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ARTICLE

The secret language of peers: How peer behaviours signal mindset and influence classroom experiences

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Abstract

Background: Extending recent work on mindset contexts, researchers have explored how peer mindsets relate to students' outcomes in the classroom. However, little is known about the specific behaviours that signal peer mindsets to students, and prior work has used correlational methods.

Aim: The present study aims to identify specific peer behaviours that indicate their mindset beliefs to others and their impact on students' psychological and academic experiences.

Methods: We conducted qualitative focus groups ($N = 15$) and an experiment ($N = 605$) with undergraduate students. We developed vignettes that experimentally manipulated mindset-signalling peer behaviours in a hypothetical peer. Participants then rated their perceptions of the hypothetical peer's mindset and their expected classroom experiences.

Results: We found that seven peer behaviours—self-deprecation, withdrawing effort, explicit verbal messages, competitiveness, disinterest in helping others, boasting about success, and downplaying struggles—shaped students' perceptions of peer mindset. These perceptions, in turn, influenced their anticipated sense of belonging, imposter feelings, evaluative concerns, and academic risk-taking. Female students were more likely to perceive competitive and unhelpful peers as having a fixed mindset.

Conclusion: The findings underscore the importance of peers in fostering inclusive, motivation-supportive classrooms. The seven identified behaviours serve as a foundation for future interventions designed to reshape peer interactions and foster a classroom environment that promotes a growth mindset.

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KEYWORDS
avoidance, behaviour, belonging, evaluative, imposter, mindset, peers

INTRODUCTION

Adolescents and emerging adults, highly attuned to social status, are especially receptive to peer influences (Murphy et al., 2013; Oldehinkel et al., 2007; Spear, 2000; Yeager et al., 2018). Peers shape their self-perceptions, sense of belonging, motivation, and achievement in school (Prinstein & Aikins, 2004; Wentzel & Skinner, 2022; Wu & Cai, 2023). In parallel, research on mindset (e.g., Dweck, 1999) has shifted focus from individual mindsets to classroom mindset cultures (e.g., Kroeper, Fried, & Murphy, 2022; Seo & Lee, 2021; Walton & Yeager, 2020; Yeager et al., 2022). While much of this work has centred on how instructors' beliefs and behaviours create the mindset cultures, growing evidence suggests that peers' mindsets also play a critical role (e.g., Muenks et al., 2021; Sheffler & Cheung, 2020; Zhang et al., 2020).

Previous studies have not clarified how peers communicate mindset beliefs or how mindset-related peer interactions impact students' psychological experiences in the classroom. This gap is critical, as adopting a growth mindset does not guarantee the ability to effectively communicate or foster a growth mindset culture. Without identifying behaviours that signal growth or fixed mindsets, it is challenging to teach youth how to create positive mindset cultures. The proposed research aims to identify specific peer behaviours that convey fixed mindset beliefs in university classrooms and examine their effects on students' psychological experiences. Specifically, it addresses two questions: What peer behaviours signal fixed-mindset beliefs, and how do these behaviours impact students' psychological experiences, such as their sense of belonging? The findings will inform targeted interventions to improve peer mindset interactions.

LITERATURE REVIEW

Growth mindset

According to Dweck (1999), individuals' beliefs about the malleability of their intelligence play a significant role in shaping their emotions, motivation, and behaviours (Dweck & Yeager, 2019). Those who believe their abilities can develop over time through hard work and effort hold more of a growth mindset. This belief fosters resilience, as individuals with a growth mindset view setbacks as an inherent part of the learning process, maintaining motivation even in the face of difficulties. Conversely, individuals who believe their abilities are innate and unchangeable hold more of a fixed mindset (Dweck et al., 1995), which can lead them to avoid challenges, give up easily when encountering obstacles, and experience reduced motivation and academic achievement (Burnette et al., 2023; Smiley et al., 2016). In essence, an individual's mindset shapes how they perceive and respond to challenges, framing them either as opportunities for growth or as threats to their learning (Dweck, 2007; Dweck & Yeager, 2019).

Research across various age groups from children to adults demonstrates that a growth mindset enhances students' key outcomes like motivation, resilience, well-being, and academic performance (Aronson et al., 2002; Blackwell et al., 2007; Burnette et al., 2023; Claro et al., 2016; Robins & Pals, 2002). Additionally, programs that teach students how to adopt and apply a growth mindset have been shown to significantly improve student performance and advancement in various settings (e.g., Outes-Leon et al., 2020; Yeager et al., 2019). However, recent research suggests that these programs may not be equally effective for all students (Tipton et al., 2023). The impact of these student-focused growth mindset interventions depends heavily on the environment (Walton & Yeager, 2020). Studies show that these programs are more beneficial when students are surrounded by peers, educators, and a broader societal culture that all promote growth mindset principles (Hecht, Gosling, et al., 2023; Lou & Li, 2023; Yeager et al., 2019, 2022). Even students with a growth mindset may struggle to fully benefit

from it in environments that do not reinforce or support their beliefs. In such cases, students may be less motivated and more reluctant to engage, highlighting how classroom culture—beyond individual beliefs—shapes motivation and behaviours. Therefore, fostering a classroom culture that supports a growth mindset may be just as important, if not more so, than simply teaching individual students about it for their learning and development.

Mindset context

Aiming to foster environments that embody a growth mindset, researchers have begun exploring how mindset *contexts* or *cultures* shape students' experiences within educational settings (e.g., Murphy et al., 2021). Many studies have focused on the impact of teachers' mindsets, students' perceptions of teachers' mindsets, and teachers' mindset-relevant practices in secondary school and university settings (e.g., Muenks et al., 2020; Seo & Lee, 2021; Yeager et al., 2022). These studies indicate that teachers' growth mindsets are associated with improvements in academic achievement, particularly for marginalized students (Canning et al., 2019; Hecht, Bryan, & Yeager, 2023; Hecht, Gosling, et al., 2023). Furthermore, researchers have identified specific teaching practices that effectively convey a growth mindset to university students (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022), which include: (1) setting high expectations for all students, (2) offering opportunities for practice and feedback, (3) supporting struggling students by sharing ideas about how to improve, and (4) emphasizing the value of learning.

Peer behaviours that contribute to mindset context

As students mature, they spend less time with family and increasingly gravitate toward peers, both in person and online (Reitz et al., 2014). Older adolescents and young adults, for instance, spend about half as much time with family as younger ones (Larson & Richards, 1991). With heightened sensitivity to social status (Murphy et al., 2013; Oldehinkel et al., 2007; Spear, 2000; Yeager et al., 2018), peer influences often outweigh those of parents or teachers during this stage (Verschueren et al., 2012). These dynamics underscore the importance of understanding peer mindsets, as peer attitudes and behaviours can significantly impact students' motivation and psychological experiences.

Research shows that peer mindsets are contagious; secondary school students with peers who strongly exhibit a fixed mindset often shift their mindsets closer to those of their peers by the end of the semester (King, 2020). In contrast, having growth mindset peers positively influences university students' confidence, task value, and use of self-regulated learning strategies (Sheffler & Cheung, 2020, 2024). Furthermore, college students' *perceptions* of peers' growth mindsets positively predict their motivation, belonging, and challenge-seeking (Muenks et al., 2021; Muenks & Yan, 2024). These findings highlight that peers who view challenges as opportunities for learning can enhance students' motivation and overall classroom experiences.

