Fixed	Growth	Nonuniversal	Universal
Student	*r*	-.32	.08	.64	-.18	.47

Engagement	*p*	.098	.697	< .001***	.372	.013*
Instructional Practice	*r*	-.26	.03	.61	-.06	.46
	p	.189	.867	< .001***	.767	.015*
Classroom Management	*r*	.01	.06	.68	.11	.44
	p	.954	.745	< .001***	.566	.019*

Note: *p < .05; **p < .01; ***p < .001.

Instructor Beliefs and Instructor Characteristics

Previous research has found no significant relationships between faculty characteristics and their mindset beliefs. To further explore this using all five beliefs, five linear models were created that examined the effects of instructor teaching experience, gender, age, race/ethnicity, and STEM discipline on instructors' self-reported beliefs.

Mindset Beliefs. Consistent with previous findings (Canning et al., 2019), instructor likelihood of endorsing growth or fixed mindset beliefs did not differ based on their teaching experience, gender, age, or race/ethnicity. Additionally, there were no significant differences across disciplines when examining mindset beliefs.

Brilliance Belief. For brilliance belief (see Table 4A), race/ethnicity was a significant predictor of instructors' levels of brilliance belief. Instructors who identified as non-underrepresented minorities (White, Asian) were more likely to endorse the brilliance belief, when compared with instructors who identified as underrepresented minorities. Furthermore, instructors in the chemistry department held significantly stronger brilliance beliefs than instructors in the department of psychology, neuroscience, and behaviour.

Nonuniversal Belief. Looking at Table 4B, only teaching experience and gender significantly predicted instructors' levels of nonuniversal belief; teachers with more years of experience and males, when compared to females, were more likely to subscribe to nonuniversal beliefs. Additionally, instructors in the Integrated Biomedical Engineering & Health Sciences discipline had significantly lower levels of nonuniversal belief when compared to instructors in Psychology.

Universal Belief. The universal belief linear model (see Table 4C) revealed that gender was a significant predictor of instructor endorsement of universal belief, females had higher levels of universal belief when compared to males. Additionally, instructors in the Integrated Biomedical Engineering & Health Sciences discipline had greater levels of universal belief when compared to instructors in Psychology.

Table 4

Instructor Characteristics as Predictors of Brilliance Belief (Table 4A), Nonuniversal Belief (Table 4B), and Universal Belief (Table 4C)

A

Effect	β	SE	t-value	p-value
Intercept	2.19	1.14	1.93	0.07
Experience	0.04	0.03	1.21	0.25
Gender	0.73	0.46	1.60	0.13
Age	-0.01	0.03	-0.51	0.62
Race/Ethnicity	-1.83	0.68	-2.68	0.02*
Earth,	-0.42	0.56	-0.75	0.46

Environment, and Society				
Interdisciplinary Science	-0.31	0.76	-0.41	0.69
Mechanical Engineering	0.55	0.46	1.19	0.25
Kinesiology	-0.58	0.43	-1.35	0.20
Biochemistry	0.06	0.46	0.13	0.90
Chemistry	2.14	0.85	2.53	0.02*
Biology	-1.13	0.75	-1.52	0.15
Medicine	0.30	0.48	0.62	0.55
Integrated Biomedical Engineering & Health Sciences	-0.94	0.85	-1.11	0.29

B

Effect	β	SE	t-value	p-value
Intercept	2.04	1.4	1.46	0.17
Experience	0.09	0.04	2.19	0.05*
Gender	1.38	0.57	2.44	0.03*
Age	-0.02	0.04	-0.52	0.61
Race/Ethnicity	-1.63	0.84	-1.93	0.07
Earth, Environment, and Society	-0.47	0.69	-0.68	0.51
Interdisciplinary	-1.07	0.94	-1.14	0.28

Science				
Mechanical Engineering	0.58	0.57	1.02	0.33
Kinesiology	-0.53	0.53	-1.00	0.33
Biochemistry	0.28	0.57	0.50	0.63
Chemistry	0.57	1.04	0.55	0.59
Biology	-1.50	0.92	-1.62	0.13
Medicine	-0.19	0.59	-0.32	0.75
Integrated Biomedical Engineering & Health Sciences	-2.73	1.05	-2.61	0.02*

C

Effect	β	SE	t-value	p-value
Intercept	3.34	1.4	2.38	0.03*
Experience	-0.01	0.04	-0.22	0.83
Gender	-1.67	0.57	-2.95	0.01*
Age	0.01	0.04	0.42	0.68
Race/Ethnicity	0.39	0.85	0.46	0.65
Earth, Environment, and Society	0.98	0.69	1.42	0.18
Interdisciplinary Science	1.20	0.94	1.27	0.23
Mechanical Engineering	0.26	0.57	0.46	0.66

Kinesiology	1.10	0.53	2.08	0.06
Biochemistry	0.04	0.57	0.06	0.95
Chemistry	1.05	1.05	1.01	0.33
Biology	0.79	0.92	0.86	0.41
Medicine	-0.51	0.59	-0.86	0.41
Integrated Biomedical Engineering & Health Sciences	2.97	1.05	2.83	0.01*

Note: Higher scores on faculty mindset beliefs reflect greater brilliance, nonuniversal, and universal beliefs respectively. Gender was coded as follows: female = 0, male = 1. Race/ethnicity was coded as follows: non-URM (White, Asian) = 0, URM = 1.

*p < .05; **p < .01; ***p < .001.

Discussion

Study 1a investigated the relationship between instructors' self-reported beliefs and their mindset-relevant behaviours, examining the effects of demographics and discipline on these beliefs.

To address the first question, a linear regression analysis was performed to determine whether instructor beliefs about mindset, universality, and brilliance predicted the six themes of mindset-relevant behaviours. Instructors with greater levels of growth mindset reported performing certain mindset-relevant behaviours more frequently, such as voicing pleasure when students perform well, encouraging engagement, providing opportunities for feedback, and voicing explicit messages about progress and success. This suggests that instructors with growth mindsets are conveying more situational cues to their students that intelligence and abilities are

malleable. Furthermore, the results showed that instructors with higher levels of universal belief also provided more opportunities for feedback. This may be due to the fact that instructors are providing all students with more feedback, assuming that this will help them achieve the highest level of success. However, given that these are self-reports, a more important consideration might be whether students' perception of instructor beliefs and frequency of mindset-relevant behaviour align with instructors' self-reported beliefs, which will be further investigated in Study 2.

An exploratory analysis was conducted to investigate the relationship between the five beliefs of interest and teachers' sense of efficacy. These results demonstrate that instructors with stronger growth mindset also have a greater perception of their self-efficacy as a teacher, across all three domains of interest. Similarly, instructors who endorsed universal beliefs more also believed they had higher levels of self-efficacy.

Although growth and fixed mindset, as well as nonuniversal and universal beliefs, have previously been thought to exist on opposite ends of a spectrum, the findings from these linear regressions support recent research suggesting that they should be analyzed as distinct constructs with unique predictive value. While growth mindset was positively correlated with mindset-relevant behaviours and teacher self-efficacy, fixed mindset was not negatively correlated with the same behaviours. Similarly, while universal beliefs were positively correlated with voicing explicit messages in class and teacher self-efficacy, nonuniversal beliefs were not negatively correlated with the same variables of interest. As such, there may be benefits of investigating these beliefs as separate variables to account for their potentially independent nature.

To investigate whether instructor demographics and STEM discipline predict their self-reported beliefs, a series of five linear regression analyses were performed to determine the

effects of instructor characteristics on the five belief measures of interest. Consistent with previous findings (Canning et al., 2019), growth and fixed mindset among instructors did not differ based on teaching experience, gender, age, race/ethnicity (URM vs. non-URM), and STEM discipline. Conversely, the results suggest that brilliance, universal, and nonuniversal beliefs seem to be related to instructor identities and may be related to STEM disciplines. However, given the small sample size, there was not enough power to draw firm conclusions. Future research should further investigate the relationship between universality and brilliance beliefs and instructor characteristics should be conducted with a larger sample size.

Overall, these data suggest that instructors' beliefs about student abilities may impact their teaching practices and perception of teaching efficacy. Additionally, each lay theory offers unique predictive value in understanding instructor beliefs and behaviours. With this in mind, Study 1b will further investigate whether instructors provide situational cues that align with their mindset to their students.

Study 1b

Methods

Overview

In the survey sent out to instructors in the faculties of science, health science, and engineering, instructors were given the opportunity to upload course syllabi for the courses they were teaching in the 2023-2024 school year. There was no limit as to how many syllabi instructors could upload. A total of 41 syllabi were collected from 25 instructors for qualitative content analysis.

Syllabus Coding

Coding Guideline Development. Two undergraduate researchers worked through the syllabi independently coding for thematic units using the coding guidelines developed by the research team. The codebook included code names, definitions, examples, and instructions (see Appendix B).

Thematic units were developed using both deductive and inductive approaches. Themes were originally derived theoretically, using the existing literature (Kroeper, Muenks, et al., 2022; Ozier, 2023). Additionally, using the syllabi, the research team generated new codes or modified existing themes. To ensure a common understanding of the coding guidelines, the two coders actively participated in the development of the coding scheme, and further modifications were made to the guidelines to improve clarity.

Using the revised coding scheme, the two coders then independently coded three syllabi. The three syllabi were then compared among coders. Any discrepancies were discussed, and the guidelines were revised again to ensure comprehensibility. The final coding scheme consisted of five major codes, reflecting the different belief lay theories, and eight subcodes, elaborating on growth mindset-relevant behaviours.

These eight subcodes included (i) accessibility of the instructor team (e.g., explicit statements encouraging students to attend office hours), (ii) encouraging engagement (e.g., encouraging students to attend class), (iii) providing opportunities for feedback (e.g., encouraging students to ask for feedback before submitting an assignment), (iv) explicit messages about success and the value of effort (e.g., telling students that anyone can succeed if they put in effort"), (v) messages about equity, diversity, and inclusion (e.g., statements about belonging in the classroom), (vi) self-care/wellness messages (e.g., statements encouraging self-

care and wellbeing), (vii) professor responsibility (e.g., statements that show professor feels personal responsibility for success for students), and (viii) progress focused grading (e.g., allowing students to revise and resubmit work based on feedback).

Assessment of Intercoder Reliability. To determine intercoder reliability, 10 uncoded syllabi were randomly selected and coded independently by the two coders. The coding frequency, agreement rate, and Cohen's kappa value can be found in **Table 5**. Agreement rate was determined based on whether both coders assigned a main text segment to the same code across the 10 syllabi.

Based on previous criteria, Cohen's kappa for $\kappa = 0.60$ was determined to be sufficient as this kappa value indicates strong agreement between the two coders. Due to the low frequency of coding instances for the fixed, brilliance, universal, and nonuniversal beliefs, only the Cohen's kappa of the growth mindset subcodes were calculated. A kappa value of 0.60 or greater was obtained for all eight subcodes. Since this indicates a sufficient level of intercoder reliability, the remaining 28 syllabi were then divided between the coders to complete independently.