Yet, what is absent from the aforementioned research is the specific behaviours that signal a fixed mindset. Only one set of studies has attempted to address this gap. Muenks and Yan (2024) asked college students to report on their peers' mindset behaviours using an open-ended survey question (e.g., "What makes you think that your [subject] peers believe that intelligence is changeable OR that intelligence is not changeable?", p. 20), and then developed a survey to explore whether students' perceptions of the behaviours were related to students' perceptions of peer mindsets. The research identified three behaviours that signal a fixed mindset: competitiveness (e.g., "Sometimes, the competition pushes my friends to think they are the brainy ones."), being highly critical of oneself (e.g., "Sometimes my friends get down on themselves and feel like they have hit a limit."), and explicitly making fixed mindset remarks (e.g., "I'm just not a math person"); and two behaviours that signal a growth mindset: willingness to help other peers and putting high effort into schoolwork. However, this research was exploratory and correlational.

The lack of focus on peer mindsets is evident, as no studies have used in-depth qualitative methods, like focus groups, to explore behaviours shaping students' perceptions. Such methods could reveal indicators missed by Muenks and Yan (2024), who relied on a single open-ended survey question. For example, studies on teacher mindsets highlight that responses to student struggles are key indicators (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022). Similarly, peer openness to sharing struggles could influence norms and encourage viewing struggles as learning opportunities—an aspect overlooked in previous research. Additionally, no experimental studies have tested the causal effects of perceived peer behaviours on students' perceptions of peer mindsets. This gap is critical, as third factors, such as poor peer relationships, could influence both perceptions of peers' fixed mindsets and their behaviours (e.g., competitiveness). It also remains unclear whether perceiving peers as having a fixed mindset acts as a mechanism through which peer behaviours influence students' psychological experiences in the classroom.

Social identity and its influence on peer mindset perceptions

The impact of peer behaviours on perceptions of peer mindset and psychological experiences (e.g., sense of belonging) may vary among students with different social identities. Research suggests that societal stereotypes make women and underrepresented minorities more sensitive to social cues about whether their identities are valued (Emerson & Murphy, 2014; Hall & Mast, 2008; Murphy et al., 2007), potentially influencing how they interpret peer behaviours as signalling fixed or growth mindsets. Similarly, socioeconomic status (SES) influences sense of belonging, with low-SES students reporting lower belonging (Jury et al., 2019). However, little research has explored how students from diverse backgrounds interpret peer behaviours as signalling a growth or fixed mindset or how these perceptions shape their classroom experiences.

THE PRESENT RESEARCH

This study aimed to address the gaps in the literature on peer mindset contexts. Our first research question seeks to identify specific peer behaviours that may signal mindset to their peers using focus groups with undergraduate students. We recruited students in science and engineering courses because prior research has shown that peer mindsets may be particularly salient in these courses (Muenks et al., 2021). Our second research question explores the effects of peer mindset behaviours on students' psychological experiences in the classroom, including the sense of belonging, imposter feelings, evaluative concerns, and academic challenge-avoidance (check Table 1 for the definitions of each construct). To answer this research question, we conducted a vignette-based experiment using seven vignettes that varied peers' behaviours. We then assessed students' perceptions of peers' mindset and their anticipated psychological experiences in a classroom with classmates like the peer in the vignette. Finally, we examined whether the effects of peer behaviours on the perceptions of peer mindset and psychological experiences in the classroom differed by student gender, race/ethnicity, and socioeconomic status (SES).

STUDY 1

We first conducted focus groups to explore how peers communicate their mindsets to other students in the classroom setting. Focus groups were employed in order to gain a richer understanding of how students come to understand their peers' mindsets, encourage discussion among participants, and provide opportunities for the participants to build on others' viewpoints and perspectives.

TABLE 1 Definition of key constructs.

Key construct	Definition
Mindset	Individual's beliefs about the malleability of ability
Sense of belonging	Subjective feeling of being accepted, valued, and included within a social or academic context
Imposter feelings	Self-doubt about one's competence and a persistent fear of being exposed as inadequate or undeserving of one's position or achievements
Evaluative concerns	The tendency to be preoccupied with how one's actions or statements are judged by others
Academic challenge avoidance	The tendency to prefer easier academic tasks with minimal learning opportunities over more challenging ones that offer greater learning potential

Methods

Participants

Fifteen students (60% women; 40% Latinx, 26.67% Asian, 26.67% White, and 6.66% Black) from a large southwestern university in the United States participated in a focus group. The project was approved by the institutional review board, and informed consent was obtained. All participants had taken an introductory chemistry course at the university in the previous semester. For details on sample demographics and recruitment, see Data S1.

Procedure

We conducted six online focus groups via Zoom, with up to four participants per group. One author facilitated the discussions, guided by six questions about students' classroom experiences with peers (see Data S1 for details). Rather than directly asking about peers' fixed mindsets, we used indirect questions (e.g., behaviours that made them feel dumb, excluded, or doubt their ability to learn and grow). This approach aimed to elicit richer, more nuanced responses by focusing on general experiences rather than mindset-specific concepts, given the retrospective nature of the discussions. While this method provided deeper insights, it may have captured constructs like the sense of belonging rather than mindset perceptions. We address this limitation in the next experimental study. Recruitment and procedural details are provided in Appendix S1.

Results

Through focus groups, we identified peer behaviours previously documented in the literature (Muenks & Yan, 2024) as well as newly observed behaviours that signal mindset to others. The peer behaviours previously identified in prior research included disinterest in helping versus willingness to help and competitiveness versus cooperativeness. Newly observed behaviours included boasting about success and sharing struggles.

Willingness to help

Echoing the results of Muenks and Yan (2024), students noted that peers' willingness to help reinforced their belief in their own potential to succeed in the field. For example, one student said: "There were

several people that were very willing to help if they understood, and they would like work out the problem with me in front of me, and other times I would share how unprepared I was feeling about the exam that was coming up, and while sometimes students related to me, other times others would tell me that I have it it's all good. I studied enough that they believe in me."

Other students also recounted experiences of a general peer culture where peers would help others when being successful. This experience made them feel that they are not dumb or lacking the potential to succeed in the class: "If someone understood one topic better than the other, they wouldn't be like, oh, this is easy. They would just be like, Oh, I understand this. I can help you like they would offer to help you, because they understood, and whenever I understood something and my friends didn't really understand, I'd be like, Oh, I get it. I can explain it to you."

Competitiveness

One student highlighted the competitive culture among peers, especially evident during classroom activities: "It was a little bit competitive, especially with the polls in class. People were trying to look over this their shoulder and see if other students had also answered the same thing, or if they answered fast enough. It was a little bit competitive because of the fact. Like, we're all kind of all in a race for being pre-health or pre-physicians." This environment of competitiveness was further intensified by the perception of others excelling rapidly, which caused the student to doubt her potential for success in the field: "I would see in one instance this particular student was very, very, very fast at doing chemistry, and he was always super like he was done within like the first 20 min when I couldn't finish the whole discussion section worksheet … and it was stuff like that that made me think, Oh, my gosh! How does he know so much? How is he so fast? And I'm over here still learning this."