Table 5

Coding Frequency, Agreement Rate, and Coehn's kappa Values of Selected Transcripts (n=10)

Code	Code Description	Coding Frequency	Agreement Rate%	Non-assignment caused by:		Cohen's kappa (κ)
				Coder 1%	Coder 2%	
AIT	Accessibility of the instructional team	21	76	20	80	0.83
EE	Encouraging engagement	25	60	70	30	0.69
FEE	Feedback	8	50	25	75	0.65
EXM	Explicit messages about success and the value of effort	5	60	0	100	0.74

DEI	Diversity, equity, and inclusion	21	76	40	60	0.83
SC	Self-care/wellness	3	67	0	100	0.80
PR	Professor responsibility	4	75	100	0	0.85
PFG	Progress-focused grading	13	62	100	0	0.74

Perceived Instructor Growth Mindset. To assess coder perceptions of instructor growth mindset, coders answered five questions (e.g., The professor in this class seems to believe that in general, their students can become excellent at applying knowledge to solve challenging problems) adapted from the ULTrA survey for instructors (Limeri & Muenks, unpublished). Each question was measured using a 5-point Likert scale with 1 indicating strongly disagree and 5 indicating strongly agree, with higher scores indicating a greater alignment with growth mindset. A mindset variable was created by averaging coder responses to the five questions. Coders' perceptions of instructor growth mindset were significantly correlated ($r = .68$, $p = .01$).

Perceived Instructor Friendliness and Warmth. To assess coder perception of instructor friendliness and warmth, coders answered two questions, with one pertaining to friendliness ("Based strictly on the syllabi, how friendly do you think this professor is?") and one pertaining to warmth ("Based strictly on the syllabi, how warm do you think the tone of the syllabi is?"). Both questions were assessed using a 5-point Likert scale with higher scores indicating more friendliness and warmth. Perception of friendliness ($r = .60$, $p = .03$) and warmth ($r = .61$, $p = .02$) between the two coders were significantly correlated.

Results

Instructor Beliefs and Relevant Messages in Syllabi

Although the original intention was to examine each lay theory, there were very few instances of brilliance, fixed, nonuniversal, and universal messages present across all 41 syllabi. Thus, the remaining analyses focus on instructor growth mindset specifically.

To assess whether instructor growth mindset aligned with the number of mindset messages communicated through their syllabi, a linear regression analysis was performed. Instructor growth mindset was positively associated with the number of growth mindset messages identified in the syllabi ($p = .03$).

Coder Perception of Instructor Mindset

To investigate how instructor mindset beliefs are communicated via course syllabi, whether coders' perception of instructor growth mindset aligned with instructors' self-reported beliefs was explored. The results indicated that there was a significant positive association between coder and instructor growth mindset measures ($p = 0.04$).

Factors Influencing Coder Perception

To further explore how coder perception of instructor mindset was influenced, a linear regression was utilized to examine whether the number of growth mindset messages coded in a syllabus predicted coder perception of instructor growth mindset. The results indicated that the number of growth mindset messages was positively associated with coder perception ($p = .003$). This suggests that instructors who include more growth mindset messages in their syllabi are perceived to have higher levels of growth mindset.

Exploratory Analysis. Given the notion that growth mindset may be confounded with perceptions of friendliness and warmth, coders were also asked to rate their perception of

instructor friendliness and warmth. A linear regression that analyzed the effect of perception of friendliness and warmth on coder perception of instructor growth mindset was conducted. The results indicated that friendliness was significantly positively associated with mindset perception (p = .03), but warmth was not significantly associated (p = .12).

Since coder perception of instructor friendliness and mindset were positively associated, a mediation analysis examining the relationship between the number of growth mindset messages and coder perception of mindset as mediated by friendliness was performed (**see Figure 2**). The analysis revealed a significant indirect effect fully mediated by perception of instructor friendliness. That is, instructors who included more growth mindset relevant messages in their syllabi were perceived to be more friendly, which led to higher perceptions of instructor growth mindset.

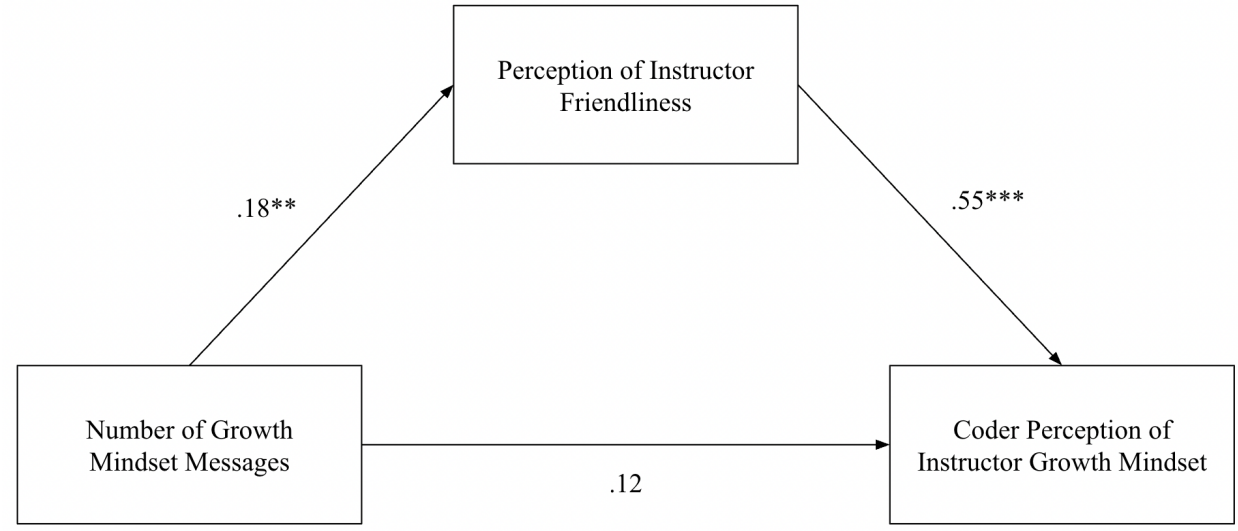

Figure 2

*Regression Coefficients for the Relationship Between Number of Growth Mindset Relevant Messages and Coder Perception of Instructor Growth Mindset as Mediated by Coder Perception of Instructor Friendliness. *p < .05; **p < .01; ***p < .001.*

Discussion

Study 1b addressed two questions: whether instructors conveyed messages in their course syllabi that aligned with their beliefs about student abilities, and whether these beliefs could be inferred from the syllabi.

To address the first question, two undergraduate coders analyzed instructors' course syllabi to identify messages that communicated brilliance, fixed, growth, nonuniversal, and universal beliefs. Due to the low prevalence of brilliance, fixed, nonuniversal, and universal beliefs, the analysis focused on whether instructors' growth mindset was communicated through growth mindset-relevant behaviours. The results revealed that instructors with higher growth mindsets communicated more growth mindset-relevant messaging in their syllabi, suggesting that the way an instructor writes their syllabi may indicate their beliefs to students. Previous findings (Ozier, 2023) have shown that the number of motives for course policies relative to the total amount of policies in a syllabi are marginally related to instructor mindset belief. Taken together with the present findings, this suggests that irrespective of motives describing the rationale for implementing course policies, the number of mindset relevant messages is a significant predictor of instructor mindset.

To explore whether instructor growth mindset can be accurately inferred from their course syllabi, whether two undergraduate coders' perception of instructor mindset was consistent with instructors' self-reported mindset was examined. The results indicated that there was a significant positive association between coder perception and instructor self-reported growth mindset. This contrasts with Ozier (2023) who found no relationship between instructors' self-reported mindset and both coder and student perceptions of instructor mindset. These findings suggest that students may be able to discern instructors' mindsets based solely on

reading their course syllabi. However, like Ozier (2023), we found little to no fixed mindset messaging, further supporting that instructors who hold fixed mindset beliefs may not view the syllabi as an effective tool to communicate their beliefs. Additionally, we found little to no messaging indicating universality or brilliance beliefs. Study 2 will further investigate whether students are able to accurately infer their instructors' beliefs.

Previous research (Ozier, 2023) has found that the proportion of motives relative to the total policies communicated in a syllabi acts as a key mediating mechanism between instructor self-reported mindset and coder perception of mindset. However, in the present study, coder perception of instructor friendliness played a significant mediating role, suggesting a potentially different pathway. This divergence may be attributed to methodological differences. Ozier (2023) examined motives in relation to course policies while the present study focused on the quantity of policies and coder perception of instructor friendliness and warmth. This may have potentially guided coders to attend more to interpersonal tone when forming impressions of instructor mindset. These results contribute to a more nuanced understanding of how the perception of instructor growth mindset and instructors' self-reported mindsets are related, indicating that multiple mediating processes may influence perception of growth mindset. Future research should investigate under what conditions motives or friendliness is more influential and explore additional mediators that may also play a role in shaping students' impressions of instructor mindset.

Study 2

The primary goals of Study 2 were to assess whether (i) students accurately perceive their instructor's beliefs about student abilities, (ii) instructor and student opinions align on how often instructors perform mindset-relevant behaviours, and (iii) students' perceptions of their

instructor's mindset supersedes instructors' self-reported mindset beliefs in predicting student motivational and engagement outcomes. Students from the courses of instructors who completed Study 1 were invited to complete a survey about their perceptions of their instructor's beliefs and teaching practices, and their motivation and engagement.

Methods

Participants

A total of 140 students from 13 courses taught by nine unique instructors from the faculties of science, health sciences, and engineering were recruited from McMaster University (Ontario, Canada). Of the 140 students, 132 were White or Asian (non-URM) and 8 were non-White or Asian (URM). There were 25 students who identified as male, 2 students who identified as non-binary, and 113 students who identified as female. Participants were able to enter a raffle for 1 of 10 $25 Amazon gift cards or a raffle for 1 $250 Amazon gift card upon completion of the survey. All questions in the survey were optional, and participants were able to enter the raffle at the end of the survey regardless of how many questions were answered. All participants provided informed consent (study approved by McMaster Research Ethics Board, #6851).

Materials

Survey. The survey was conducted using LimeSurvey and was provided to participants through the recruitment announcement each instructor shared with their class (see Appendix C). Participants were asked to report their course, instructor, age, gender, and race/ethnicity. Students were also asked to assess their perception of their instructors' mindset, universality, and brilliance beliefs, and their perception of how often their instructors performed mindset-relevant

teaching behaviours. Additionally, they were also asked to self-report their own beliefs and answer questions regarding their motivation and engagement in the course.

Measures

Perception of Instructor Mindset-Relevant Behaviours. Students were asked to self-report the frequency to which their instructors performed mindset-relevant behaviours that act as situational cues to students about their mindset. The items used aligned with the behaviours that instructors were asked to self-report in Study 1. Of the 20 items used to assess mindset-relevant behaviours, two measured opportunities for office hours (e.g., "How often do you mention and remind your class about office hours?"; $\alpha = .57$), two items measured instructors commenting on grades with one item about voicing displeasure (e.g., "How often do you verbally express displeasure in grades if they are below your standards?") and one item regarding voicing pleasure. Five items reflected instances where instructors encouraged engagement (e.g., "How often do you explicitly encourage students to come to class?; $\alpha = .69$), nine items reflected providing opportunities for feedback (e.g., "How often do you encourage students to seek professor or TA feedback before turning in an assignment?"; $\alpha = .81$), and two items measured communicating explicit messages about the value of effort in course achievement (e.g., "How often do you tell students that anyone can do well in your class if they put in effort?"; $\alpha = .83$). All items were measured using a 6-point Likert scale with 1 indicating never and 6 indicating very often.