While observing other students' success is an unavoidable aspect of classroom settings, the students' accounts highlight how a competitive peer culture can transform perceptions of others' achievements into self-doubt about one's own inherent abilities and potential for success. This dynamic is inevitably pronounced in environments where achievements are publicly measured and compared (e.g., Church et al., 2001). Further amplifying this issue, in the next section, students highlighted how boasting about success in such environments can exacerbate these feelings and convey the message that ability is fixed and unchangeable.

Boasting about success

In response to a question about when peers made them doubt their potential to succeed, several students recalled an incident where their peers casually mentioned the ease of tasks that the student found challenging: "I struggled a lot with the few questions…, and they would say, Oh, no! I thought this one was easy." Another student also recounted a similar incident: "You know everybody [in the class] is talking about this is going to be easy. It's not that hard … So it's just like this extra layer of like feeling bad that these are tests that were very difficult for me, but it didn't sound like they were very difficult for everyone else." Students may say this while unconsciously comparing their abilities to their peers, seeking acknowledgment, or simply being unaware of others' experiences. This behaviour is especially common in competitive environments where academic success is highly valued. However, students' narratives highlight that even seemingly benign comments about the ease of a task can significantly impact their peers' self-perception and academic confidence. The experiences described sharply contrast with an earlier comment by a student recounting how willing her peers were to help ("If someone understood one topic better than the other, they wouldn't be like, oh, like this is easy. They would just be like, Oh, I understand this. I can help you like they would offer to help you.")

Sharing struggles

In response to the question about which peer behaviours help them believe they could be successful, students shared experiences of how hearing their peers openly discuss their own struggles: *"I think understanding that everyone struggles at times is important… So understanding that you're not the only one that may not be doing well is important if you're not doing well." Another student said, "When I heard people also struggling on the same topics, or like asking the same questions. I would know that I wasn't like the only one having a hard time … We would all have more motivation to do well, on the next one or something."* Students in our focus group frequently mentioned this, partly because the course included small discussion groups, making it easier to share struggles compared to larger courses without such group activities. This highlights the importance of the environment in shaping how students signal their mindsets to their peers. Further, these comments illustrate how sharing collective experiences of difficulty can normalize the struggle. Open discussions about challenges help students view these challenges as natural parts of learning, rather than signs of inability to succeed. When peers share their struggles, it allows students to understand that their peers do not perceive struggles as a sign of lacking the innate ability to succeed in the field.

In summary, our focus groups confirmed two previously noted peer behaviours that signal mindset to others: competitiveness and willingness to help (Muenks & Yan, 2024). Three of the other behaviours found in Muenks and Yan (2024), explicit verbal messages, self-deprecation, and effort, were not found in our focus group. However, we identified two previously unreported peer behaviours. Students mentioned boasting about success and sharing struggles as behaviours that made them feel they either lacked or had the potential to succeed. These behaviours potentially influence perceptions of peer mindset. While the approach enabled the identification of new behaviours, a clear limitation remains: it is unclear whether these behaviours directly influence perceptions of peer mindset or just general feelings of inadequacy or lack of belonging. Study 2 addresses this limitation.

STUDY 2

We conducted an experiment to test the causal effects of seven peer behaviours hypothesized to signal fixed versus growth mindsets — the five identified in Muenks and Yan (2024) and the two additional behaviours observed in Study 1. Although retrospective interviews (our focus groups) and open-ended surveys (Muenks & Yan, 2024) identified seven peer behaviours that students commonly observe, it remains unclear if these behaviours actually *influence* the perceptions of peers' mindsets and their psychological experiences in classrooms, such as their sense of belonging. This experimental study directly addresses this issue.

Methods

Participants

The participants were recruited through a departmental subject pool at a competitive, large, southwestern university in the United States. The project was approved by the institutional review board and informed consent was obtained. Participants included 605 students (65.7% women; 35.8% white, 27.7% Asian or Asian American, 24.0% Latinx, 5.6% Black, 5.4% Multi-racial, 1.5% Middle Eastern or North African). For details on sample demographics and recruitment, see Data S2.

Procedure and manipulation of peer characteristics

A vignette-based experimental manipulation is a research method in which participants are presented with short, systematically designed scenarios (vignettes) that simulate real-world situations (Skilling & Stylianides, 2020). When carefully constructed, experimental vignettes can increase external validity compared to traditional experimental methods that remove participants from their natural environments by portraying realistic situations (Aguinis & Bradely, 2014). Vignettes allow researchers to manipulate key variables while maintaining control over contextual factors, ensuring internal validity (see Data S3 for additional details about vignette-based experimental manipulation, including its advantages and shortcomings).

In our study, students read seven online vignettes depicting peers in common academic settings (Table 2). Each vignette depicted one of seven behaviours hypothesized to signal fixed or growth mindsets. Gender-neutral names were used to minimize gender bias. The development and validation of these stories is detailed in Data S3.

For each vignette, participants were randomly assigned to read a story featuring either fixed or growth mindset behaviours. After each story, they answered questions about their perceptions of the peer and their anticipated psychological experiences in a classroom with peers like the vignette character. Finally, participants provided demographic information. This experimental design was not preregistered.

Measures

All study variables, except for academic challenge avoidance, were assessed on a 5-point Likert-type scale (1 = *Very Unlikely* to 5 = *Very Likely*). All survey items are listed in Appendix 1.

Manipulation check

Each vignette included a manipulation check question to confirm whether it effectively portrayed the intended peer behaviour (e.g., "How likely is Alex to be self-deprecating when facing challenges?").

Perception of peers' fixed mindset beliefs

For each vignette, students answered two items assessing the hypothetical peer's fixed mindset belief ($rs = .79–.94$, $\rho = .88–.97$). These items were adapted from Dweck (1999) and were averaged to create a composite variable. All adaptations were made minimally and solely to ensure that the items aligned more accurately with the hypothetical vignettes.

Outcome measures

After reading each story, students answered items measuring how they anticipate they would feel if they were in a class with others like the hypothetical peer, specifically two items each measuring: (a) *sense of belonging* ($rs = .73–.90$; $\rho = .85–.95$, adapted from Murphy & Zirkel, 2015), (b) *imposter feelings* ($rs = .46–.75$, $\rho = .63–.86$; adapted from Leary et al., 2000), and (c) *evaluative concerns* ($rs = .77–.87$, $\rho = .87–.94$; adapted from Wout et al., 2010). Higher scores on these outcome measures represented a higher level of students' sense of belonging, imposter feelings, and worry about negative evaluations.

In addition, at the end of each story, students were also asked whether they would either *seek or avoid academic challenges* if they were in this class with a question adapted from Rege et al. (2021). Two options were presented to students: a harder assignment, from which they would likely learn more, and an easier assignment, from which they would likely learn less.

Data analysis. We used structural equation modelling (SEM) in Mplus version 8.10 (Muthén & Muthén, 1998-2017) to examine the relationships among peer behaviours (i.e., vignette conditions), perceptions of peers' mindsets, and outcome variables (see Figure 1). The independent variable was peer behaviour vignette condition (e.g., growth [sharing struggles] vs. fixed [downplaying struggles]). The mediator was the perception of the peer's mindset, and the outcome variables were the sense of

TABLE 2 Vignette-based experimental manipulation (Study 2).

	Vignette		
Peer behaviour	**Fixed**	**Growth**	**How realistic is this vignette?***
Self-deprecation	Alex is a diligent college student known for high standards and strong work ethic. Unfortunately, poor performance on assignments or exams takes a toll on Alex's self-esteem. Each setback triggers intense self-evaluation, leading to feelings of disappointment and self-doubt. When faced with challenging assignments or exams, Alex is often self-critical and tends to become negative if doing poorly. After receiving negative feedback, Alex's demeanour visibly changes. Alex becomes visibly tense and disheartened, expressing disappointment in performance	Alex is given a complex writing assignment that proves to be much more difficult than anticipated. Despite struggling with the task and receiving feedback that points out multiple areas for improvement, Alex maintains an enthusiastic attitude and expresses excitement about the learning process. When faced with challenging writing assignments and subsequent feedback, Alex responds with a positive attitude. Alex acknowledges the areas of improvement as opportunities for growth and expresses gratitude for the chance to learn from mistakes	• Most students acknowledged encountering both types of Alex • Some students noted that they themselves might oscillate between both attitudes, depending on their experiences and academic performance • One student shared an example of a peer who fits self-deprecating Alex perfectly, describing how self-deprecating thoughts snowball into a cycle of poor performance • Another student suggested that competitive or difficult courses may make self-deprecation more prevalent
Effort	Rory tends to withdraw effort when facing challenging tasks. Whenever Rory encounters difficult assignments or exams, their natural response is to put less effort into them instead of tackling these challenges head-on. Rory may procrastinate, seek distractions, or even give up prematurely. Rory finds comfort in avoiding the discomfort associated with challenging tasks, even if it means sacrificing the opportunity to learn and grow	Rory thrives on challenges and responds with increased effort. When Rory faces difficult assignments or exams, rather than being deterred by the complexity of the task, Rory seeks out additional resources, adopts effective study strategies, and dedicates extra time to mastering the material	• Students had mixed experiences regarding which Rory was more common • Some students reported seeing more Rory 2 (students persisting despite challenges) in classroom settings, as they believed most students were there to learn and expected difficulty • Others strongly disagreed, arguing that many students withdraw effort when faced with challenges. Several shared examples of classmates who dropped courses, disengaged, or even left college entirely after struggling • Multiple students shared examples of peers who initially enrolled in college without clear goals, became overwhelmed, and ultimately withdrew from their courses or disengaged • Some students noted that entire classes would experience a withdrawal effect when a course became too difficult, with large portions of students dropping out

TABLE 2 (Continued)

	Vignette		
Peer behaviour	**Fixed**	**Growth**	**How realistic is this vignette?***
Explicit verbal messages	Whenever Jessie faces academic challenges, Jessie often says things like, "I'm not smart enough to do this" and "I have to be smart to do well"	When Jessie encounters academic challenges, Jessie says things like "I can get smarter at this" and "With practice and effort, I can improve"	• Most students reported encountering both attitudes frequently, but opinions varied on which was more common • Some students shared personal experiences of friends who openly expressed fixed mindset beliefs, such as believing they were incapable of success in certain subjects • Students mentioned that academic experiences in high school often reinforced fixed mindset beliefs, particularly when teachers and peers emphasized talent over effort • Several students discussed how major vs. non-major courses influence the behaviours; students were more likely to convey a growth mindset message in their chosen major but might hold a fixed mindset in subjects they disliked or struggled with • One student noted that they frequently heard classmates express doubts about their abilities in math, avoiding certain courses due to the belief that they were simply "not good at it"
Competitiveness	Kerry thrives on competition. Kerry finds motivation and engagement skyrocket when pitted against peers. Whether it's in the classroom or extracurricular activities, Kerry's energized by the prospect of outperforming others. Kerry enjoys comparing their own achievements to those of classmates, using their successes as a benchmark to push Kerry further. Kerry's sense of accomplishment often stems from being recognized as the top performer and being one step ahead of peers	Kerry values cooperation over competition. Kerry thrives in collaborative environments where students work together toward common goals. Kerry believes that pooling collective knowledge and skills leads to better outcomes for everyone involved. Kerry enjoys the exchange of ideas and the opportunity to learn from peers. Rather than striving to outdo others, Kerry finds fulfilment in contributing strengths to the group and learning from others' perspectives	• Some students felt that collaborative behaviours (Kerry 2) were more common, especially in difficult classes where students relied on each other for support • Others shared that they were competitive (Kerry 1) in high school but shifted toward a more collaborative mindset in college • A student from STEM noted that competitive attitudes were much more common in STEM fields, particularly in classes where grading curves encouraged students to bring others' scores down • Some students shared experiences where competition was so intense that students deliberately prevented others from accessing study resources • In contrast, students in language courses or discussion-based classes reported experiencing more collaboration due to the nature of the coursework • Several students mentioned that competition was more prevalent in high school due to class rankings but became less relevant in college

(Continues)

TABLE 2 (Continued)

	Vignette		
Peer behaviour	**Fixed**	**Growth**	**How realistic is this vignette?***
Disinterested in helping others	Ryan tends to prioritize their own progress over helping others during group work. When working in a group, Ryan often focuses on completing their own tasks efficiently and may show impatience if peers struggle to understand the material. Ryan may exhibit signs of frustration when other students ask questions or seek clarification. Ryan's impatience may lead them to dismiss questions quickly or provide limited assistance. Ryan's primary concern is getting their own work done	Ryan takes a proactive and supportive approach during group work. Ryan prioritizes the success of the entire group and believes in fostering a collaborative learning environment. Ryan is always willing to help others, whether by explaining concepts, answering questions, or providing guidance. Ryan dedicates time to ensure that everyone comprehends the material	• Students generally reported encountering both types of Ryan, with behaviour depending on the situation and personal priorities • Some students found Ryan 2 (helpful) more common in collaborative courses, especially when group work was required • Others noted that Ryan 1 behaviours (disinterest in helping) were more common in labs where students prioritized finishing early over assisting others • Several students admitted that they themselves oscillate between both attitudes depending on their workload, time constraints, and personal motivation
Boasting success	One day, Jordan casually mentioned to friends, "Oh, I got an A on that exam. Honestly, I didn't even study that much. It's just easy for me." Jordan continued to discuss the achievement, highlighting how they didn't need to put in as much effort as others	One day, when asked about the recent exam in class, Jordan responded, "I think it went pretty well, and I'm happy with how it turned out." Jordan avoided emphasizing success. Despite accomplishments, Jordan is not one to boast about their achievements	• Nearly all students agreed that Jordan 2 (humble) was overwhelmingly more common in their experience • Many felt that openly boasting about academic success would be seen as immature and socially unacceptable in college • Some students recalled more boastful behaviours in high school but believed that maturity and self-awareness reduced such attitudes in college • A few students suggested that boasting might occur in certain contexts, such as trying to impress someone, but it was generally rare • Some students observed that when high-achieving students shared their grades, they often accompanied it with study tips or resources rather than just stating their success