Perception of Instructor Beliefs. Instructor beliefs about student abilities were measured using an adapted version of the instructor ULTrA survey designed to measure mindset, universality, and brilliance beliefs (Limeri et al., 2023; Limeri & Muenks, unpublished). Students answered a total of 25 items assessing their perceptions of their instructors' beliefs on

student abilities. Each item corresponded with a question that instructors had answered about their own beliefs. Of the 25 items, five questions were asked for each belief: brilliance (e.g., "People who are highly successful in my field have a natural talent for it"; α = .91), fixed (e.g., "In general, how well my students learn is something that they cannot change very much"; α = .89), growth (e.g., If they want to, a typical student in my class can become as effective at applying knowledge as experts in my field; α = .89), nonuniversal (e.g., "Some of my students will always be less effective at learning than those who have a natural talent for it"; α = .93), and universal (e.g., "Any of my students who try could become as good at applying knowledge as experts in my field"; α = .92). Each item was assessed using a 5-point Likert scale 1 (strongly disagree) to 5 (strongly agree). Higher scores reflected greater self-reported beliefs.

Student Beliefs. Student beliefs were measured using the ULTrA survey (Limeri et al., 2023). There was a total of 25 items assessing students' mindset, universality, and brilliance beliefs. There were 5 questions assessing each belief: brilliance (e.g., "People who are highly successful in STEM have a natural talent for it"; α = .92), fixed (e.g., "How well I learn is something that I cannot change very much", α = .73), growth (e.g., "If I try, I can become as effective at learning as STEM experts", α = .91), nonuniversal (e.g., "Even if they try, some people could never become as effective at analyzing information as their peers", α = .82), and universal (e.g., "Anyone who tries could become as good at applying knowledge as STEM experts", α = .87).

Motivation and Engagement. Various motivation and engagement variables were assessed using 25 items. Participants were asked to report how challenging they found the course and how much effort they were putting into it. Two items asked students to report the utility-value of the course (e.g., "I think that what I am learning in this course is important, α = .93), and

two items asked about the interest-value of the course (e.g., "I am really looking forward to learning more from this class, α = .92). Students were also asked about their sense of belonging across two items (e.g., I feel like I belong as a student, α = .83). Three items measured student self-efficacy in the course (e.g., "I know that I can learn new concepts well in this course, α = .82). To measure achievement goal theory, two items measured mastery approach (e.g., "My goal is to learn as much as possible in this course, α = .74), two items measured performance approach (e.g., "My goal is to perform better than the other students in this course, α = .87), and two items measured performance avoidance (e.g., "My goal is to avoid performing poorly compared to others in this course, α = .91). Two items measured whether students saw difficulty as impossibility (e.g., "When a goal feels difficult to attain, then it is probably out of my reach", α = .84). Four items measured students perceived cost of the course (e.g., "This course requires too much effort, α = .84). Two items measured procrastination (e.g., "I have problems prioritizing tasks for this course, α = .75). All questions were asked using a 6-point Likert scale with 1 indicating a strong disagreement with the statement and 6 indicating a strong agreeance.

Results

Demographics and Data Exclusion

A total of 144 students from 13 courses taught by nine unique instructors from the faculties of science, health sciences, and engineering were recruited from McMaster University (Ontario, Canada). Of the 146 students, 3 were excluded for writing course codes or instructors that were not asked to help with participant recruitment and 1 was excluded for leaving all measures blank aside from demographics. Thus, the final sample consisted of 140 students. The average of participants was 19.94 (SD = 1.31).

Student Perceptions of Instructor Beliefs

Student perceptions of instructor belief scores were calculated by averaging responses for five beliefs: brilliance (M = 1.87, SD = 0.85), fixed (M = 1.69, SD = 0.80), growth (M = 4.27, SD = 0.70), nonuniversal (M = 1.55, SD = 0.82), and universal (M = 4.40, SD = 0.64). Higher scores indicated that students more strongly perceived their instructor as endorsing the given belief.

To assess alignment between instructor self-reported beliefs and student perceptions, five linear models were conducted to model student perceptions using instructors' self-reported measures for each belief. Instructor ID was included as a random effect to account for the nested structure of students within instructors for all models except for the growth mindset model. Since the ICC of the growth mindset model was zero, no variance was attributable to differences between instructors. The intraclass correlations for the other four models were near zero (brilliance ICC = .04; fixed ICC = .06; nonuniversal ICC = .03; universal ICC = .03), indicating that variation in perceived instructor beliefs was still driven largely by individual differences among students rather than differences between instructors.

There was no significant relationship between student perception and instructor beliefs for brilliance ($\beta = 0.13$, $p = .317$), fixed ($\beta = -0.07$, $p = 618$), growth ($\beta = -0.10$, $p = .319$), nonuniversal ($\beta = -0.05$, $p = .536$), and universal ($\beta = -0.06$, $p = .538$) beliefs. This suggests that student perceptions of instructor beliefs do not align with instructor self-reported beliefs.

Student Perceptions of Instructor Behaviours

Student perceptions of mindset-relevant teaching behaviour scores were calculated by averaging student responses from 1 (never) to 6 (very often) for six behaviours: providing office hours (M = 4.38, SD = 1.24), voicing displeasure (M = 1.63, SD = 1.16), voicing pleasure (M =

3.63, SD = 1.76), encouraging engagement (M = 4.78, SD = 0.88), providing opportunities for feedback (M = 3.94, SD = 1.02), and explicit messages about progress and success (M = 4.23, SD = 1.55).

To assess alignment between instructor self-reported teaching behaviours and student perceptions, six linear mixed effect models were conducted to examine whether instructor self-reported measures for each behaviour predicted students' perceptions of the frequency of those behaviours. Instructor ID was included as a random effect to account for the nested structure of students within instructors. Results indicated that instructor self-reported frequency was not a significant predictor of student perceptions of frequency of office hours ($\beta = -0.37$, $p = .191$), voicing displeasure ($\beta = -0.23$, $p = .628$), voicing pleasure ($\beta = 0.07$, $p = .713$), encouraging engagement ($\beta = 0.22$, $p = .477$), providing feedback ($\beta = -0.30$, $p = .379$), or explicit messages about the value of effort and success ($\beta = -0.03$, $p = .823$). Overall, these results indicate that students' perceptions of how often their instructors are performing mindset-relevant behaviours in class do not align with instructors' self-reported frequency levels.

The ICC for each model was also calculated for each of the six behaviours. Results indicated low between-instructor variance for office hours (ICC = .04), voicing displeasure (ICC = .04), and explicit messages (ICC = .03), suggesting that only 3 to 4 percent of the variance in these models were attributable to differences between instructors. In contrast, higher ICCs were observed for voicing pleasure (ICC = .18), encouraging engagement (ICC = .14), and providing feedback (ICC = .19) indicating that instructor-level differences accounted for a more substantial proportion of variance in these behaviours.

Motivational Outcomes

To examine whether students' motivational outcomes are better predicted by instructors' self-reported beliefs or by students' perceptions of those beliefs, we conducted multiple regression analyses on ten motivational outcomes. For each outcome, we estimated three models: (1) an instructor-only model that included three instructor belief variables (growth, fixed, and universal), (2) a perception-only model with five student-rated instructor belief variables (growth, fixed, brilliance, nonuniversal, and universal), and (3) a combined model that included all eight predictors. For outcomes where students were nested within instructors and the random effect of instructor ID contributed non-negligibly to model fit, we estimated multilevel models with random intercepts for instructor. For mixed effect models, the marginal R^2 values were calculated using the "muMIn" package on R. The results are summarized below.

Challenge. Models A (ICC = .06), B (ICC = .06), and C (ICC = .02) were fitted with a random intercept for instructorID to account for nesting of students. However, the low ICC values indicate that most of the variation in perceived challenge of the course can be attributed to within-instructor differences, rather than differences between instructors. The fixed effects of the instructor-only model explained only 3.7% of the variance in students' perceptions of how challenging the course was (marginal R^2 = .037) and none of the instructor beliefs were significant predictors (see Table 6). The fixed effects of the perception-only model explained nearly double the variance (marginal R^2 = .068) though none of the student perception variables were significant predictors. The fixed effects of the combined model explained 11.6% of the variance (marginal R^2 = .116), with negligible changes in coefficients from the perception-only model, indicating that student perceptions are driving the relationship.

Table 6

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Challenge

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	2.90 (1.47)	1.91 (1.42)	0.70 (1.97)
Instructor Growth	-0.10 (0.32)	—	-0.20 (0.29)
Instructor Fixed	-0.18 (0.35)	—	-0.13 (0.27)
Instructor Universal	0.40 (0.39)	—	0.55 (0.35)
Perception Growth	—	-0.05 (0.28)	-0.07 (0.28)
Perception Fixed	—	0.18 (0.23)	0.17 (0.24)
Perception Brilliance	—	0.27 (0.18)	0.34 (0.18)
Perception Nonuniversal	—	0.11 (0.24)	0.05 (0.25)
Perception Universal	—	0.28 (0.28)	0.29 (0.28)

Note: *p < .05; **p < .01; ***p < .001.

Utility Value. A random intercept for instructor ID was included in models A (ICC = .08) and C (ICC = .07) though within-instructor differences explained only 7 to 8% of the variance in the respective models. The fixed effects (instructor growth, fixed, and universal beliefs) in the instructor-only model accounted for 3.9% of the variance in student perception of course utility value (marginal R^2 = .039). The perception-only model accounted for slightly more variance (R^2 = .048) though there were no significant predictors. The fixed effects of the combined model explained 10.8% of the variance (R^2 = .108), with negligible changes in coefficients from the perception-only model, indicating that student perceptions are driving the relationship.

Table 7

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Utility Value

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	4.05* (1.17)	3.59** (1.09)	1.79 (1.64)
Instructor Growth	0.05 (0.26)	—	0.09 (0.26)
Instructor Fixed	-0.09 (0.29)	—	0.03 (0.28)
Instructor Universal	0.26 (0.31)	—	0.28 (0.31)
Perception Growth	—	0.07 (0.22)	0.07 (0.22)
Perception Fixed	—	0.10 (0.18)	0.08 (0.18)
Perception Brilliance	—	-0.01 (0.14)	0.04 (0.14)
Perception Nonuniversal	—	-0.12 (0.19)	-0.12 (0.19)
Perception Universal	—	0.31 (0.22)	0.34 (0.22)

Note: *p < .05; **p < .01; ***p < .001.