TABLE 2 (Continued)

	Vignette		
Peer behaviour	**Fixed**	**Growth**	**How realistic is this vignette?***
Downplaying struggles	Parker prefers not to reveal challenges and difficulties to others. Parker believes in maintaining a strong and composed image to peers. Even when facing academic or personal setbacks, Parker tends to downplay struggles and put on a brave face. One day, when a friend asked Parker how they were managing the heavy course load, Parker replied, "It's not too bad. Just staying on top of things." In reality, Parker had been feeling overwhelmed and stressed due to the workload. However, Parker didn't want to appear weak	Parker believes in the power of vulnerability and open communication. One day, during a study group session, the topic of upcoming exams came up. Parker hesitated before admitting, "Honestly, I'm feeling really overwhelmed with the material. I've been struggling to keep up, and I'm not sure if I'll be ready for the test." Whether it's academic stress, personal issues, or self-doubt, Parker is open about their experiences	• Most students believed that whether someone was Parker 1 (downplaying struggles) or Parker 2 (sharing struggles) depended on social context • Many students shared that they were more likely to reveal struggles to close friends but would maintain a composed appearance around acquaintances • Some students noted that instructor attitude played a key role—when professors encouraged discussion and vulnerability, students were more willing to admit struggles • Larger lecture courses tended to limit openness, as students rarely spoke to one another • One student linked Parker 1 behaviours to societal pressures to appear competent and capable, making it harder for students to openly admit struggles • Some students reflected on personal experiences of transitioning from Parker 1 to Parker 2, realizing that sharing struggles was healthier and led to more support

Note: *This column presents a summary of the focus group discussion where six undergraduate students from various disciplines discussed how realistic they perceived each vignette to be. Please refer to the Data S3 for details.

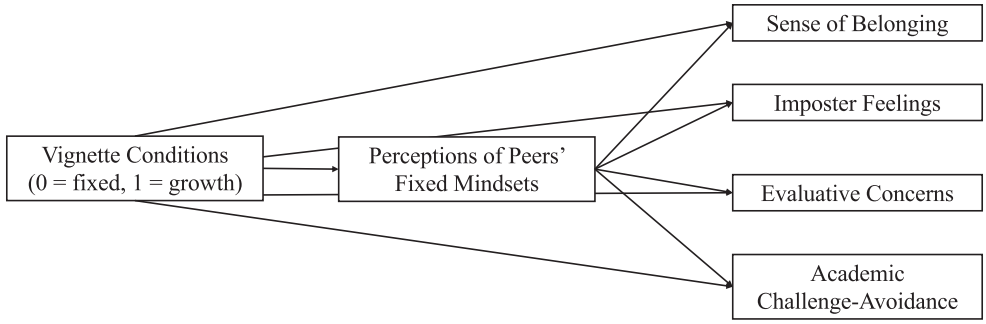

FIGURE 1 Structural equation model demonstrating the hypothesized relations. Personal fixed mindset beliefs were included as covariates in the model but were removed from the figure for graphical simplicity.

TABLE 3 Model fit results (Study 2).

Peer characteristics	χ^2	*df*	*p*-value	RMSEA	CFI	TLI	SRMR
Self-deprecation	2.436	1	.1186	.049	0.999	0.976	.020
Effort	0.117	1	.7328	.000	1.000	1.000	.004
Explicit verbal messages	3.295	1	.0695	.062	0.999	0.973	.024
Competitiveness	0.113	1	.7363	.000	1.000	1.000	.004
Disinterest in helping others	2.692	1	.1008	.053	0.999	0.980	.024
Boasting success	1.191	1	.2751	.018	1.000	0.997	.014
Downplaying struggles	0.053	1	.8718	.000	1.000	1.000	.003

Note: The description of peer characteristics displays the fixed-mindset condition.

belonging, imposter feelings, evaluative concerns, and academic challenge-avoidance. Personal mindset beliefs were included as covariates. Considering the unique narratives of each vignette, we conducted a separate model for each. In addition, we conducted multigroup modelling to compare path coefficients across students' gender, race/ethnicity, and family socioeconomic status. For more information about the analyses, please refer to Data S4.

Results

Preliminary analyses in Data S4 include details about descriptive statistics, bivariate correlations among the key variables, missing data analyses, and manipulation check results. Moreover, model fit indices and path coefficients of SEM across seven vignettes are presented in Tables 3 and 4. The indirect effects with bootstrapped 95% biased-corrected confidence intervals are displayed in Table 5.

Regardless of vignette-specific narratives, students who read about peers behaving in ways that signalled a growth mindset were less likely to perceive the hypothetical peer as holding fixed mindset beliefs ($-.89 < \beta < -.57$, *ps* <. 001). When students perceived peers as having a more fixed mindset, they reported a lower sense of belonging ($-.57 < \beta < -.29$, *ps* < .001), stronger feelings of impostorism ($.20 < \beta < .42$, *ps* < .001) and greater evaluative concerns ($.23 < \beta < .47$, *ps* < .001). Except for effort-related peer behaviour, stronger perceptions of peers' fixed mindset beliefs were associated with greater academic challenge avoidance ($.23 < \beta < .35$, *ps* < .001). For effort-related peer behaviour, although students perceived higher levels of fixed mindset beliefs in peers who withdrew effort when facing challenges, these perceptions did not influence their own academic challenge avoidance. Instead, the peers'

TABLE 4 Structural equation modelling results (Study 2).