Interest Value. In the instructor-only model, 10.6% of the variance was accounted for by between-instructor differences (ICC = .106), and the fixed effects of the model, consisting of instructors' self-reported beliefs, explained 6.3% of the total variance (marginal R^2 = .063). The perception-only model had a higher ICC indicating that 13.9% of the variance was attributable to between-instructor variability (ICC = .139). This suggests that student perceptions of instructor beliefs were meaningfully shaped by shared classroom experiences. The fixed effects of the perception-only model, which consisted of student perceptions of five instructor beliefs, explained 7.9% of the variance in students' perceptions of course interest value (marginal R^2 = .079). In the combined model, the random effect for instructor ID explained no variance, indicating that the fixed effects fully accounted for between-instructor differences in student interest. The combined model explained 11.1% of the variance. Within the combined model, instructors' self-reported growth mindsets (β = 0.73, p = .001) were positively associated with

students' interest in the course, instructors' self-reported universal beliefs were negatively associated (β = -0.56, p = .038). This suggests that while instructors who endorsed a growth mindset tended to foster more student interest, those who endorsed universal beliefs may unintentionally undermine student engagement.

Table 8

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Interest Value

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	4.80 (1.37)	3.61** (1.20)	2.88 (1.59)
Instructor Growth	0.56 (0.30)	—	0.73** (0.22)
Instructor Fixed	-0.34 (0.35)	—	-0.07 (0.19)
Instructor Universal	-0.41 (0.35)	—	-0.56* (0.27)
Perception Growth	—	0.34 (0.23)	0.32 (0.23)
Perception Fixed	—	0.03 (0.19)	-0.05 (0.19)
Perception Brilliance	—	-0.02 (0.15)	-0.05 (0.15)
Perception Nonuniversal	—	-0.10 (0.20)	-0.03 (0.20)
Perception Universal	—	0.03 (0.23)	0.06 (0.23)

Note: *p < .05; **p < .01; ***p < .001.

Belonging. The random effect of instructor ID to account for nesting of students across all three models accounted for zero variance, suggesting that all the variation in student sense of belonging was attributable to within-instructor differences. Instructor beliefs did a poor job accounting for variance in students' sense of belonging in the course (R^2 = -.022). In contrast, the perception-only model explained 9.3% of the variance. There were no significant predictors across all three models. The combined model predicted slightly less variance than the perception-

only model, accounting for 7.9% (R^2 = .079). This suggests that the predictive value of student belonging comes from student perceptions.

Table 9

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Belonging

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	4.41*** (1.09)	3.83** (1.27)	2.64 (1.74)
Instructor Growth	0.07 (0.25)	—	0.14 (0.25)
Instructor Fixed	0.02 (0.21)	—	0.13 (0.21)
Instructor Universal	0.02 (0.30)	—	0.04 (0.29)
Perception Growth	—	0.04 (0.25)	0.04 (0.26)
Perception Fixed	—	-0.03 (0.20)	-0.04 (0.21)
Perception Brilliance	—	-0.24 (0.16)	-0.24 (0.17)
Perception Nonuniversal	—	-0.02 (0.22)	0.00 (0.22)
Perception Universal	—	0.31 (0.25)	0.34 (0.26)

Note: *p < .05; **p < .01; ***p < .001.

Self-Efficacy. Between-instructor differences accounted for 6% variance in student sense of self-efficacy in models A and B (ICC = .06) and 12% of the variance in model C (ICC = .12), indicating that majority of the variance is due to within-instructor differences. The fixed effects of the instructor-only model accounted for 0% of the variance, and no instructor self-reported beliefs were significant predictors. In contrast, the fixed effects of the perception-only model, consisting of student perceptions of five instructor beliefs, accounted for 22.1% of the variance (marginal R^2 = .221). Additionally, students' perception of instructor growth mindset beliefs was positively associated with self-efficacy (β = 0.43, p = .038). Although instructors may endorse

growth mindset beliefs, this finding suggests that it is critical for students' self-efficacy that instructors are able to properly communicate this to students. The fixed effects of the combined model accounted for slightly less variance than the perception-only model (marginal R^2 = .213) and students' perceptions of instructor growth mindset remained a significant predictor of self-efficacy (β = 0.46, p = .045). Again, there were negligible changes in coefficients from the perception-only model, again indicating that student perceptions are driving the relationship.

Table 10

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Self-Efficacy

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	4.72* (1.19)	3.83*** (1.05)	3.36 (1.68)
Instructor Growth	0.03 (0.26)	—	0.16 (0.27)
Instructor Fixed	-0.02 (0.28)	—	0.03 (0.32)
Instructor Universal	-0.02 (0.31)	—	-0.08 (0.32)
Perception Growth	—	0.43* (0.21)	0.46* (0.21)
Perception Fixed	—	-0.30 (0.17)	-0.31 (0.17)
Perception Brilliance	—	-0.09 (0.13)	-0.10 (0.14)
Perception Nonuniversal	—	0.05 (0.18)	0.06 (0.18)
Perception Universal	—	-0.08 (0.21)	-0.06 (0.21)

Note: *p < .05; **p < .01; ***p < .001.

Mastery Approach. In the instructor-only model, between-instructor differences accounted for 3% of the variance (ICC = .03). Instructor beliefs accounted for 3.8% of the variance in students using a mastery approach in the course (marginal R^2 = .038), though none of the beliefs were significant predictors. On the other hand, the perception-only model accounted

for 6.4% of the variance ($R^2 = .064$), though none of the variables were significantly associated with using a mastery approach. Between-instructor differences did not account for any variance in the combined model. The combined model explained 8.2% of the variance, with very similar coefficients to the perception-only model indicating that the predictive value comes from student perceptions.

Table 11

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Mastery Approach

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	3.07* (1.11)	3.89** (1.20)	1.68 (1.61)
Instructor Growth	0.16 (0.25)	—	0.26 (0.23)
Instructor Fixed	0.02 (0.24)	—	0.12 (0.19)
Instructor Universal	0.24 (0.30)	—	0.14 (0.27)
Perception Growth	—	0.23 (0.24)	0.21 (0.23)
Perception Fixed	—	0.01 (0.19)	-0.04 (0.19)
Perception Brilliance	—	-0.25 (0.15)	-0.23 (0.15)
Perception Nonuniversal	—	0.06 (0.20)	0.08 (0.20)
Perception Universal	—	0.09 (0.24)	0.14 (0.24)

Note: *p < .05; **p < .01; ***p < .001.

Performance Approach. Between-instructor differences did not explain any variance across all three models. When examining students' performance approach to the course, all three models did a poor job accounting for the variance. The adjusted R^2 values were -.014, -.001, -

.016 for the instructor-only, perception-only, and combined models respectively. Across all three models, there were no significant predictors.

Table 12

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Performance Approach

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	3.24* (1.45)	5.02** (1.80)	3.69 (2.46)
Instructor Growth	0.08 (0.33)	—	0.12 (0.35)
Instructor Fixed	-0.01 (0.28)	—	0.01 (0.29)
Instructor Universal	0.19 (0.39)	—	0.16 (0.41)
Perception Growth	—	-0.50 (0.35)	-0.52 (0.36)
Perception Fixed	—	0.07 (0.29)	0.03 (0.29)
Perception Brilliance	—	-0.24 (0.22)	-0.20 (0.23)
Perception Nonuniversal	—	-0.10 (0.30)	-0.11 (0.31)
Perception Universal	—	0.48 (0.36)	0.50 (0.36)

Note: *p < .05; **p < .01; ***p < .001.

Performance Avoidance. When looking at the performance avoidance goal orientation, between-instructor differences did not account for any variance in the instructor-only model. The instructor-only model accounted for 1% variance (R^2 = .010) and there were no significant predictors of performance avoidance goal orientation. On the other hand, the between-instructor differences in the perception-only model accounted for 3% of the variance (ICC = .03). The fixed effects of the perception-only model which consisted of student perceptions of the five instructor beliefs accounted for 4.9% of the variance, though there were no significant predictors.

The combined model predicted 2.7% of the variance (R^2 = .027). There were no significant predictors, and the variance was all explained by within-instructor differences. There were again negligible changes in the coefficients of the combined model when compared to the perception-only model, indicating that student perceptions are driving this relationship.

Table 13

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Performance Avoidance

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	3.93** (1.38)	5.18 (1.70)	4.27 (2.29)
Instructor Growth	-0.10 (0.32)	—	-0.17 (0.32)
Instructor Fixed	-0.27 (0.27)	—	-0.22 (0.27)
Instructor Universal	0.35 (0.37)	—	0.50 (0.38)
Perception Growth	—	-0.60 (0.33)	-0.63 (0.33)
Perception Fixed	—	0.09 (0.27)	0.05 (0.27)
Perception Brilliance	—	-0.03 (0.21)	0.04 (0.22)
Perception Nonuniversal	—	-0.36 (0.28)	-0.43 (0.29)
Perception Universal	—	0.55 (0.33)	0.55 (0.33)

Note: *p < .05; **p < .01; ***p < .001.

Difficulty as Impossibility. Instructor beliefs accounted for 1.4% of the variance when considering whether students view difficulty or challenges as impossibility. There were no significant predictors. Between-instructor differences only explained variance for the perception-only model. However, the ICC was relatively low (ICC = .03), suggesting that the majority of the variance was attributable to within-instructor differences rather than between-instructor

differences. The fixed effects of the perception model accounted for 10.8% of the variance (marginal R^2 = .108). The combined model accounted for slightly less of the variance (R^2 = .090), with very similar coefficients to the perception-only model, indicating that the majority of the predictive value comes from student perceptions of instructor beliefs.

Table 14

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Difficulty as Impossibility

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	1.56 (1.21)	2.75 (1.44)	2.47 (1.95)
Instructor Growth	-0.22 (0.28)	—	-0.23 (0.27)
Instructor Fixed	-0.16 (0.23)	—	-0.21 (0.23)
Instructor Universal	0.47 (0.33)	—	0.41 (0.33)
Perception Growth	—	-0.48 (0.28)	-0.50 (0.28)
Perception Fixed	—	-0.05 (0.23)	-0.06 (0.23)
Perception Brilliance	—	0.04 (0.18)	0.10 (0.18)
Perception Nonuniversal	—	0.33 (0.24)	0.27 (0.25)
Perception Universal	—	0.26 (0.28)	0.25 (0.29)

Note: *p < .05; **p < .01; ***p < .001.

Cost. Between-instructor differences accounted for 20% of the variance in students' perception of cost of the course (ICC = .20). The fixed effects of the instructor-only model, consisting of the three beliefs, accounted for 1.6% of the variance (marginal R^2 = .016). In the perception-only model, differences between instructors accounted for 10% of the variance (ICC = .10), and the fixed effects accounted for 14.8% of the variance (marginal R^2 = .148).

Differences between instructors accounted for 7% of the variance in the combined model (ICC = .07). The fixed effects of the combined model accounted for 19.2% of the variance (marginal R^2 = .192). Across all three models, there were no significant predictors of students' perception of cost. Similar to the previous linear mixed effect models, the coefficients from the perception and combined models were relatively similar. This suggests that it may be student perceptions of instructor beliefs that may be driving how costly students perceive the course to be.

Table 15

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Cost

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	2.28 (1.88)	2.20 (1.23)	2.40 (1.83)
Instructor Growth	-0.38 (0.39)	—	-0.52 (0.28)
Instructor Fixed	-0.10 (0.52)	—	-0.08 (0.31)
Instructor Universal	0.44 (0.46)	—	0.55 (0.34)
Perception Growth	—	-0.25 (0.24)	-0.25 (0.24)
Perception Fixed	—	0.28 (0.20)	0.31 (0.20)
Perception Brilliance	—	0.04 (0.15)	0.08 (0.16)
Perception Nonuniversal	—	0.19 (0.21)	0.13 (0.21)
Perception Universal	—	0.16 (0.24)	0.13 (0.24)

Note: *p < .05; **p < .01; ***p < .001.

Engagement Variables

Effort. Differences between instructors accounted for 10% of the variance (ICC = .10) in the instructor-only model. The fixed effects of the model, consisting of the instructors' self-reported beliefs, accounted for 3.7% of the variance in students perceived effort (marginal R^2 =

.037). On the other hand, the fixed effects in the perception-only model accounted for 1.5% of the variance (marginal R^2 = .015) and the differences between instructors accounted for 8% of the variance (ICC = .08). The combined model fixed effects explained 4.5% of the variance (marginal R^2 = .045), while the random intercept of instructor ID accounting for student nesting within instructor accounted for 9% of the variance (ICC = .09). Across all three models, there were no significant predictors of students' reports of effort in the course.

Table 16

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Effort

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	4.89* (1.48)	3.86** (1.33)	4.32* (2.04)
Instructor Growth	-0.44 (0.32)	—	-0.42 (0.32)
Instructor Fixed	-0.19 (0.38)	—	-0.13 (0.37)
Instructor Universal	0.41 (0.38)	—	0.41 (0.38)
Perception Growth	—	-0.25 (0.26)	-0.26 (0.26)
Perception Fixed	—	0.02 (0.21)	0.04 (0.22)
Perception Brilliance	—	0.03 (0.17)	0.06 (0.17)
Perception Nonuniversal	—	0.06 (0.23)	0.00 (0.23)
Perception Universal	—	0.32 (0.26)	0.30 (0.26)

Note: *p < .05; **p < .01; ***p < .001.

Procrastination. The random effect of instructor ID accounted for 4% of the variance in the instructor-only model (ICC = .04), and the fixed effects of instructor self-reported beliefs accounted for 2.2% of the variance in students' reported procrastination (marginal R^2 = .022). On the other hand, within-instructor variance accounted for all differences among student

procrastination in the perception-only model. The perception-only model accounted for 2.5% of the variance (R^2 = .025). Additionally, students perceiving instructors to endorse a stronger fixed mindset was positively associated with them procrastinating more in the course (β = 0.65, p = .014). Between-instructor differences accounted for 3% of the variance in the combined model (ICC = .03). The combined model accounted for 7.6% of the variance, and perception of a fixed mindset remained a significant predictor of procrastination (β = 0.65, p = .016).

Table 17

Instructor Beliefs and Student Perception of Instructor Beliefs as Predictors of Procrastination

	Instructor Model	Perception Model	Combined Model
Effect	β (SE)	β (SE)	β (SE)
Intercept	3.15 (1.53)	1.69 (1.65)	2.56 (2.36)
Instructor Growth	-0.33 (0.34)	—	-0.38 (0.35)
Instructor Fixed	-0.20 (0.35)	—	-0.14 (0.35)
Instructor Universal	0.36 (0.41)	—	0.32 (0.42)
Perception Growth	—	0.04 (0.32)	0.04 (0.33)
Perception Fixed	—	0.65* (0.26)	0.65* (0.27)
Perception Brilliance	—	-0.29 (0.21)	-0.24 (0.21)
Perception Nonuniversal	—	-0.04 (0.27)	-0.09 (0.28)
Perception Universal	—	0.12 (0.32)	0.05 (0.32)

Note: *p < .05; **p < .01; ***p < .001.

Discussion

Study 2 aimed to address two main research questions: (i) whether instructors' self-reported and students' perceptions of instructor beliefs and teaching practice aligned, and (ii)

whether instructors' self-reported beliefs or students' perceptions of instructor beliefs were more powerful predictors of student motivational and engagement outcomes.

To address the first question, a series of linear models were conducted. The results of the five linear models examining alignment between instructor beliefs and students' perceptions of those beliefs were all nonsignificant. This suggests that there is a misalignment between instructors' beliefs and what students are perceiving. Moreover, when considering the results across the six mindset-relevant behaviours, the same disconnect is found. These misalignments suggest that student perceptions are not shaped by the instructors' intentions but rather how these beliefs are communicated and interpreted.

To address whether instructor self-reported beliefs or student perceptions of those beliefs are more powerful predictors of student motivational outcomes, a series of three linear mixed effect models were conducted for each outcome. Overall, the combined models that included both instructor beliefs and student perceptions accounted for the most variance across outcomes.

However, student perceptions emerged as more consistent and stronger predictors of student outcomes over instructor self-reports, except for performance approach goal orientation and perceived effort. Across outcomes, instructor beliefs predicted little to no variance (0 to 6.3%). Conversely, student perceptions explained considerably more variance for select outcomes. For instance, the perception-only model accounted for 22.1% of the variance in students' sense of self-efficacy, whereas the instructor-only model accounted for zero variance. In fact, for self-efficacy, adding instructor beliefs to the perception-only model reduced the explained variance, suggesting that there may be some redundancy introduced leading to a poorer model fit. This pattern held consistent for several other variables, such as belonging, performance avoidance goal orientation, and viewing difficulty as impossibility, where the

instructor-only model explained little to no variance, and the perception-only models explained between 4.9 to 14.8% of the variance. Similarly, combining the models led to a worse model fit. Even in the cases of utility value and interest value, where instructor beliefs had a larger impact, student perceptions still accounted for slightly more variance.

There were two notable instances where student perceptions of instructor beliefs were particularly influential in predicting student outcomes. First, students who perceived their instructor to endorse the potential of developing intellectual abilities also reported higher levels of self-efficacy. These students may interpret course challenges as opportunities to grow, rather than as a reflection of inability, which can strengthen their belief in their ability to succeed when faced with difficulty. Thus, students may be more inclined to believe that they can do well while learning and completing challenging tasks. This relationship was not observed with instructor self-reported growth mindset, suggesting that even instructors who hold growth mindset beliefs may not be communicating them meaningfully to students in a way that can enhance self-efficacy. Second, students who believed their instructors to endorse fixed mindset beliefs also reported procrastinating more. When students believe that their instructors see intellectual abilities as fixed, they may interpret challenges as diagnostic of low ability. This may lead to students ultimately postponing assignments and having trouble prioritizing tasks. Together, these findings underscore a consistent pattern: instructor beliefs are not the sole factor in student outcomes, it is also important to consider how students perceive those beliefs. Given the nature of self-efficacy and procrastination, these results suggest that student perceptions of instructor beliefs may play a particularly important role in student psychological outcomes, ultimately shaping how students approach academic challenges.

One unexpected finding was that none of the three models accounted for variance in students' performance approach goal orientations. These goals, which represent a desire to outperform one's peers and demonstrate competence, have previously been associated with a fixed mindset. It was hypothesized that perceiving an instructor to hold fixed mindset or brilliance beliefs would predict a greater level of performance approach goals. However, the lack of predictive power across the three models suggests that instructor beliefs and student perceptions may not be the drivers of student performance approach goal orientation. One possible explanation is that performance approach goals are more strongly influenced by student-level variables, such as their own beliefs, self-efficacy, or personal motivations for achievement. Students who endorse fixed or brilliance views may set performance approach goals to affirm their own abilities, regardless of perceived instructor views. Performance approach goals also have practical implications for students, such as those considering postgraduate schooling. Thus, it may instead be their own personal motivations that account for their likelihood of setting performance-oriented goals. The null findings may also reflect limited statistical power, due to the small sample size. Future studies should aim to further explore the interaction between this goal orientation and instructor beliefs and student perceptions.

Although student perceptions were generally more robust predictors of student outcomes, instructor beliefs were also significantly associated with predicting select outcomes. Instructors who endorsed a stronger growth mindset were associated with students being more interested in the course. In contrast, instructors who endorsed stronger universal beliefs were associated with students reporting lower levels of course interest. Although universal beliefs are considered positively valenced, these results suggest that instructors who strongly endorse these beliefs may be inadvertently undermining student interest, a key predictor of course achievement. While well

intentioned, it is possible that universal beliefs may not be effectively communicated to students. This interpretation is supported by the finding that students' perceptions of instructor universal beliefs were not significantly related to course interest. It may be that these beliefs influence teaching practices in subtle ways that are not salient enough for students to perceive clearly. For example, an instructor who endorses universal beliefs may alter the type of support or feedback offered in the course to reflect their belief that everyone has the potential to reach the highest level of ability. While this may be intended to motivate, such approaches may lead students to feel more pressure to be able to reach their instructors' expectations or to perceive a lack of individualized support, leading to a reduced sense of interest in the course. However, since we did not measure behaviours that corresponded with universal beliefs, future research should investigate how these beliefs are communicated in the classroom and why they may be negatively correlated with course interest. Similar to previous findings, these findings suggest that while students' interpretations of instructor beliefs are crucial, instructor beliefs still play a role in shaping the classroom environment despite being unnoticed by students.

Together, these findings reinforce the critical role of both instructor beliefs and student interpretation in the motivational process, despite the discrepancies between instructor beliefs and behaviours and student perceptions. The predictive value of student perceptions in understanding student outcomes highlights that regardless of what instructors believe internally, it is consistently what students perceive—and how they interpret classroom messages and instructor behaviour—that generally shapes their motivation. These findings also suggest that to enhance student motivation and engagement, it would be more valuable to target student perceptions of instructor beliefs, rather than trying to shape instructors' beliefs.

General Discussion

In the present two-part study, I first investigated how instructor beliefs influence their teaching practices and messaging and then investigated how these beliefs predicted student experiences and outcomes. Throughout both studies, my goal was to examine the nuanced differences between the five beliefs, and the value they provided in predicting student outcomes.

Effect of Instructor Beliefs on Teaching Practice

The results of Study 1 revealed that instructors with greater levels of growth mindset reported performing mindset-relevant behaviours more frequently. This finding aligns with previous research suggesting that instructors who more strongly endorse growth mindset are more likely to endorse teaching practices that are associated with growth mindset. In the present study, voicing pleasure when students perform well, encouraging engagement, providing opportunities for feedback, and voicing explicit messages about progress and success, were all associated with instructor mindset. One unexpected finding is that instructors' mindsets did not predict the frequency to which they provided office hours or voicing displeasure, suggesting that the frequency of these behaviours may be more standard across instructors. One important consideration that may differentiate between instructors with growth and fixed mindsets may be *how* instructors frame these messages. Although voicing displeasure is a negatively valenced behaviour, the key difference when it comes to categorizing the behaviour lies in how the message is framed (Kroeper, Fried, et al., 2022). For instance, when instructors voice displeasure about student grades, adding that they know their students could improve with more effort and practice would signal growth mindset beliefs (e.g., "The class's performance on the last test was poor. However, I know that you can all improve by working hard and practicing for the next test."). Conversely, an instructor with a fixed mindset may interpret poor performance as a result

of inability, which might be reflected in what they voice to students (e.g., "The class's performance on the last test was poor. If you aren't good at coding, you might want to consider whether this course is right for you."). Future research would benefit from exploring the rationale instructors provide for mindset-relevant policies in their course to investigate whether instructor beliefs align with their motives. However, the present findings suggest that instructors with growth mindsets are conveying more situational cues to their students that intelligence and abilities are malleable.