	Self-deprecation			Effort			Explicit verbal Messages			Competitiveness			Disinterested in Helping others			Boasting Success			Downplaying struggles		
	b	SE	*β*	*b*	SE	*β*	*b*	SE	*β*	*b*	SE	*β*	*b*	SE	*β*	*b*	SE	*β*	*b*	SE	*β*
Belonging																					
Condition	.48***	.09	.25	.38***	.11	.19	.34**	.13	.16	1.10***	.09	.46	1.40***	.12	.50	.85***	.12	.38	.94***	.08	.45
PMind	−.34***	.04	−.43	−.34***	.05	−.45	−.37***	.04	−.57	−.33***	.05	−.31	−.44***	.04	−.40	−.34***	.05	−.34	−.33***	.05	−.29
Mind	−.003	.03	−.003	.02	.03	.02	−.03	.03	−.03	.06	.04	.04	.04	.04	.03	.06	.04	.05	.03	.04	.03
Imposter																					
Condition	−.31**	.10	−.16	.03	.11	.02	−.21	.15	−.11	−.77***	.09	−.35	−.63***	.12	−.26	−.59***	.11	−.28	−.89***	.08	−.42
PMind	.26***	.04	.33	.15**	.05	.20	.19***	.05	.32	.31***	.04	.32	.39***	.05	.42	.32***	.05	.33	.25***	.05	.21
Mind	.05	.04	.06	.08*	.04	.09	.06	.04	.07	−.06	.04	−.06	−.003	.04	−.003	−.003	.04	−.003	.03	.04	.02
Evaluation																					
Condition	−.42***	.10	−.20	.22*	.11	.11	−.36*	.16	−.17	−.87***	.10	−.38	−.65***	.12	−.26	−.42***	.11	−.20	−.68***	.09	−.31
PMind	.30***	.05	.36	.20***	.05	.26	.15**	.05	.23	.23***	.05	.22	.45***	.05	.47	.36***	.05	.36	.32***	.06	.26
Mind	.05	.04	.05	.09*	.04	.09	.10*	.04	.10	−.02	.05	−.02	−.01	.04	−.01	−.03	.04	−.03	−.02	.04	−.02
Avoidance																					
Condition	−.76***	.16	−.32	−.87***	.16	−.39	−.44	.25	−.20	−.55***	.12	−.25	−.80***	.17	−.32	−.51**	.16	−.23	−.35**	.12	−.17
PMind	.30***	.06	.31	.09	.06	.10	.22**	.07	.32	.34***	.05	.34	.33***	.06	.35	.25***	.07	.25	.26***	.07	.23
Mind	−.06	.06	−.05	.02	.06	.01	−.01	.06	−.01	−.03	.05	−.03	.12*	.06	.10	−.08	.06	−.08	−.05	.06	−.04
PMind																					
Condition	−1.83***	.07	−.74	−1.94***	.07	−.75	−2.88***	.06	−.89	−1.27***	.08	−.57	−2.01***	.07	−.77	−1.52***	.06	−.70	−.79***	.07	−.45
Mind	.23***	.04	.19	.07	.04	.06	.09**	.03	.06	.15***	.04	.14	.16***	.04	.12	.12***	.04	.12	.14***	.03	.16

Note: Avoidance = Academic challenge avoidance; Belonging = Sense of belonging; Condition = Experimental condition (0 = peers behaving in ways that signalled a fixed mindset, 1 = peers behaving in ways that signalled a growth mindset); Evaluation = Evaluative concerns; Imposter = Imposter feelings; Mind = Personal fixed mindset beliefs (covariate); PMind (mediator) = Perceptions of peer fixed mindset beliefs; SE = Standard error of unstandardized path coefficients. *$p < .05$; **$p < .01$; ***$p < .001$ (The significance level was adjusted to .001 by using Bonferroni correction considering the use of multiple modelling testing).

TABLE 5 The mediating effects of perceptions of peers' mindsets between peer behaviours and outcome variables (Study 2).

Peer characteristics	Indirect effect	Indirect effect (SE)	95% bias-corrected Confidence interval (CI)
Self-deprecating	Condition → PMind → Belong	.32*** (.04)	[.25, .40]
	Condition → PMind → Imposter	−.24*** (.04)	[−.32, −.16]
	Condition → PMind → Evaluation	−.27*** (.04)	[−.34, −.18]
	Condition → PMind → Avoidance	−.23*** (.05)	[−.33, −.14]
Effort	Condition → PMind → Belong	.33*** (.05)	[.24, .43]
	Condition → PMind → Imposter	−.15** (.05)	[−.25, −.07]
	Condition → PMind → Evaluation	−.19*** (.05)	[−.29, −.10]
	Condition → PMind → Avoidance	−.07 (.06)	[−.19, .03]
Explicit verbal messages	Condition → PMind → Belong	.50*** (.06)	[.39, .60]
	Condition → PMind → Imposter	−.29*** (.07)	[−.42, −.15]
	Condition → PMind → Evaluation	−.21** (.07)	[−.34, −.07]
	Condition → PMind → Avoidance	−.28** (.09)	[−.47, −.10]
Competitiveness	Condition → PMind → Belong	.18*** (.03)	[.13, .23]
	Condition → PMind → Imposter	−.18*** (.03)	[−.24, −.13]
	Condition → PMind → Evaluation	−.13*** (.03)	[−.18, −.08]
	Condition → PMind → Avoidance	−.19*** (.03)	[−.26, −.13]
Disinterested in helping others	Condition → PMind → Belong	.31*** (.03)	[.25, .38]
	Condition → PMind → Imposter	−.33*** (.04)	[−.41, −.24]
	Condition → PMind → Evaluation	−.36*** (.04)	[−.44, −.29]
	Condition → PMind → Avoidance	−.27*** (.05)	[−.37, −.17]
Boasting success	Condition → PMind → Belong	.24*** (.04)	[.16, .32]
	Condition → PMind → Imposter	−.23*** (.04)	[−.30, −.16]
	Condition → PMind → Evaluation	−.25*** (.04)	[−.33, −.19]
	Condition → PMind → Avoidance	−.17** (.05)	[−.27, −.08]
Downplaying struggles	Condition → PMind → Belong	.13*** (.02)	[.09, .17]
	Condition → PMind → Imposter	−.09*** (.02)	[−.13, −.06]
	Condition → PMind → Evaluation	−.12*** (.02)	[−.16, −.07]
	Condition → PMind → Avoidance	−.10*** (03)	[−.15, −.05]

Note: Avoidance = Academic challenge-avoidance; Belonging = Sense of belonging; Evaluation = Evaluative concerns; Imposter = Imposter feelings; PMind (mediator) = Perceptions of peer fixed mindset beliefs; SE = Standard error; Standardized beta coefficient estimate is reported. *$p < .05$; **$p < .01$; ***$p < .001$.

behaviours directly influenced students' academic challenge avoidance, suggesting the involvement of other mechanisms.

Path differences by gender, race/ethnicity, and mother's education

To examine differences in path coefficients based on students' gender, race, and mother's education, we conducted multigroup modelling. There were no significant structural differences in the associations between manipulated peer behaviours, perceptions of peer mindset beliefs, and the four outcomes across race/ethnicity or mother's education (see Data S5 for the detailed results). The only observed structural difference was by gender (Table 6). The effects of having competitive and unwilling-to-help peers on perceptions of peer mindset were stronger for female students than for male students.

TABLE 6 Multi-group structural equation modelling: gender.

Vignette	Models	df	χ^2	RMSEA	CFI	TLI	SRMR
Self-deprecation	Unconstrained	2	4.93	.071	.998	.951	.030
	Constrained	22	29.83	.035	.994	.988	.065
Effort	Unconstrained	2	3.53	.051	.998	.967	.024
	Constrained	22	27.32	.029	.995	.990	.054
Explicit verbal messages	Unconstrained	2	4.41	.064	.999	.974	.027
	Constrained	22	33.83	.043	.994	.988	.051
Competitiveness	Unconstrained	2	0.10	.000	.000	1.000	.004
	Constrained	22	56.71[a]	.074	.971	.944	.091
Disinterested in helping others	Unconstrained	2	3.02	.042	.999	.988	.025
	Constrained	22	62.27[a]	.079	.997	.957	.097
Boasting success	Unconstrained	2	2.22	.019	.000	.997	.017
	Constrained	22	56.05[a]	.073	.975	.952	.093
Downplaying struggles	Unconstrained	2	2.13	.015	.000	.997	.018
	Constrained	22	53.95[a]	.071	.966	.936	.091

Abbreviation: *df*, degrees of freedom.