Another notable finding was that instructors with higher levels of universal belief also provided more opportunities for feedback. Instructors who strongly endorse universal beliefs may believe that providing multiple opportunities for feedback will allow students to reach their potential. To my knowledge, universal beliefs have not previously been empirically linked to feedback opportunities. Due to the closed-ended nature of the survey questions, the present study was only able to examine instructors' self-reports on the frequency of which they offered various opportunities for feedback. However, these results suggest that instructors who hold universal beliefs may be structuring their courses to provide more opportunities for feedback. Future studies should investigate this question more in-depth to determine whether it is simply the frequency of feedback that differs or if the type of feedback also differs.

Aside from teaching behaviours, growth mindset and universal beliefs also predicted teacher sense of self-efficacy across all three dimensions of self-efficacy. This supports previous findings which revealed that instructors' growth mindset acted positively on their self-efficacy which indirectly led to instructors endorsing autonomy-supportive teaching practices (Leroy et al., 2007).

Effect of Instructor Beliefs on Messaging

The results of Study 1b revealed that instructors who more strongly endorse growth mindset also have more messages that communicate growth mindset beliefs in their course syllabi. While this study focused on the number of policies and messages communicating growth mindset beliefs, previous research has found that instructors with growth mindset beliefs are also more likely to include rationale for policies, along with more growth mindset words (Ozier, 2023). Although we were unable to determine how much of the syllabi was written by the instructor themself, as opposed to using a departmental or university template, the present findings along with previous research suggests that instructors who hold growth mindsets are more likely to include messaging that conveys these beliefs to students in their course syllabi.

In contrast, little to no fixed, brilliance, or universality messages were found across syllabi, irrespective of instructors' self-reported beliefs. This supports the findings of Ozier (2023) which found that instructors with fixed mindsets were less likely to include messages conveying these beliefs to students in their syllabi. However, the present findings extend these results to brilliance, universal, and nonuniversal beliefs as well. These results suggest that instructors may not view their syllabi as an effective tool to communicate these four beliefs to students. It is important to note that in the present sample, instructors generally reported low endorsement of brilliance, nonuniversal, and fixed mindset beliefs. Thus, one possible explanation for the lack of observed messaging across the syllabi for these beliefs may be because instructors generally did not report endorsing these beliefs. Another possible explanation is that instructors may be more inclined to strictly include information about course policies for students to refer to in syllabi, as opposed to including their own beliefs about student abilities. To address this, future research should investigate the value instructors place on their syllabi as a

tool to communicate their beliefs about student abilities, and whether they communicate these messages to students more explicitly in real-time interactions, such as lectures.

Another notable finding was that coders' perceptions of instructor growth mindset aligned with instructors' self-reported growth mindset, however, this relationship was mediated by coders' perceptions of instructor friendliness. This result is particularly compelling since previous research found no association between coder perceptions and instructor beliefs (Ozier, 2023). The mediation suggests that instructors who are friendlier may be more likely to have their mindset beliefs accurately identified by outside observers, highlighting the importance of relational cues. Complementing this, previous research (Ozier, 2023) has also found that the proportion of motives relative to the total policies communicated in a syllabus can also act as a key mediating mechanism between instructor self-reported mindset and coder perception of mindset. Together, these findings highlight that both relational cues and how policies are framed can shape how instructor beliefs are interpreted. Further research should replicate these studies to better understand the factors that may influence students' perceptions of instructor beliefs.

Effect of Instructor Beliefs on Student Outcomes

Consistent with previous findings, the results of Study 2 indicated that students' perceptions teaching behaviour frequency did not align with one another (Kroeper, Fried, et al., 2022). One possible explanation is that students could be drawing upon multiple reference points, such as their experiences across courses and instructors, whereas instructors are likely evaluating their own behaviour relative to past iterations of their own courses or intentional changes they have made over time. Similarly, when it came to instructor beliefs, there was also a disconnect between student perceptions and instructor self-reported beliefs. This contradicts previous research that has suggested that there is a small, positive association between students'

and instructors' growth mindset (Muenks et al., 2024). This suggests that regardless of belief, instructors often fail to communicate them in meaningful ways to students.

Overall, student perceptions emerged as more consistent and stronger predictors of student outcomes than instructor self-reports, apart from performance approach goal orientation and perceived effort when compared to instructor beliefs. This aligns with the present literature highlighting the importance of student perceptions in understanding their psychosocial outcomes (LaCosse et al., 2021; Muenks et al., 2024; Rattan et al., 2018). Student perceptions explained a considerable amount of variance for certain motivational outcomes, including student self-efficacy, which has previously been associated with course achievement. Overall, the predictive value of student perceptions in understanding student outcomes emphasizes that regardless of what instructors believe, it is consistently what students perceive that generally shapes their motivation. Thus, when educators and policy makers consider how to design courses or develop interventions that enhance student motivation and engagement, rather than targeting instructor beliefs, it may be more valuable to focus on teaching instructors to effectively communicate those beliefs.

That is not to say that instructor perceptions were not important in predicting student outcomes. When it came to how interesting students found the course, instructors' growth mindsets were positively associated, whereas their universal beliefs were negatively associated. Although the positive association between instructor growth mindset and student interest has previously been documented (LaCosse et al., 2021; Muenks et al., 2020), the negative association between universal beliefs and course interest was unexpected. Perceiving instructors to hold universal beliefs has generally been associated with positive student outcomes, including a greater sense of belonging and better course performance (Rattan et al., 2018). Although it is

not clear why students report feeling more disinterested when instructors hold stronger universal beliefs, one possible explanation may be that instructors are designing their courses in ways that reflect their beliefs that may lead to students feeling pressured to meet their instructor's expectations. Given that students' perceptions of universal beliefs were not related to interest-value, these results suggest that instructors' beliefs may be causing them to adjust their teaching, but in ways that are not salient enough for students to meaningfully perceive as universal beliefs in class. These results suggest that further research should investigate how instructors with universal beliefs may be trying to communicate these messages to students, and whether this may inadvertently have a negative impact on their outcomes.

Implications on Future Lay Theory Research

The present research contributes to a growing literature examining how mindset, universality, and brilliance beliefs are related. Consistent with emerging findings (Bian et al., 2018; Limeri et al., 2023; Muradoglu et al., 2025; Rattan, Savani, et al., 2012), the present results suggest that mindset, universality, and brilliance are three distinct lay theories. While nonuniversal, fixed, and brilliance beliefs were related constructs, along with growth and universal beliefs, the correlations ranged from very weak to moderate ($|r| > .59$). If these were truly identical constructs, one would expect that the correlations would be very strong between constructs.

Additionally, this research provides further support for the studying of fixed/growth mindset and nonuniversal/universal beliefs as separate constructs to untangle the nuanced differences between the constructs. Across studies, these constructs were separate and provided unique predictive value in explaining instructor beliefs and behaviours, as well as student outcomes. For instance, while growth mindset and universal beliefs were positively related to

instructor sense of self-efficacy, fixed mindset and nonuniversal beliefs were not negatively correlated as would be expected for opposite ends of a spectrum. This also held true when considering students' perceptions of these constructs, rather than self-reports. Student perception of fixed mindset was positively associated with perceived cost of the course. Conversely, student perception of instructor growth mindset did not contribute uniquely to predicting cost. These results support the emerging perspective that in order to better understand how mindset and universality beliefs contribute to student outcomes, it is valuable to study them as separate factors, rather than on the same spectrum.

Furthermore, consistent with previous findings (Canning et al., 2019), the present study did not find any significant differences across instructor characteristics or STEM disciplines when examining fixed and growth mindset. However, when investigating universality and brilliance beliefs, the results suggested that some social groups and disciplines may be more likely to hold these beliefs. For instance, as instructors gained more years of teaching experience, they were also more likely to endorse nonuniversal beliefs. Interestingly, teaching experience did not contribute unique explanatory value in predicting universal beliefs. This suggests that in addition to being distinct constructs, different factors may also contribute to the endorsement of universal and nonuniversal beliefs. Additionally, there was some preliminary evidence that beliefs may differ across disciplines. In the present study, results suggested that chemistry instructors were more likely than psychology instructors to endorse brilliance beliefs. Though this aligns with previous work showing that chemistry is typically associated with more field-specific ability beliefs than psychology (Leslie et al., 2015), the same observation was not observed when comparing engineering and psychology instructors. Additionally, the distribution of instructors across disciplines lead to small sample sizes per discipline, ultimately reducing the

generalizability and statistical power of these analyses. Thus, alongside prior research showing differences across cultural groups (Rattan, Savani, et al., 2012) and across disciplines (Leslie et al., 2015), further research should aim to replicate this study to investigate if universality and brilliance beliefs are tied to instructor identities and disciplines. These findings would better inform educators and policy makers about whether beliefs may be concentrated in certain disciplines, which could hinder student achievement and outcomes, particularly for historically underrepresented groups.

Limitations and Future Directions

The current study has several limitations that should be acknowledged. Firstly, most of the measures across both studies relied on participants' self-report, apart from the content analysis of the syllabi. Although much of the research investigating these lay theories has relied on self-report, it is possible that participants may have been influenced by the social desirability bias and thus answering favourably.

This study also relied on a convenience sample of instructors and students from a single university, which may limit the generalizability of the findings. Since participants were self-selected volunteers, this may also have introduced bias since those who participated may differ systematically from those who did not. As a result, these findings may not be representative of the beliefs and experiences of broader instructor and student populations. Future studies should aim to replicate these findings and consider either incorporating random or stratified sampling techniques to obtain a more representative sample of instructors and students across institutions.

Furthermore, because the scope of the research was limited to a convenience sample, we were unable to examine the association between instructor beliefs and implications on broader student outcomes, such as intent to persist in STEM, since undergraduate students are typically

taking five different courses with different instructors. We were also unable to collect more objective student outcomes such as course achievement or real behavioural observations of instructor behaviour during interactions with students, in settings such as a lecture or lab. Furthermore, given the standardization of course syllabi, it is difficult to determine with certainty whether messaging was written by the instructor or if it was mandated by the department or university. Future studies would benefit from broadening the scope of research to better understand how student outcomes and perceptions vary across courses and include more objective measures of instructor behaviour or student outcomes.

Finally, the sample size across both studies was limited. This may have impacted both the generalizability of the results, and whether there was enough statistical power to fully capture statistically significant results. Future studies should consider replicating the study using larger sample sizes to improve the generalizability of these findings.

Conclusions

An instructor plays a crucial part in student learning experiences, and ultimately, their outcomes. The current study is one of the few that investigates how mindset, universality, and brilliance beliefs interact to predict instructor behaviours, messaging, and influence on student outcomes. The present findings suggest that instructors' self-efficacy and endorsement of growth mindset teaching behaviours is significantly associated with their growth mindset and universal beliefs. This is notable, given the previous association of instructor self-efficacy and teaching practices on student outcomes. Practically, these results indicate that instructor-based interventions aimed at increasing growth mindset and universal belief endorsement may be valuable in improving instructor behaviours and optimizing teaching practices. However, the present findings also suggest that instructors need to ensure their pedagogical values are not just

held privately, but clearly communicated and reinforced in their interactions, feedback, and classroom environment. Institutional efforts to train instructors in inclusive and growth-oriented practices should also emphasize the visibility and consistency of these beliefs, as it is students' perceptions, not instructors' intentions, that ultimately drive motivation.

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Appendices

Appendix A

1. Which course(s) do you teach?
2. How many years of university teaching experience do you have?
3. What is your gender?
4. What is your age?
5. How do you identify your 'race'/ethnicity? Select the item that best applies.
    a. Arab
    b. Black (including African, African-Canadian, African-American, Caribbean)
    c. Chinese (including Mainland China, Hong Kong, Macau, and Taiwan)
    d. Filipino/a
    e. Indo-Caribbean, Indo-African, Indo-Fijian, or West-Indian
    f. Japanese
    g. Korean
    h. Latin, Central, or South American (e.g., Brazilian, Chilean, Columbian, Mexican)
    i. North African (Egyptian, Libyan)
    j. Pacific Islanders or Polynesian/Melanesian/Micronesian (e.g., Cook Island Māori, Hawaiian Maoli, Fijians, Marquesan, Marshallese, Niuean, Samoans, Tahitian Mā'ohi, Tongan, New Zealand Māori)
    k. South Asian (e.g., Bangladeshi, Pakistani, Indian, Sri Lankan, Punjabi)
    l. South East Asian (e.g., Cambodian, Malaysian, Thai, Vietnamese)
    m. West Asian (e.g., Afghani, Armenian, Iranian, Iraqi, Israeli, Jordanian, Lebanese, Palestinian, Syrian, Yemeni)
    n. White (including European, White-Canadian/American/Australian/South African)
    o. Multiracial/ethnic (with at least one parent in a non-White group above)
    p. Other
    q. Decline to answer
6. On a scale of 1 (not at all)–10 (very), how motivated do you think your students are?
7. On a scale of 1 (not at all)–10 (very), how engaged do you think your students are?
8. What is the course average for each of the course(s) you are currently teaching?
9. Please upload the syllabi for any courses you are teaching this year.
10. How many hours of office hours can a student access per week? (professor and TA office hours combined)
11. How many office hours do you offer per week? (professor office hours)

How often do you do the following? (1 = Never to 6 = Very Often)

12. Increase your office hours availability when tests or assignments are due
13. Mention and remind your class about office hours

14. Verbally express displeasure in grades if they are below your standards
15. Verbally express happiness if the grades are high
16. Explicitly encourage students to come to class
17. Allow students to ask questions in class
18. Offer extra practice problems or study resources
19. Give opportunities for students to participate in class
20. Teach students how to study/provide study guides/suggest study methods
21. Offer opportunities for students to provide feedback on your classes
22. Incorporate student feedback into your teaching
23. Release test/quiz answers for students to review
24. Provide office hours to review test/quiz answers
25. Spend class time reviewing test/quiz answers
26. Encourage students to reach out to you directly with questions (i.e. via email, after class)
27. Encourage students to reach out to the TA with questions (i.e. via email)
28. Encourage students to seek professor or TA feedback before turning in an assignment
29. Complete "check-ins" with your students, before an assignment or test
30. Tell students that anyone can do well in your class if they put in effort
31. Tell students that it is more important to give their full effort in this class than to get things right

Please indicate the extent to which you agree or disagree with the following statements. There There are no correct answers, we want to understand how you think about these ideas. (1 = Strongly disagree; 2 = Somewhat disagree; 3 = Neither agree nor disagree; 4 = Somewhat agree; 5 = Strongly agree; Prefer not to respond)

32. Even if they try, some of my students could never become as effective at analyzing information as their peers.
33. Only my students who have a natural talent can become good enough at applying knowledge to solve the most difficult problems.
34. Only my students who have a natural talent can become excellent at analyzing information.
35. Some of my students will always be less effective at learning than those who have a natural talent for it.
36. Only some of my students have the intellectual ability to become a successful professional in my field.
37. With enough hard work, any of my students could become as good at analyzing information as highly successful professionals in my field.
38. Any of my students who try could become as good at applying knowledge as experts in my field.

39. Any of my students could become as effective at learning as highly successful students in my field.
40. All of my students have the intellectual ability to become a successful professional in my field if they want to.
41. With enough motivation, any of my students can become as good at applying knowledge as high achieving students in my field.
42. Excelling in my field requires natural talent.
43. People who are highly successful in my field have a natural talent for it.
44. Becoming a top student in my field requires an innate talent that just can't be taught.
45. People have to be naturally talented to excel in challenging courses in my field.
46. Being a highly successful professional in my field requires natural talent that just can't be taught.
47. In general, how well my students learn is something that they cannot change very much.
48. It would be very difficult for ordinary students in my class to improve how well they can apply knowledge.
49. My typical student's ability to apply knowledge will change very little over time.
50. An ordinary student in my class would never be able to reach the highest level of intellectual ability.
51. At the end of college, a typical student's ability to analyze information will be at about the same level that it is now.
52. The typical student in my class can become as good at analyzing information as highly successful professionals in my field if they try hard enough.
53. In general, my students can become excellent at applying knowledge to solve challenging problems.
54. If they want to, a typical student in my class can become as effective at applying knowledge as experts in my field.
55. If they try, ordinary students in my class can become as effective at learning as experts in my field.
56. My students could improve their intellectual abilities to the same level as successful professionals in my field.

57. Imagine a student who failed an assignment in your class. How blameworthy is this student for failing? 1 (not blameworthy) to 7 (completely blameworthy)
58. Imagine a student who consistently fails assignments in your class. How blameworthy is this student for failing? 1 (not blameworthy) to 7 (completely blameworthy)

Please indicate your opinion about each of the statements below. Response scale for following questions: 1 = Nothing/Not at all, 2, 3 = Very Little, 4, 5 = Some Influence, 6, 7 = Quite A Bit, 8, 9 = A Great Deal

59. How much can you do to get through to the most difficult undergraduate students?
60. How much can you do to control disruptive behavior in the classroom?
61. How much can you do to motivate students who show low interest in course work?
62. How much can you do to get undergraduates to believe they can do well in course work?
63. How much can you do to ensure that your assessment strategies accurately evaluate student learning?
64. To what extent are you able to create lessons that hold students' interest?
65. How much can you gauge student comprehension of what you have taught?
66. To what extent can you influence the self-discipline of your students?
67. How much can you do to overcome a student's resistance to a particular topic?
68. How much can you do to get students to follow course policies?
69. How much can you do to improve the understanding of a student who is failing?
70. How much can you do to calm a student who is disruptive or noisy?
71. How much can you use a variety of assessment strategies?
72. To what extent can you vary teaching strategies to best communicate information to your students?
73. How well can you implement alternative strategies in your classroom?

Appendix B

Content Analysis Coding Guidelines

Purpose of the manual: This document includes instructions on how to code course outlines to gain information regarding non-universal, universal, brilliance, fixed, and growth mindset beliefs.

Step 1: Identifying the frequency of messages about the 5 beliefs

1. Non-universal: The belief that only some people have the potential to reach the highest levels of ability, regardless of their circumstances or efforts.

Examples:

- "Students who are not quick learners should consider dropping this course."
- "Only a select few students have the innate talent to excel in this subject."

Key-words:

- Selective potential, Certain individuals, Not everyone

2. Universal: The belief that everyone has the potential to reach the highest levels of ability, regardless of their circumstances or background.

Examples:

- "All students have the potential to succeed in this course with dedication and hard work."
- "Every student, regardless of background, can excel in this subject through consistent effort."
- "Success in this class is achievable by anyone who is willing to put in the necessary time and commitment."

Key-words:

- Equal opportunity, Regardless of background

3. Brilliance: The belief that success in a particular field requires innate intellectual talent or "brilliance" that cannot be taught or developed through effort alone.

Examples:

- "Excelling in this course requires natural talent"
- "Only exceptional students will succeed in this course"

Key-words:

- Exceptional talent, Genius, Innate brilliance, Gifted

4. Fixed: The belief that intelligence or abilities are static and cannot be changed or developed.

Examples:

- "Practice will not result in progress for everyone."
- "It is difficult to progress in this course"
- "I hold regular office hours because, in my experience, this extra time allows smart students to show their natural [math] skills and discuss the material with me in depth."
- "If you have not mastered those concepts, you should come see me because I believe it will be very difficult, if not impossible, for you to grasp the more difficult material in this course."
- "I assign these homework assignments because I believe it allows students to demonstrate their math abilities."
- "The purpose of these quizzes is to show me which students are understanding and excelling, and which are not."
- "The reason for this recommendation is that I believe that attending class is key for demonstrating your knowledge of the concepts covered in the course and showcasing your [math] abilities."
- "Note that each aspect of the course (i.e., homework, quizzes, and exams) comprise roughly an equal portion of your grade. I have designed the course this way because I believe it's important for smart students to have many opportunities to demonstrate their abilities and prove their competence throughout the semester (not just at the end)."

Key-words:

- Talent, Difficult, Limited

5. Growth: The belief that intelligence and abilities can be improved through effort and learning.

Examples:

- "Success in this course is not determined by innate talent but by dedication and perseverance."
- "Students are encouraged to view challenges as opportunities for growth and learning."
- "Mistakes are seen as valuable learning experiences that contribute to personal development."
- "The focus is on continuous improvement and progress rather than fixed levels of achievement."
- "I hold regular office hours because, in my experience, this extra time allows students to ask questions and improve their understanding of the material."
- "If you have not mastered those concepts, you should come see me because I believe that reviewing the Calculus I materials will grow your understanding so you can grasp the more difficult material in this course"
- "I assign these homework assignments because I believe it allows students to practice and develop their skills."

- "The purpose of these quizzes is to show me how well students are understanding the material and whether I need to review certain concepts with the class"
- "I strongly recommend that all students come to class. The reason for this recommendation is that I believe that attending class is key for learning and engaging with the material and for improving your math skills."
- "I have designed the course this way because I believe it's important for all students to have many opportunities to practice and monitor their improvement throughout the semester (not just at the end)"

Key-words:

- Development, Improvement, Effort, Learning, Progress, Resilience, Embracing mistakes

NOTE: the key words are meant to help you identify messages but ultimately, you will need to use your judgement. For example, "Improvement" is listed as a key word for growth. However, if the statement is, "Improvement is very difficult unless you are gifted in this subject", it should NOT be coded as growth.