[a]$p < .001$. The chi-square score difference between the unconstrained and the constrained model was statistically significant.

Moreover, the direct effects of the peers who boasted about their success and downplayed struggles on imposter feelings were stronger for female students than for male students.

DISCUSSION

Even if a student believes that their abilities can change, maintaining such a belief is challenging when surrounded by peers who strongly believe that abilities are innate gifts one must be born with (King, 2020). Identifying peer behaviours that signal a fixed mindset to their peers poses great importance as it lays the foundation for future interventions aimed at changing peer cultures. Without this knowledge, it is impossible to know which peer behaviours to target for change to promote growth mindset peer cultures.

Previous studies have identified five peer behaviours that signal mindset in classroom settings: (1) disinterest in helping others versus willingness to help, (2) withdrawing effort versus appreciating and putting in effort, (3) competitiveness versus cooperativeness, (4) self-deprecation versus self-encouragement, (5) explicit fixed verbal messages versus explicit growth verbal messages (Muenks & Yan, 2024). In our focus groups, we identified two additional characteristics through which students communicate their mindset: (6) boasting about success and (7) downplaying struggles. These last two behaviours were not identified in the previous study (Muenks & Yan, 2024) but emerged in our study, potentially due to disciplinary differences. While Muenks and Yan (2024) examined students from a biology course, our focus groups consisted of students from a chemistry course. Compared to biology, boasting about success and sharing struggles may be more prevalent in chemistry for various reasons—for instance, chemistry tends to have a higher proportion of men, which may influence behavioural norms related to boasting. Additionally, our chemistry course incorporated small-group work, creating an environment where students may feel more comfortable openly sharing their struggles. This distinction was also evident in our supplemental focus group, where we validated our experimental materials (Table 2). Students from different disciplines reported varying frequencies of these behaviours—competitive behaviours were more commonly observed in STEM disciplines, whereas collaborative behaviours were more prevalent in discussion-based social science courses. Future research could further

investigate how disciplinary differences influence mindset-signalling behaviours, as seen in a recent study (e.g., Rutten et al., 2024).

During our focus groups (Study 1), we also observed that these characteristics are not entirely independent. For instance, one student noted the competitive culture of peers as a factor that made her doubt their potential for success and highlighted that boasting about success had particularly negative implications in such a competitive culture. Conversely, a student in a less competitive environment noted that peers offering help when she fell behind made her feel included. This illustrates how these peer behaviours may work together to create a broad peer culture of fixed or growth mindset and may have synergistic or exacerbating effects.

More importantly, this is the first study to establish causal connections among peer behaviours, students' perceptions of peer mindset, and their psychological experiences in the classroom. Previous correlational research has established evidence linking peer behaviours to perceptions of peer mindset (Muenks & Yan, 2024), and a separate correlational study showed evidence of the link between perceptions of peer mindset and students' psychological experiences in the classroom (Muenks et al., 2021). However, it was unclear until this study whether these peer behaviours indeed *influence* important psychological experiences of students *through* the perceptions of their peers' mindset. Our study shows that all seven peer behaviours influence the sense of belonging, imposter feelings, and evaluative concerns through students' perceptions of peers' mindset. When students believe that their peers act in ways that signal a fixed mindset, such as downplaying struggles, they are more likely to believe that the peer has a fixed mindset, which in turn makes them feel less included in the classroom, feel unworthy of the credits they receive, worry more about being judged, and choose easier tasks that offer little learning opportunities. The average total effects of peer mindset behaviour conditions on outcomes in Study 2 were $|\beta| = .49$ (r_{PB}[1] = .47), representing a medium effect size (Cohen, 1992). This effect is comparable to those observed for other motivational constructs, such as attribution ($d = .54$, medium effect), self-affirmation ($d = .38$, small to medium effect) and social belongingness ($d = .35$, small to medium effect; Lazowski & Hulleman, 2016).

Why would students expect to have these negative psychological experiences when they believe that their peers have a fixed mindset? When students perceive that their peers value innate ability as crucial for success in the field, it is easy for students to worry about being judged by others regarding their innate ability to succeed. This worry can amplify imposter feelings—the sense that they are unworthy of the credits they are receiving—and make them feel like they do not belong with their peers or in the field. These compounded negative psychological experiences can in turn lead students to choose easier tasks to avoid risk, even though these tasks provide little learning opportunities (Hecht, Murphy, et al., 2023; Murphy et al., 2021).

Of note, for many outcomes, perceptions of peer mindset were not the sole mediator. This means that peer behaviours influenced students' sense of belonging, imposter feelings, evaluative concerns, and academic challenge-avoidance not only through the perceptions of peers' mindset but also through other mechanisms. Moreover, for behaviours involving withdrawing effort, peer behaviours directly influenced academic challenge-avoidance rather than through the perceptions of peer mindset. The potential other mechanisms may include goal contagion (King & Mendoza, 2020) and stereotype threat (Van Loo et al., 2013). For example, when a student observes others withdrawing their effort when struggling, their goals to avoid appearing unintelligent may become contagious among peers, prompting them to avoid challenging academic tasks. These mechanisms need to be further studied in the future to identify the precise ways in which these peer behaviours impact students' critical psychological experiences in classrooms.

Also, we found that female college students are more likely to perceive their peers who are competitive and disinterested in helping others as having a fixed mindset. Women are often socialized to value communal goals in U.S. society (Diekman & Steinberg, 2013). As such, women often exhibit higher interpersonal sensitivity than men, which includes the ability to detect subtleties in social environments (Hall & Mast, 2008). This heightened sensitivity could make female students more likely to

[1]We converted β values to Peterson-Brown correlation coefficients to facilitate comparison with other effect sizes (Peterson & Brown, 2005).

notice and interpret competitive or non-collaborative behaviours as signs of a fixed mindset, whereas male students may tend to view those behaviours as a norm that can be displayed by peers regardless of their mindsets. In addition, women in competitive environments, such as STEM fields, tend to experience greater imposter feelings and a lower sense of belonging (Deiglmayr et al., 2019; Muradoglu et al., 2022). These negative psychological experiences may lead women to be more sensitive to peers' behavioural cues to signal fixed mindset compared to their male counterparts, reinforcing their perceptions of peers as holding fixed mindsets. Future research is needed to better understand the mechanisms driving these perceptions to develop effective strategies to mitigate them.