Step 2: Coding Additional Behaviours for GROWTH Mindset

In this step, you will be coding additional behaviours for a growth mindset. The literature shows that behaviours such as **encouraging office hours, engagement, and feedback**, as well as explicit messages, are related to a growth mindset. The behaviours and examples of their occurrences in a course outline are listed below.

1. Accessibility of Instructional Team (AIT-GROW)

a. Readily available office hours on the course outline
b. Explicit statements encouraging students to attend office hours
c. Explicitly asking students to book a meeting if they need help
d. Available via email for questions outside of the classroom

2. Encouraging Engagement (EE-GROW)

a. Participation grades/bonus marks for participation
b. Encouraging students to attend class
c. Mandatory attendance
d. Encouraging group projects or peer review sessions that focus on collective problem-solving
e. Incorporating collaborative discussions or peer learning activities into class participation marks.

3. Feedback (FEE-GROW)

a. Quiz/test grades being released or available for viewing
b. Special office hours to discuss grades
c. Encouraging students to ask for feedback before submitting an assignment
d. Holding review sessions in class, shown in the class schedule

e. Peer review assignments
f. Assign graded homework with feedback

4. Explicit messages about success and the value of effort (EXM-GROW)
a. "You will succeed in this course if you put your mind to it."
b. "Anyone can succeed if they put in effort."
c. "Reviewing materials will grow your understanding"
d. Using phrases like "learning is a process" or "mistakes are part of learning" in course materials.
e. Highlighting examples of past student growth or improvement as a motivational tool.

5. Diversity messages (DEI-GROW)
a. Statements about equity, diversity, and inclusion with respect to developing skills and learning
b. Statements about belonging in the classroom

6. Self-care/Wellness (SC-GROW)
a. Statements encouraging self-care and well-being of students with respect to learning

7. Professor Responsibility (PR-GROW)
a. Professor shows they are willing to take feedback
b. Statements that show professor feels personal responsibility for success for students
    i. "I want you guys to learn the material and ***I*** will help you learn it."
    ii. "Please come to office hours if you don't understand something. I will go over it with you until you understand it."
c. Openness to adapting lecture according to student response (if poor student performance)

8. Progress-focused grading (PFG-GROW)
a. Dropping lowest grades (giving students the chance to grow and learn without penalizing them)
b. Increasing assessment weight throughout the semester (giving students the chance to try, get feedback, and apply it to a higher-stakes assessment)
c. Option for reweighting assessments
d. Assessments that are required or encouraged but weighted very low (0-1%) and are meant to provide students with preliminary feedback
e. Approximately equally weighted course components to give students opportunities to practice throughout the course.
f. Allowing students to revise and resubmit work based on feedback
g. Providing flexible assignment deadlines or grace periods to accommodate different learning paces.

Appendix C

1. Which course are you filling this survey out for?
2. What is your gender?
3. What is your age?
4. How do you identify your 'race'/ethnicity? Select the item that best applies.
    a. Arab
    b. Black (including African, African-Canadian, African-American, Caribbean)
    c. Chinese (including Mainland China, Hong Kong, Macau, and Taiwan)
    d. Filipino/a
    e. Indo-Caribbean, Indo-African, Indo-Fijian, or West-Indian
    f. Japanese
    g. Korean
    h. Latin, Central, or South American (e.g., Brazilian, Chilean, Columbian, Mexican)
    i. North African (Egyptian, Libyan)
    j. Pacific Islanders or Polynesian/Melanesian/Micronesian (e.g., Cook Island Māori, Hawaiian Maoli, Fijians, Marquesan, Marshallese, Niuean, Samoans, Tahitian Mā'ohi, Tongan, New Zealand Māori)
    k. South Asian (e.g., Bangladeshi, Pakistani, Indian, Sri Lankan, Punjabi)
    l. South East Asian (e.g., Cambodian, Malaysian, Thai, Vietnamese)
    m. West Asian (e.g., Afghani, Armenian, Iranian, Iraqi, Israeli, Jordanian, Lebanese, Palestinian, Syrian, Yemeni)
    n. White (including European, White-Canadian/American/Australian/South African)
    o. Multiracial/ethnic (with at least one parent in a non-White group above)
    p. Other
    q. Decline to answer

How often does your professor do the following? (1 = Never to 6 = Very Often)

1. Increase office hour availability when tests or assignments are due
2. Mention and remind the class about office hours
3. Verbally express displeasure in grades if they are below their standards
4. Verbally express happiness if the grades are high
5. Explicitly encourage students to come to class
6. Allow students to ask questions in class
7. Offer extra practice problems or study resources
8. Give opportunities for students to participate in class
9. Teach students how to study/provide study guides/suggest study methods
10. Offer opportunities for students to provide feedback on their classes
11. Incorporate student feedback into their teaching

12. Release test/quiz answers for students to review
13. Provide office hours to review test/quiz answers
14. Spend class time reviewing test/quiz answers
15. Encourage students to reach out to them directly with questions (i.e. via email, after class)
16. Encourage students to reach out to the TA with questions (i.e. via email)
17. Encourage students to seek professor or TA feedback before turning in an assignment
18. Complete "check-ins" with their students, before an assignment or test
19. Tell students that anyone can do well in their class if they put in effort
20. Tell students that it is more important to give their full effort in this class than to get things right

Please indicate the extent to which you agree or disagree with the following statements. There are no correct answers, we want to understand how you think about these ideas. (1 = Strongly disagree; 2 = Somewhat disagree; 3 = Neither agree nor disagree; 4 = Somewhat agree; 5 = Strongly agree; Prefer not to respond)

1. My professors thinks that even if we try, some students could never become as effective at analyzing information as their peers.
2. My professor thinks that only students who have a natural talent can become good enough at applying knowledge to solve the most difficult problems.
3. My professor thinks only students who have a natural talent can become excellent at analyzing information.
4. My professor thinks some students will always be less effective at learning than those who have a natural talent for it.
5. My professor thinks only some students have the intellectual ability to become a successful professional in my field.
6. My professor thinks that with enough hard work, any student could become as good at analyzing information as highly successful professionals in my field.
7. My professor thinks that any student who try could become as good at applying knowledge as experts in their field.
8. My professor thinks that any student could become as effective at learning as highly successful students in their field.
9. My professor thinks that all of their students have the intellectual ability to become a successful professional in their field if they want to.
10. My professor thinks that with enough motivation, any of their students can become as good at applying knowledge as high achieving students in their field.
11. My professor thinks that excelling in my field requires natural talent.
12. My professor thinks that people who are highly successful in their field have a natural talent for it.

13. My professor thinks that becoming a top student in their field requires an innate talent that just can't be taught.
14. My professor thinks that people have to be naturally talented to excel in challenging courses in this field.
15. My professor thinks that being a highly successful professional in this field requires natural talent that just can't be taught.
16. My professor thinks that in general, how well their students learn is something that they cannot change very much.
17. My professor thinks that it would be very difficult for ordinary students in my class to improve how well they can apply knowledge.
18. My professor thinks that the typical student's ability to apply knowledge will change very little over time.
19. My professor thinks that an ordinary student in my class would never be able to reach the highest level of intellectual ability.
20. My professor thinks that at the end of college, a typical student's ability to analyze information will be at about the same level that it is now.
21. My professor thinks that the typical student in my class can become as good at analyzing information as highly successful professionals in their field if they try hard enough.
22. My professor thinks that in general, students can become excellent at applying knowledge to solve challenging problems.
23. My professor thinks that if they want to, a typical student in my class can become as effective at applying knowledge as experts in their field.
24. My professor thinks that if they try, ordinary students in my class can become as effective at learning as experts in their field.
25. My professor thinks that students could improve their intellectual abilities to the same level as successful professionals in their field.

Please indicate the extent to which you agree or disagree with the following statements. There are no correct answers, we want to understand how you think about these ideas. (1 = Strongly disagree; 2 = Somewhat disagree; 3 = Neither agree nor disagree; 4 = Somewhat agree; 5 = Strongly agree; Prefer not to respond)

1. I can become as good at analyzing information as highly successful STEM professionals if I try hard enough.
2. If I want to, I can become as effective at applying knowledge as STEM experts.
3. I can become excellent at applying knowledge to solve challenging problems.
4. If I try, I can become as effective at learning as STEM experts.
5. I could improve my intellectual abilities to the same level as successful STEM professionals.

6. At the end of college, my ability to analyze information will be at about the same level that it is now.
7. How well I learn is something that I cannot change very much.
8. My ability to apply knowledge will change very little over time.
9. I will never be able to reach the highest level of intellectual ability.
10. It would be very difficult for me to improve how well I can apply knowledge.
11. Excelling in STEM requires natural talent.
12. People who are highly successful in STEM have a natural talent for it.
13. Becoming a top student in STEM requires an innate talent that just can't be taught.
14. People have to be naturally talented to excel in challenging STEM courses.
15. Being a highly successful STEM professional requires natural talent that just can't be taught.
16. With enough hard work, anyone could become as good at analyzing information as highly successful STEM professionals.
17. Anyone who tries could become as good at applying knowledge as STEM experts.
18. Anyone could become as effective at learning as highly successful STEM students.
19. Everyone has the intellectual ability to become a successful STEM professional if they want to.
20. With enough motivation, anyone can become as good at applying knowledge as high achieving STEM students.
21. Even if they try, some people could never become as effective at analyzing information as their peers.
22. Only people with a natural talent can become good enough at applying knowledge to solve the most difficult problems.
23. Only people with a natural talent can become excellent at analyzing information.
24. Some people will always be less effective at learning than those who have a natural talent for it.
25. Only some people have the intellectual ability to become a successful STEM professional

Please indicate the extent to which you agree or disagree with the following statements for this course. There are no correct answers, we want to understand how you think about these ideas. Item (1 = Strongly disagree, 6 = Strongly agree)

1. This is a challenging course.
2. I put a lot of effort into this course every week.
3. I think the content of this class is useful to learn.
4. I think what I am learning in this course is important.
5. I am really looking forward to learning more from this class.
6. I am very interested in this class.
7. I feel like I belong as a student in this course.

8. I feel like I can be myself in this class.
9. I will do very well in this course.
10. I know that I can learn new concepts well in this course.
11. I can do even the hardest work in this class if I try.
12. My aim is to completely master the material presented in this class.
13. My goal is to learn as much as possible in this class.
14. My aim is to perform well relative to other students in this class.
15. My goal is to perform better than the other students in this class.
16. I aim to avoid doing worse than other students in this class.
17. My goal is to avoid performing poorly compared to others in this class.
18. When a goal feels difficult to attain, then it is probably out of my reach.
19. I know a goal is impossible for me when it feels difficult to work on.
20. This class requires too much effort.
21. Because of other things that I do, I don't have time to put into this course.
22. This class requires me to give up too many other activities I value.
23. I feel emotionally drained when thinking about this course.
24. I postpone working on assignments for this class until I need to do them.
25. I have problems prioritizing tasks for this course.