Our findings inform theoretical approaches to achievement motivation by bridging peer research (e.g., Wentzel, 2022) with mindset research (e.g., Dweck, 1999). Traditionally, mindset has been conceptualised as an internal belief system that individuals develop about intelligence and ability (e.g., Dweck, 1999). However, recent research has expanded this view, recognising the role of contextual influences such as teacher mindsets and classroom cultures (e.g., Carroll et al., 2023). Our study builds on this work by proposing that peers also play a critical role in shaping the classroom mindset culture through social signalling. This insight strengthens the argument that mindset is not merely an individual psychological construct but a social construct—one that is actively communicated, reinforced, and influenced by interactions with others. By identifying distinct peer behaviours that convey mindset beliefs, our study highlights how mindset operates within a social ecosystem rather than solely within an individual's cognition. By identifying seven distinct peer behaviours that communicate mindset beliefs, our study advances the literature by shifting the focus from mindset as an individual characteristic to mindset as a socially transmitted construct. This shift underscores the importance of social and cultural influences on achievement motivation, emphasizing that a student's motivation and academic experiences are shaped not only by their own beliefs but also by the behaviours and attitudes of their peers.

Understanding mindset as a socially constructed and reinforced phenomenon opens new directions for interventions, suggesting that fostering a growth mindset culture requires attention to peer interactions and social dynamics, not just individual beliefs. Our research suggests that educators should strive to create a learning environment where growth mindset peer behaviours among peers are not only permitted but also encouraged. For example, it is easier for students to share their struggles and help one another in small group settings, where collaboration is emphasized, rather than in large classes, where competition may be more pronounced. As such, creating small group discussions within a large lecture class may help encourage students to display more growth mindset behaviours. Educators can promote a collaborative and inclusive atmosphere by designing course structures that encourage mutual support, such as using absolute grading rather than relative performance grading, which can reduce competition and foster a sense of community. These changes can help students cultivate a peer culture that better signals a growth mindset.

Limitations and future directions

One limitation of the current study is that the manipulated peers were presented in a vignette, and student outcomes were assessed by asking students to imagine their classmates as the peers described in the vignette. The vignette methodology has been widely used in psychological studies and often yields results consistent with behavioural manipulations (e.g., Hainmueller et al., 2015). Additionally, the vignette methodology in the current research mirrors real-word situations in which students may hear about courses from their friends (e.g., "the class is very competitive") and enter the classroom with a preconceived psychological state (e.g., an initial lack of belonging at the beginning of the semester). However, its ecological validity is inherently lower than that of real classroom settings.

Furthermore, one vignette—depicting boasting about success while minimizing effort—was perceived as less realistic by some students during the validation focus group (see Table 2 and Data S3 for details). Instead, students suggested that peers typically boast about success while providing additional

context. Therefore, researchers intending to use the boasting success vignette should consider revising it for improved validity.

Moreover, the present study was conducted at a large, competitive institution in the southern U.S. with a high proportion of participants being Asian, Latinx, and White, and only a small number of Black and Indigenous students. Thus, we recommend that future research replicate the current findings in more authentic classroom settings with diverse demographic populations before drawing any definitive conclusions.

We also note the limitation of our measures of outcomes. While our two-item measures demonstrated adequate reliability across vignettes, a potential limitation is whether they fully capture the intended constructs. To mitigate this, we selected items with strong content validity; however, two-item measures inherently offer less depth than multi-item scales. Future research could expand on our findings by incorporating additional items or alternative measurement approaches to enhance construct coverage and reliability.

Finally, our research focused on specific peer behaviours that signal mindset to classmates and on students' perceptions of peer mindset. While these behaviours and perceptions contribute to a broader mindset culture—comprising shared values, norms, and beliefs about the malleability of ability—they do not fully capture the classroom mindset culture. We encourage future research to examine additional factors that shape classroom mindset culture, including shared beliefs, group norms, instructor influences, and curriculum design, to provide a more comprehensive understanding.

CONCLUSION

This study highlights the potential profound impact of mindset-signalling peer behaviours on students' sense of belonging, imposter feelings, evaluative concerns, and their willingness to engage in academically challenging tasks. By identifying and understanding the specific peer behaviours that signal a fixed versus a growth mindset, educators and administrators can better design interventions aimed at fostering a more supportive and inclusive peer cultures. Moving forward, it is imperative that future studies replicate these findings through behavioural manipulations and field interventions to solidify our understanding and develop effective strategies that can transform educational practices and outcomes.

AUTHOR CONTRIBUTIONS

Eunjin Seo: Conceptualization; methodology; investigation; writing – review and editing; writing – original draft. **So Yeon Lee:** Data curation; formal analysis; writing – original draft; writing – review and editing. **Katherine Muenks:** Conceptualization; investigation; writing – review and editing. **Yiqiu Yan:** Conceptualization; writing – review and editing; investigation.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX 1

FULL LIST OF SURVEY MEASURES

Perceptions of Peers' Mindset (adapted from Dweck, 1999)

1. How likely do you think it is that [peer name] believes that people have a certain amount of intelligence, and they really can not do much to change it?
2. How likely do you think it is that [peer name] believes that intelligence is something that you can not change very much?

Sense of Belonging (adapted from Murphy & Zirkel, 2015)

1. I would feel that I belong in the class.
2. I would feel accepted in the class.

Imposter Feelings (adapted from Leary et al., 2000)

1. I would feel like an "imposter".
2. I would worry that people might find out that I am not as capable as they think I am.

Evaluative Concerns (adapted from Wout et al., 2010)

1. I would worry that I might have said the wrong thing.
2. I would worry that I might have made a mistake.

Academic Challenge Avoidance (adapted from Rege et al., 2021)

Again, imagine that the majority of your classmates were like [peer name].
If you had a choice between one of two assignments in the class, which would you choose?

- One that was harder and would probably lead to a lower grade, but where you would learn more.
- One that was easier and would probably lead to a higher grade, but where you would learn less.

Personal Mindset (adapted from Dweck, 1999)

1. I believe that people have a certain amount of intelligence, and they really can not do much to change it.
2. I believe that intelligence is something that you can not change very much.

Note: The response scale for personal mindset utilized the original format, ranging from 1 (Strongly Disagree) to 6 (Strongly Agree).

Gender

In research, we often must present demographic information in categories. We understand these labels are limiting. If you had to select one of the options below, which one best describes your gender identity?

- Female
- Male
- Non-binary/third gender, please specify:
- Prefer not to say

Race/ethnicity

When thinking about physical attributes usually ascribed to race, which of the following general labels describe how you would describe yourself racially? Please mark all that apply.

- Asian
- Black
- Indigenous, Aboriginal, or First Nations
- Latino or Hispanic
- Middle Eastern
- White
- Other, please specify:
- I prefer not to answer

Mother's Education

Which of the following is the highest degree or level your mother has earned or completed?

- I prefer not to answer
- No schooling completed
- Completed elementary school
- Completed middle or junior high school
- Some high school, no diploma
- High school diploma
- GED or alternative credential
- Just started college, no college credit earned yet
- Some college credit, but less than one year of college credit
- One or more years of college credit, no degree
- Technical, trade, or vocational school certificate or apprenticeship
- Associate degree, academic (for example: AA, AS)
- Associate degree, occupational (for example: AAA, AAS)
- Bachelor's degree (for example: BA, BS)
- Master's degree (for example: MA, MBA, MEd, MEng, MS, MSW)
- Specialist degree (for example: EdS)
- Professional degree beyond the bachelor's degree (for example: DDS, DVM, JD, MD, PharmD, PsyD)
- Doctoral degree (for example: EdD, PhD)
- Other, please specify: