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The Power of We: How Cooperative Mindsets Predict Help-Seeking Strategies and Academic Engagement in STEM and HEED Fields

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ABSTRACT

Academic help-seeking is a core strategy of self-regulated learning, yet it is often underutilized due to perceived social costs. This study examines how university students' cooperative mindsets—a set of beliefs that emphasize the value of cooperation for academic success—relate to help-seeking strategies and academic engagement within two gendered academic domains: STEM (science, technology, engineering, and mathematics) and HEED (health care, elementary education, and the domestic spheres). Drawing on survey data from 590 German higher education students, we examined gender and domain differences in cooperative mindsets and tested a mediation model linking cooperative mindsets to academic engagement through autonomy-oriented help-seeking and help-seeking avoidance. Results showed that female students across both domains reported stronger cooperative mindsets and lower avoidance of help-seeking than their male peers. Unexpectedly, STEM students endorsed cooperative mindsets more strongly than HEED students.

Mediation analyses indicated that, for male students in both domains, cooperative mindsets were indirectly associated with academic engagement through autonomy-oriented help-seeking. For female students, no indirect effects were found, but cooperative mindsets were associated with more adaptive help-seeking and academic engagement. Our findings suggest that cooperative mindsets can serve as a psychological resource by promoting adaptive help-seeking behaviors for both male and female students, though they enhanced academic engagement indirectly only for male students. We discuss how making cooperation visible as an academic norm may help foster more inclusive and engaging learning environments.

KEYWORDS: Cooperative mindsets; help-seeking; academic engagement; STEM; HEED; gender

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INTRODUCTION

Seeking academic help from peers is widely recognized as a crucial self-regulatory strategy, associated with improved student outcomes and increased academic engagement (Karabenick & Gonida, 2018), the latter being a key contributor to university students' overall success (Fong et al., 2023; Xerri et al., 2018). In higher education, students are typically expected to manage their learning with a high degree of autonomy. In such contexts, the ability to seek help from peers plays a vital role (Broadbent & Lodge, 2021) in staying engaged in academic activities—cognitively, by mastering academic demands, and socially, by building supportive relationships (Fong et al., 2023; Won et al., 2021; Xerri et al., 2018; Zander et al., 2018). Yet, despite these benefits, students often refrain from asking for help and support (Karabenick, 2003; Zander & Höhne, 2021), making academic engagement a rather individual experience (Li et al., 2023; Thomas & Tagler, 2019). This reluctance is typically understood as stemming from threats to self-esteem—concerns about appearing incompetent or being judged by peers (Nadler, 2012; Ryan et al., 2001; Ryan et al., 2009).

However, academic help-seeking is more than a self-regulatory learning strategy. As the only type of self-regulation that involves social interaction with others (Nadler, 2015), it is not only shaped by the academic environment and culture in which it occurs but also rooted in underlying assumptions about how learning should happen (Karabenick, 1998). In this study, we focus on students' cooperative mindsets—that is, their beliefs about the value of peer cooperation for learning and academic success, as well as their feelings that accompany cooperative work. Thus, cooperative mindsets capture students' broader assumptions about the nature of academic work, i.e., whether it is an individual or collective effort. These mindsets are central to understanding academic help-seeking: Students who view academic learning as an inherently social process may be more inclined to turn to and engage with peers when facing challenges—not only because they expect help to be effective, but also because they perceive it as legitimate and aligned with the learning norms they endorse (Johnson & Johnson, 2009; Jördens et al., 2024).

This reframing of help-seeking is particularly relevant in gendered academic contexts. In STEM fields (science, technology, engineering, and mathematics), students continue to encounter messages from the prevailing academic culture that equate success with innate "brilliance" and individual talent—traits often associated with masculine ideals of the "lone genius" (Deiglmayr et al., 2019; Leathwood, 2006; Leslie et al., 2015; Muradoglu et al., 2023; Simonton, 2013; Storage et al., 2016). Such messages, even when subtly conveyed, may undermine students' beliefs that asking for help is part of the learning process. Instead, these messages imply that academic success depends on working independently and not needing support from others (Canning et al., 2022; Muenks et al., 2020). Although women generally engage more in adaptive academic help-seeking than men (Brown et al., 2021), this pattern is disrupted in STEM fields, where female students report

greater avoidance of help-seeking than in HEED fields (health care, elementary education, and the domestic spheres), in which women are more prominently represented than their male peers (Zander & Höhne, 2021).

In the present study, we investigate how cooperative mindsets relate to students' academic help-seeking strategies and their academic engagement across two distinct academic domains. By comparing students in STEM and HEED fields—contexts that differ in gender representation and epistemic values—we examine how cooperative mindsets may either facilitate or hinder students' academic engagement, depending on the academic context and its underlying culture.

Academic Help-Seeking: Inferiority or Resource?

Over the past two decades, the understanding of academic help-seeking in educational psychology has shifted fundamentally. Once viewed as a sign of dependency or incompetence, it is now recognized as a core component of self-regulated learning and academic development (Karabenick & Gonida, 2018; Newman, 2002). In fact, academic help-seeking—a specific form of task engagement (Newman & Schwager, 1993)—has been identified as a significant predictor of students' overall academic engagement, persistence, and achievement, especially when learners are faced with complex or demanding academic tasks (Duchesne et al., 2019; Ryan & Shim, 2012; Ryan & Shin, 2011; Won & Chang, 2024).

At the same time, help-seeking remains distinct from other self-regulatory strategies in one important respect: It requires social interaction and thus exposes students to interpersonal and reputational risks (Nadler, 2012). As a result, it can carry psychological costs, since it may be interpreted by others—or feared by the individual—as a sign of incompetence or lack of ability (Nadler, 2012; Ryan et al., 2001). Such concerns are particularly salient in academic environments where success is believed to depend on innate intellectual ability. Within STEM academic cultures, where individual "brilliance" and high-level cognitive performance are emphasized, asking for help may conflict with implicit norms of autonomy and mastery. In these settings, seeking academic support or actively forming collaboration networks may be perceived as evidence of intellectual inferiority, thereby contributing to the avoidance of help-seeking (Ryan et al., 2001; Smalley & Hopkins, 2020; Zander & Höhne, 2021).

Although male students generally report higher levels of help-seeking avoidance across academic domains (Sheu & Sedlacek, 2004; Zander & Höhne, 2021), research suggests that female students in STEM may also disengage from help-seeking in response to what has been described as the "chilly climate" of these fields (Callister, 2006; Miner et al., 2019; Settles et al., 2006; Simon et al., 2017). Compared to their counterparts in HEED fields, female students in STEM report significantly higher avoidance of academic help-seeking, suggesting a response to perceived social norms that discourage visible reliance on others (Zander & Höhne, 2021).

We argue that help-seeking continues to suffer from an image problem: Despite its empirically demonstrated value for academic outcomes, it remains underutilized (Brown et al., 2021; Li et al., 2023). This is particularly the case in STEM domains, where male students are overrepresented (Zander & Höhne, 2021). Students often

anticipate high social and psychological costs—shaped by academic cultures (Leslie et al., 2015; Muradoglu et al., 2023; Storage et al., 2016), by instructor cues that may signal whether students' innate ability or rather personal effort and development are valued (Höhne et al., 2024; LaCosse et al., 2021; Muenks et al., 2020), but also by students' individual beliefs about how academic progress is made (Eccles, 2009; Wang & Eccles, 2013).

While prior research has established positive links between students' perceptions of social support in peer relationships, collaborative peer contexts, and classroom engagement in schools (e.g., Kilday & Ryan, 2024; Wentzel & Watkins, 2002), evidence is more limited in higher education, with recent work increasingly focusing on digital learning environments (e.g., Gillies & Turner, 2025; Martín-Arbós et al., 2021). To our knowledge, relatively few studies have examined this relationship directly in university settings, and these studies have rarely considered differences across subject domains or gender. The present study addresses this gap by investigating how academic help-seeking and engagement relate across subject domains (STEM vs. HEED) and gender, where distinct cultural norms surrounding independence and cooperation may shape students' mindsets and behaviors.

Cooperative Mindsets: Key to Academic Help-Seeking and Engagement?

Cooperative mindsets refer to belief systems about how academic success is achieved (Jördens et al., 2024; Jördens et al., under review). They capture the extent to which students regard learning and performance as co-created with peers rather than accomplished in isolation. Individuals with a cooperative mindset assume that understanding complex material, mastering skills, and performing well in exams or projects crucially depend on exchanging ideas, asking questions, and jointly working through problems with others (Jördens et al., 2024). In line with this conceptualization and our use of the construct in the present work, cooperative mindsets include both (a) a belief in the instrumental value of cooperation for academic progress and (b) the sense that cooperating with peers is a personally meaningful and desirable part of studying.[1]

From the perspective of social interdependence theory (Johnson & Johnson, 2009), cooperative mindsets can be understood as students' subjective construal of positive interdependence: the belief that one's academic outcomes are linked to, and improved by, others' success rather than threatened by it. Social interdependence theory distinguishes positive interdependence (cooperation), negative interdependence (competition), and the absence of interdependence (individualism), and posits that these different goal structures systematically shape interaction patterns and outcomes (Johnson & Johnson, 2009). Across decades of research, cooperative (positively interdependent) learning structures have been shown to yield more positive peer relations and prosocial behavior, higher academic engagement and achievement, as well as better psychological adjustment than competitive or individualistic structures (e.g., Johnson et al., 1981; Roseth et al.,

[1] The term "mindset" has gained significant popularity in educational psychology, particularly through the work on growth mindsets, which refer to the beliefs that intellectual abilities are malleable and can be developed through effort and task persistence (Dweck, 1999, 2006; Molden & Dweck, 2006). Growth mindsets contrast with fixed mindsets, which describe beliefs that intelligence is innate and largely unchangeable (Dweck, 1999, 2006; Molden & Dweck, 2006). While growth vs. fixed mindsets (also referred to as implicit theories of intelligence; Dweck, 2012) focus on beliefs about the nature and development of personal attributes such as intelligence, cooperative mindsets reflect a different kind of belief system: one that concerns the social conditions and processes believed to promote or hinder academic development.

2008; Van Ryzin & Roseth, 2021; Van Ryzin et al., 2020). Cooperative mindsets, in this sense, express a positive orientation toward interdependence in academic work. Cognitively, they entail the expectation that collaboration is an effective route to deep understanding, persistence in the face of difficulty, and high performance. Affectively, they involve anticipating collaboration as energizing, enjoyable, and identity-consistent rather than as burdensome or risky (Jördens et al., 2024).

This dual cognitive-affective orientation is consistent with a substantial body of research documenting that cooperative learning structures and collaborative climates foster academic motivation, self-efficacy, adaptive help-seeking, achievement, and creative performance (e.g., Bittner & Heidemeier, 2013; Johnson & Johnson, 2009; Lu et al., 2019; Micari & Pazos, 2021; Smalley & Hopkins, 2020; Xue et al., 2018). Building on this work, recent evidence indicates that students with stronger cooperative mindsets perceive their course climate as more supportive and cooperative and see (digital) cooperation as having a stronger positive impact on their learning outcomes (Jördens et al., 2024). Taken together, cooperative mindsets can be understood as the psychological lens through which students interpret academic environments and peer interactions: When students believe that "this is a place where we succeed with one another," they should be more willing to seek and offer academic help and, in turn, to engage more deeply with their studies.

Cooperative Mindsets in STEM and HEED

The term "chilly climate" has been used to describe academic environments—particularly in STEM—that feel unwelcoming or exclusionary, especially to women and members of underrepresented groups (Callister, 2006; Miner et al., 2019; Settles et al., 2006; Simon et al., 2017). Such climates are shaped by a combination of subtle and overt signals: negative social interactions, systemic barriers, and cultural norms that undermine students' sense of belonging and legitimacy (Parson & Ozaki, 2017). In STEM contexts, these signals often take the form of implicit messages that frame academic success as the result of individual effort, exceptional ability, and competitive performance (Canning et al., 2019; Kroeper et al., 2022; Muenks et al., 2020). Phrases such as "look to your left and right—only one of you will graduate," or course descriptions that emphasize difficulty and exclusivity, could reinforce norms of intellectual selectivity and discourage showing vulnerability or mutual support. The experience may be "double trouble" for students from underrepresented groups in STEM who are already facing negative stereotypes (Van Veelen et al., 2019), given that asking for help may additionally confirm the existing negative stereotypes. The chilly climate can also be specifically challenging for students who prioritize communal goals for their future careers, i.e., the ideal of collaborating with and helping others, as well as contributing to the broader good—goals that are often perceived as misaligned with STEM careers (Boucher et al., 2017; Diekman et al., 2011; Diekman et al., 2017).

While previous research suggests that STEM students may be less inclined to endorse cooperative values or to perceive collaboration as central to academic success (Covarrubias et al., 2019; Riegle-Crumb et al., 2019), the extent to which students in different academic domains hold cooperative mindsets has not yet been examined systematically. To our knowledge, no prior study has directly compared students' beliefs about the value of collaboration in STEM and HEED fields, or

explored how these beliefs relate to concrete academic learning strategies such as help-seeking.

This raises several interrelated research questions that will be addressed in this study: Are students in STEM less likely than their HEED peers to believe that collaboration is essential for academic progress? Do such beliefs differ by gender, particularly in fields where one gender is underrepresented (i.e., female students in STEM and male students in HEED)? And critically, how do cooperative mindsets relate to students' willingness to seek academic help and their academic engagement?

Importantly, the absence of visible collaboration or help-seeking behavior in an academic environment does not necessarily indicate that students reject the value of collaboration. It may instead reflect pluralistic ignorance (Sargent & Newman, 2021). Applied to academic help-seeking, this psychological phenomenon describes the situation in which individuals privately endorse a norm (e.g., the value of collaboration) but believe that others do not, leading them to conform to a perceived norm of independence. In such cases, students may avoid seeking help not because they question its usefulness but because they fear that asking for help violates a shared norm—when in fact, many peers may feel similarly but remain silent.

Cooperative mindsets may offer a psychological counterweight to such perceived norms of independence. When students believe that collaboration is not only useful but socially appropriate and expected, they may interpret help-seeking not as a sign of weakness or deficiency, but as a legitimate and even valued academic behavior. In this way, cooperative mindsets may lower the anticipated social costs of help-seeking, making it more likely that students will seek support when needed, especially in environments where performance pressure and autonomy norms are strong.

Understanding the dynamics of cooperative mindsets in STEM and HEED contexts can thus offer critical insight into both the persistence of help-seeking avoidance and potential pathways toward more adaptive help-seeking and engagement in different academic cultures. It also stands to highlight the importance of academic environments that not only permit, but actively legitimize and encourage collaboration and mutual support, particularly in disciplines where competitive individualism is the default norm.

The Present Study

Students' beliefs about the value and legitimacy of peer cooperation for academic success—what we refer to as cooperative mindsets—may play an important role in how they navigate academic challenges. Such beliefs may shape how students seek help when they struggle, how they interpret learning as a shared or individual process, and ultimately how engaged they feel in their studies.

In this study, we examine whether cooperative mindsets differ by gender and subject domain, comparing students in STEM and HEED fields, which represent contrasting academic cultures. These cultures differ not only in gender representation but also in the values they attach to individual versus collective academic work. Drawing on data from German university students, we investigate

whether cooperative mindsets can explain variance in students' help-seeking strategies and academic engagement above and beyond field-specific ability beliefs and academic self-efficacy.

Building on a social-cognitive perspective of self-regulated learning, which emphasizes the role of individual beliefs, motivational orientations, and perceived social norms in guiding academic behavior, we also examine whether help-seeking strategies mediate the link between cooperative mindsets and academic engagement. That is, we test whether students who endorse cooperative mindsets are more engaged because they are more likely to seek help autonomously and less likely to avoid seeking help.

Based on this framework, we test several hypotheses.

1) Within both domains, we expect female students to report higher levels of cooperative mindsets than male students, reflecting gender differences in communal motivational orientations (H1).

2) Based on prior research that portrays STEM fields as characterized by a "chilly climate" with fewer opportunities for collaboration, we hypothesize that students in STEM will report lower cooperative mindsets than students in HEED fields (H2).

3) We propose that cooperative mindsets will positively predict autonomy-oriented help-seeking (H3a) and negatively predict avoidance of help-seeking (H3b).

4) We hypothesize that students' help-seeking strategies will mediate the relationship between cooperative mindsets and academic engagement; specifically, that autonomy-oriented help-seeking will have a positive indirect effect (H4a) and help-seeking avoidance a negative indirect effect (H4b).

We further explore whether the relationships between students' cooperative mindsets, help-seeking strategies, and academic engagement vary by gender and academic domain.

By linking cooperative mindsets to academic help-seeking as a self-regulated yet inherently social learning strategy, this research examines a social-psychological mechanism through which students' academic engagement is shaped not only by personal competence beliefs but also by their perceptions of the role of others in facilitating their individual learning and academic success in higher education.

METHODS

Sample

A total of 239 STEM and 385 HEED students participated in our study. Of them, 24 did not indicate their gender and were excluded from the analyses. In addition, 10 students indicated a diverse gender identity. However, due to the small size of this subgroup, it was not possible to include them in comparisons with male and female students, and they were therefore also excluded from the analyses.

Our final sample consisted of 213 STEM (146 male, 67 female) and 377 HEED (93 male, 284 female) students, with an average age of 23.38 years (*SD* = 5.14). Among STEM students, 94.8% were enrolled in a bachelor's program, 2.8% in a

master's program, and 2.3% did not indicate a degree program. The largest proportion was studying computer science (63.4%), followed by bioinformatics (22.5%) and mathematics (3.8%). Among HEED students, 42.7% were enrolled in a bachelor's program and 32.1% in a master's program, while 25.2% did not provide information on their current degree level. The HEED students reported studying in a range of departments: 35.8% reported being formally assigned to the Department of Education, followed by 26.8% to the Department of Special Needs Education, 25.2% to the Department of Psychology, 22.8% to the Department of German Studies, 21% to the Department of Philosophy, and 15.4% to the Department of Political Science. Since a large proportion of students (62.6%) were enrolled in teacher education programs, multiple institutional affiliations were possible.

Procedure

Data collection took place in October and November 2021, during the period when universities in Germany were returning to in-person teaching following the COVID-19 pandemic. STEM data were collected at the Department of Computer Science at a large German university during three lectures. Students participated either on-site using paper-and-pencil questionnaires or online via the Unipark survey platform (Questback, 2020). HEED data were collected at the Faculty of Humanities at another large German university. Here, students were invited to participate exclusively online via Unipark, and recruitment was conducted via a faculty-wide mailing list.

Prior to providing written consent, students were informed that participation was voluntary, that their responses would remain anonymous, that all data would be handled confidentially, and that they could withdraw from the study at any time without providing a reason.

Measures

Academic Engagement

We used a shortened version of a measure by Gusy et al. (2016) to assess students' vigor, dedication, and absorption in their academic activities. Students indicated their agreement with three items (e.g., "I am enthusiastic about my studies.") on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The measure demonstrated good internal consistency across both domains (STEM α = .83 and HEED α = .88). A complete list of items for this scale can be found in Appendix A.1.

Help-Seeking Strategies

Students' help-seeking strategies were measured using an adapted and shortened version of the Help-Seeking Scale by Komissarouk et al. (2017). Since our focus was on help-seeking related to academic tasks and challenges within the university setting, rather than general help-seeking in daily life, the scale was adapted to reflect the university context and specifically peer-related academic help-seeking behavior. Whereas the original measure captures three help-seeking strategies, we focused solely on two in the present study: autonomy-oriented help-seeking and avoidance of help-seeking. This decision was based on prior findings suggesting their greater relevance in academic contexts than dependency-oriented help-seeking (see Zander & Höhne, 2021). Each subscale consisted of four items

measuring autonomy-oriented help-seeking (e.g., "When I encounter academic difficulties, I talk to fellow students to improve my ability to cope with it.") and avoidance of help-seeking (e.g., "When I try to solve an academic problem, I count on myself alone and not on anyone else."). Both subscales showed an acceptable to excellent internal consistency across both subject domains: $autonomy_{STEM}$ (α = .82), $avoidance_{STEM}$ (α = .75), $autonomy_{HEED}$ (α = .91), and $avoidance_{HEED}$ (α = .83). On each of the subscales, students indicated their agreement on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The full set of items for both subscales is available in Appendix A.2.

Cooperative Mindsets

The preliminary Cooperative and Competitive Mindsets (CoCoM) Scale by Jördens et al. (under review) was used to measure students' cooperative orientation in academic contexts. Four items (e.g., "To succeed in this field of study, it is important to cooperate with fellow students.") were rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) and showed acceptable internal consistency (STEM α = .70 and HEED α = .76). A detailed list of items for this scale can be found in Appendix A.3.

Field-Specific Ability Beliefs

Field-specific ability beliefs were included as a covariate because previous research has shown that such beliefs can influence students' perceptions of who belongs and succeeds in a given academic field (e.g., Leslie et al., 2015; Muradoglu et al., 2023; Storage et al., 2016). We assessed students' beliefs about the importance of innate talent or "brilliance" for success in their academic field using a measure by Leslie et al. (2015), which was translated into German and adapted by Deiglmayr et al. (2019). The scale consists of four items (e.g., "Being a top scholar in my field of study requires a special aptitude that just can't be taught.") and used a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The scale showed acceptable reliability across both domains (STEM α = .72 and HEED α = .79). The full list of items for this scale can be found in Appendix A.4.

Field-Specific Academic Self-Efficacy

Field-specific academic self-efficacy was included as a control variable, as it has been shown to be related to both students' help-seeking strategies (Zander & Höhne, 2021) and academic engagement (Baños et al., 2023; Meng & Zhang, 2023). We employed an adapted measure by Jerusalem and Schwarzer (1986), which captures students' perceived ability to meet academic requirements. Agreement with three items (e.g., "I am confident that I have the necessary skills to succeed in my field of study.") was rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The measure demonstrated acceptable to good internal consistency across both domains (STEM α = .83 and HEED α = .78). The complete set of items for this scale is provided in Appendix A.5.

Sociodemographic Variables

We assessed students' gender (i.e., "What is your gender?"), age (i.e., "How old are you?"), and academic degree (i.e., "What degree are you currently pursuing?") via single items. Subject domain was not directly assessed but determined by the institutional context in which students were surveyed. For the purpose of sample description and analyses, gender (0 = male, 1 = female), academic degree (0 =

bachelor's program, 1 = master's program), and subject domain (0 = STEM, 1 = HEED) were coded as binary variables. The gender item additionally included a third response option (diverse); however, as noted above, this subgroup was too small to be included in the analyses.

Statistical Analyses

Unless stated otherwise, all analyses were conducted using Mplus version 8.11 (Muthén & Muthén, 1998–2017). First, we calculated descriptive statistics and bivariate correlations for all variables relevant to the analysis. As a preliminary step prior to the primary mediation analyses, we examined mean differences by gender and subject domain to provide a descriptive overview of group differences in the key study variables using simple linear regression models with the respective binary grouping variable as predictor. This approach yields results equivalent to independent samples *t*-tests while additionally providing standardized regression coefficients (β) as effect size estimates and benefiting from full information maximum likelihood estimation (FIML) for handling missing data. Gender and subject domain were examined separately at this stage, as their interplay is addressed in the domain-specific multiple-group mediation models.

To ensure comparability across groups, measurement invariance was tested for all key variables across subject domain and gender. This involved sequentially testing configural invariance (i.e., equal factor structure), metric invariance (i.e., equal factor loadings), and scalar invariance (i.e., equal factor loadings and intercepts). Invariance was assessed by evaluating absolute model fit at each level (CFI ≥ .95, RMSEA ≤ .08, SRMR ≤ .08; Browne & Cudeck, 1993). Following Chen (2007), metric invariance was indicated by a change in CFI of ≤ .010 supplemented by a change in RMSEA of ≤ .015 or a change in SRMR of ≤ .030; scalar invariance was indicated by a change in CFI of ≤ .010 supplemented by a change in RMSEA of ≤ .015 or a change in SRMR of ≤ .010. When full scalar invariance was not achieved, partial scalar invariance was tested following Byrne et al. (1989).

Following these initial analyses, we specified two domain-specific multiple-group mediation models, using gender as the grouping variable: one for students in STEM fields and the other for students in HEED fields. In each model, students' cooperative mindsets served as a predictor variable. The associations with students' academic engagement were expected to be mediated by two distinct help-seeking strategies: autonomy-oriented help-seeking and avoidance of help-seeking. The residual covariance between the two mediators was freely estimated to account for shared variance not captured by the predictors. Field-specific ability beliefs and self-efficacy were included as covariates to control for individual differences in domain-related beliefs. The mediation models are fully saturated ($df = 0$), meaning the number of freely estimated parameters equals the number of unique elements in the observed variance-covariance matrix. Traditional model fit indices (e.g., χ^2, CFI, RMSEA, SRMR) are therefore not informative for these models, as the model-implied covariance matrix is algebraically identical to the observed matrix by construction (Kline, 2016). Following Hayes (2022), the models were evaluated based on the significance of the hypothesized indirect effects using bootstrapped confidence intervals (5,000 iterations) and R^2 values for each endogenous variable.

Missing data were handled using FIML, which provides unbiased estimates under the assumption of data missing at random and is preferable to listwise deletion or single imputation (Peugh & Enders, 2004; Schafer & Graham, 2002). To avoid listwise deletion due to missingness in predictor variables, means and variances of all independent variables were specified, treating them as dependent variables in the Mplus model framework (see Hox et al., 2015). The preliminary regression and measurement invariance models were estimated using the robust maximum likelihood estimator (MLR), which accounts for non-normality and provides robust standard errors. The mediation models were estimated using maximum likelihood (ML) with bootstrapped standard errors and confidence intervals because MLR is not compatible with bootstrapping in Mplus.

RESULTS

Descriptive Statistics and Group Differences

Descriptive statistics and standardized regression coefficients for gender and subject domain differences in the key study variables are presented in Table 1. Across the full sample, female students reported significantly higher cooperative mindsets, supporting H1. They also reported lower levels of avoidance of help-seeking and stronger field-specific ability beliefs than male students. No significant gender differences were found for academic engagement, autonomy-oriented help-seeking, or field-specific academic self-efficacy.

Within the STEM sample, female students reported significantly higher cooperative mindsets, which is again consistent with H1. Additionally, they reported significantly lower avoidance of help-seeking than their male peers. No other gender differences within STEM reached significance.

Within the HEED sample, female students likewise reported significantly higher levels of cooperative mindsets than male students, further supporting H1. They also reported higher levels of academic engagement, autonomy-oriented help-seeking, and field-specific ability beliefs, as well as lower avoidance of help-seeking. No gender difference emerged in field-specific academic self-efficacy.

Comparisons across subject domains showed that STEM students reported significantly higher cooperative mindsets compared to HEED students, regardless of gender. Thus, contrary to our expectations formulated in H2, students' cooperative mindsets were higher in STEM than in HEED. In addition, STEM students reported higher academic engagement and autonomy-oriented help-seeking, as well as lower field-specific academic self-efficacy than HEED students. No significant domain differences were found for avoidance of help-seeking or field-specific ability beliefs.

Gender-specific domain comparisons further indicated that male STEM students reported significantly higher cooperative mindsets, academic engagement, and autonomy-oriented help-seeking than male HEED students. Among female students, those in STEM reported significantly higher cooperative mindsets and autonomy-oriented help-seeking, but lower field-specific academic self-efficacy than female HEED students.

Table 1. *Descriptive Statistics and Group Differences by Gender and Subject Domain*

		Academic engagement	Autonomy-oriented help-seeking	Avoidance of help-seeking	Cooperative mindsets	Field-specific ability beliefs	Field-specific academic self-efficacy
	N	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Subject domain							
Total	590	3.59 (0.88)	3.51 (0.96)	2.36 (0.95)	3.76 (0.74)	2.34 (0.74)	4.09 (0.64)
STEM	213	3.68 (0.81)	3.75 (0.76)	2.37 (0.85)	3.91 (0.64)	2.30 (0.70)	4.00 (0.70)
HEED	377	3.53 (0.90)	3.37 (1.04)	2.35 (1.00)	3.67 (0.78)	2.36 (0.76)	4.14 (0.60)
β (*SE*)		−.09 (0.04)	−.19 (0.04)	−.02 (0.04)	−.16 (0.04)	.04 (0.04)	.10 (0.04)
p		.039	.000	.721	.000	.397	.011
STEM							
Total	213	3.68 (0.81)	3.75 (0.76)	2.37 (0.85)	3.91 (0.64)	2.30 (0.70)	4.00 (0.70)
Male	146	3.72 (0.80)	3.68 (0.78)	2.46 (0.84)	3.80 (0.64)	2.28 (0.71)	4.03 (0.65)
Female	67	3.59 (0.82)	3.88 (0.70)	2.20 (0.85)	4.15 (0.58)	2.35 (0.68)	3.94 (0.79)
β (*SE*)		−.06 (0.07)	.12 (0.07)	−.14 (0.07)	.25 (0.06)	.05 (0.07)	−.06 (0.07)
p		.363	.066	.036	.000	.505	.383
HEED							
Total	377	3.53 (0.90)	3.37 (1.04)	2.35 (1.00)	3.67 (0.78)	2.36 (0.76)	4.14 (0.60)
Male	93	3.33 (0.89)	3.07 (1.01)	2.60 (1.03)	3.43 (0.82)	2.19 (0.76)	4.14 (0.56)
Female	284	3.60 (0.90)	3.47 (1.03)	2.26 (0.97)	3.75 (0.75)	2.41 (0.76)	4.14 (0.61)
β (*SE*)		.13 (0.05)	.16 (0.05)	−.15 (0.05)	.18 (0.05)	.13 (0.05)	−.00 (0.05)
p		.011	.001	.004	.000	.012	.932
Gender							
Total	590	3.59 (0.88)	3.51 (0.96)	2.36 (0.95)	3.76 (0.74)	2.34 (0.74)	4.09 (0.64)
Male	239	3.57 (0.86)	3.45 (0.92)	2.51 (0.92)	3.66 (0.74)	2.24 (0.73)	4.07 (0.62)
Female	351	3.60 (0.89)	3.55 (0.99)	2.25 (0.95)	3.82 (0.74)	2.40 (0.74)	4.10 (0.65)
β (*SE*)		.02 (0.04)	.05 (0.04)	−.14 (0.04)	.11 (0.04)	.10 (0.04)	.02 (0.04)
p		.632	.217	.001	.007	.012	.629
Male							
Total	239	3.57 (0.86)	3.45 (0.92)	2.51 (0.92)	3.66 (0.74)	2.24 (0.73)	4.07 (0.62)
STEM	146	3.72 (0.80)	3.68 (0.78)	2.46 (0.84)	3.80 (0.64)	2.28 (0.71)	4.03 (0.65)
HEED	93	3.33 (0.89)	3.07 (1.01)	2.60 (1.03)	3.43 (0.82)	2.19 (0.76)	4.14 (0.56)
β (*SE*)		−.23 (0.06)	−.32 (0.06)	.08 (0.06)	−.25 (0.06)	−.06 (0.06)	.09 (0.06)
p		.000	.000	.237	.000	.334	.163
Female							
Total	351	3.60 (0.89)	3.55 (0.99)	2.25 (0.95)	3.82 (0.74)	2.40 (0.74)	4.10 (0.65)
STEM	67	3.59 (0.82)	3.88 (0.70)	2.20 (0.85)	4.15 (0.58)	2.35 (0.68)	3.94 (0.79)
HEED	284	3.60 (0.90)	3.47 (1.03)	2.26 (0.97)	3.75 (0.75)	2.41 (0.76)	4.14 (0.61)
β (*SE*)		−.01 (0.05)	−.17 (0.05)	.03 (0.05)	−.21 (0.05)	.03 (0.05)	.12 (0.05)
p		.904	.001	.620	.000	.540	.024

Note. Gender: 0 = male, 1 = female. Subject domain: 0 = STEM, 1 = HEED.

Table 2 presents bivariate correlations among the key variables, separately for STEM and HEED students. As expected, students' cooperative mindsets were positively associated with autonomy-oriented help-seeking and negatively with avoidance of help-seeking within both subject domains. Field-specific ability beliefs, however, showed opposite patterns across domains: in STEM, they were negatively associated with autonomy-oriented help-seeking and only weakly and non-significantly related to avoidance, whereas in HEED, they were positively associated with autonomy-oriented help-seeking and negatively with avoidance of help-seeking. In the STEM group, academic engagement was only significantly related to autonomy-oriented help-seeking, while correlations with the remaining variables were small and not statistically significant. In contrast, in the HEED group, academic engagement was positively associated with cooperative mindsets, field-specific ability beliefs, and autonomy-oriented help-seeking, as well as negatively with avoidance of help-seeking.

Table 2. *Correlations by Subject Domain*

	1.	2.	3.	4.	5.	6.	7.
1. Academic engagement	-	.23***	.05	.09	−.07	.47***	−.06
2. Autonomy-oriented help-seeking	.31***	-	−.58***	.36***	−.17**	.14*	.12
3. Avoidance of help-seeking	−.23***	−.68***	-	−.22***	.13	−.06	−.14*
4. Cooperative mindsets	.28***	.49***	−.41***	-	−.02	.08	.25***
5. Field-specific ability beliefs	.19***	.23***	−.15**	.22***	-	−.18**	.05
6. Field-specific academic self-efficacy	.34***	.10	−.15**	−.04	−.06	-	−.06
7. Gender	.13**	.16***	−.15**	.18***	.13**	−.00	-

Note. Values for STEM students are shown above and for HEED students below the diagonal. Gender: 0 = male, 1 = female. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Measurement Invariance

Across subject domain, scalar invariance was established for all variables except avoidance of help-seeking, for which partial scalar invariance was achieved by freely estimating the intercepts for items 2 and 3. Across gender, scalar invariance was established for academic engagement, autonomy-oriented help-seeking, avoidance of help-seeking, cooperative mindsets, field-specific ability beliefs, and field-specific academic self-efficacy. A detailed presentation of the model fit indices and comparisons between the configural, metric, and scalar models for each variable can be found in Appendix B.1 for subject domain and Appendix B.2 for gender.

Domain-Specific Multiple-Group Mediation Models

STEM Domain

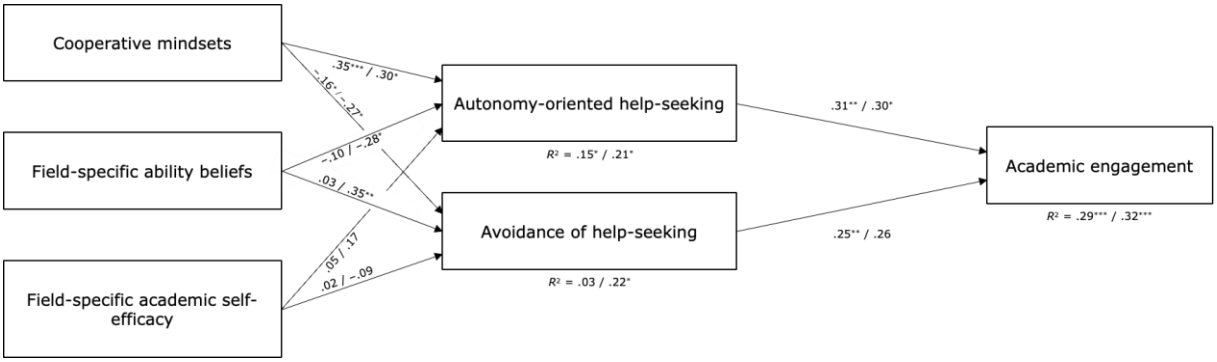
Figure 1 presents the results of the STEM-specific multiple-group mediation model. Cooperative mindsets significantly predicted both help-seeking strategies, supporting H3a and H3b. Specifically, for both male and female students, they were positively related to autonomy-oriented help-seeking and negatively related to avoidance of help-seeking. The direct path from cooperative mindsets to academic engagement was not significant for either gender group. In addition, field-specific ability beliefs significantly predicted lower autonomy-oriented help-seeking, as well as greater avoidance of help-seeking among female students, but showed no significant associations among male students.

Autonomy-oriented help-seeking predicted academic engagement in both gender groups. Avoidance of help-seeking significantly predicted academic engagement only in male students, though the direction of this effect was positive. In female students, this association was not significant.

The mediation analysis revealed one significant indirect effect: Among male students, cooperative mindsets had a positive indirect effect on academic engagement through autonomy-oriented help-seeking (β = .11, p = .036, 95% CI [.02, .22]), providing support for H4a. However, no significant indirect effects via help-seeking avoidance were found, offering no support for H4b. For female students, neither indirect effect was significant.

The model accounted for a large proportion of variance in academic engagement for both male and female students. Variance explained in autonomy-oriented help-seeking was moderate in both gender groups, while variance explained in avoidance of help-seeking was small for male students but moderate for female students.

Figure 1. *Multiple-Group Mediation Model in STEM*



Note. Standardized regression coefficients of the multiple-group mediation model for male/female students in STEM. Covariances between the predictor and covariates, as well as residual covariances between the two mediators, were estimated but are not depicted for clarity. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

HEED Domain

Figure 2 summarizes the results of the HEED-specific mediation model. Consistent with H3a and H3b, cooperative mindsets were strongly associated with students' help-seeking strategies across both gender groups: They positively predicted autonomy-oriented help-seeking and negatively predicted avoidance of help-seeking. Moreover, the direct path from cooperative mindsets to academic engagement was not significant for male students but significant and positive for female students. Among the covariates, significant effects were found only for female students: Field-specific ability beliefs were positively associated with autonomy-oriented help-seeking, while field-specific academic self-efficacy positively predicted autonomy-oriented help-seeking and negatively predicted avoidance of help-seeking.

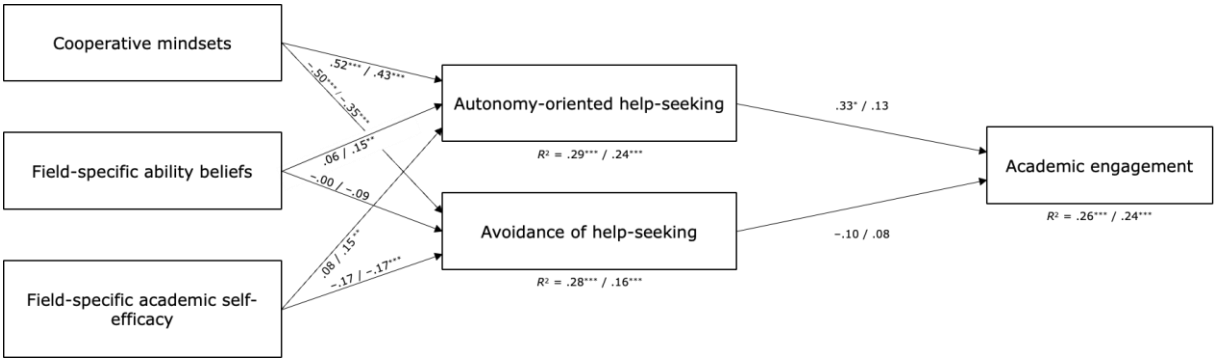
Autonomy-oriented help-seeking predicted academic engagement in male students, but not in female students. Avoidance of help-seeking did not significantly predict academic engagement in either gender group.

The mediation analysis showed one significant indirect effect: In the male group, cooperative mindsets had a positive indirect effect on academic engagement through autonomy-oriented help-seeking (β = .17, p = .021, 95% CI [.04, .32]), providing support for H4a. A similar indirect effect was observed in female students but was only marginally significant. No significant indirect effects through help-seeking avoidance were found, offering no support for H4b.

The model explained a large proportion of variance in academic engagement for both male and female students. Variance explained in autonomy-oriented help-

seeking was large for male and moderate for female students. Likewise, variance explained in avoidance of help-seeking was large for male and moderate for female students.

Figure 2. *Multiple-Group Mediation Model in HEED*



Note. Standardized regression coefficients of the multiple-group mediation model for male/female students in HEED. Covariances between the predictor and covariates, as well as residual covariances between the two mediators, were estimated but are not depicted for clarity. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

DISCUSSION

Recent research increasingly recognizes that students' academic engagement is not just a product of inner motivation and interest but also of their experiences with peers, such as their ability to seek help, to collaborate, and to feel that their contributions matter within a community of learners (Johnson & Johnson, 2009; Micari & Pazos, 2021; Won et al., 2021; Zander et al., 2018). Our study contributes to this growing shift by testing how cooperative mindsets—students' beliefs about the value of cooperation for academic success—relate to students' help-seeking strategies and academic engagement across the gendered academic cultures of STEM and HEED domains.

Our study revealed three main findings. First, and converging with previous findings, female students across both subject domains reported higher cooperative mindsets than their male peers. This gender gap aligns with broader evidence on male and female students' social motivation and interpersonal orientation (Greene & DeBacker, 2004). While we are not aware of studies directly comparing male and female students' cooperative mindsets across STEM and HEED fields, multiple studies document that female students tend to be more attuned to cooperation and exhibit higher levels of cooperative behavior across educational contexts (Dzionek-Kozłowska & Rehman, 2017; Molina et al., 2013; Thöni et al., 2021). Importantly, this difference is not confined to beliefs about the value of cooperation. Female students also reported lower levels of help-seeking avoidance than male students, which is a pattern consistent with previous findings (Brown et al., 2021; Sheu & Sedlacek, 2004; Zander & Höhne, 2021). Together, these results suggest that female students are more inclined than male students to combine a self-directed approach to learning with the use of social resources. Beyond these proximal differences, our findings also speak to broader questions of gender equity in STEM. Research on communal goal congruity shows that women, on average, are more likely to pursue and persist in fields that afford working with and helping others, and to disengage when STEM is framed as cold, competitive, and individualistic (Diekman et al., 2010; Diekman et al., 2015; Leslie et al., 2015). In this light, our results suggest that cooperative mindsets are not simply "nice to have," but may be a critical psychological lever for retaining high-potential women in STEM.

Second, and contrary to our expectations, STEM students reported stronger cooperative mindsets than HEED students. One plausible interpretation is that STEM students recognize collaboration and peer problem solving as important for success in their field, even though dominant cultural narratives often emphasize individual "brilliance." In the present context, however, introductory STEM courses were largely lecture-based, with assessments focusing on individual performance and only limited formal opportunities for structured group work. The higher cooperative mindsets observed among STEM students therefore seem unlikely to be a simple reflection of existing pedagogical practices. Rather, they may indicate students' aspirational beliefs about how learning in STEM should be organized or their perceived need for greater opportunities to collaborate. Because we did not directly assess students' perceptions of instructional practices or norms, these interpretations remain tentative and point to an important avenue for future research on how disciplinary and institutional contexts shape cooperative mindsets during the transition into university (cf. Höhne & Zander, 2019; Walton & Cohen, 2007). This finding is particularly interesting when considered in relation to field-specific ability beliefs typically identified as prevailing in STEM (Deiglmayr et al., 2019; Leslie et al., 2015; Muradoglu et al., 2023; Storage et al., 2016). If replicated in future studies, this pattern would complicate the dominant narrative about STEM as a field where academic success is primarily attributed to innate ability or "brilliance," and instead suggest that many STEM students endorse strong beliefs about the value of collaboration and peer learning.

Third, our findings highlight the complex dynamics of help-seeking as they relate to academic engagement, particularly in STEM. Male students reported higher levels of help-seeking avoidance, yet this did not negatively relate to their academic engagement. In fact, for male students, autonomy-oriented help-seeking and avoidance of help-seeking were positively associated with academic engagement. One interpretation is that there may be two distinct routes to academic engagement for men. For some, collaboration is integrated into an agentic learning approach through autonomy-oriented help-seeking. For others, when seeking help threatens self-esteem (Nadler, 2012) or conflicts with ideals of self-reliance and effortless performance associated with masculine roles and male-dominated academic cultures (Brown et al., 2021; Kessels & Steinmayr, 2013), engagement may take the form of increased individual effort instead: working hard, but "keeping quiet about it." In such cases, avoidance of help may sometimes reflect a compensatory strategy rather than disengagement.

The picture looks different for female STEM students. Among female students—but not their male peers—endorsement of field-specific ability beliefs was associated with lower levels of autonomy-oriented help-seeking as well as greater avoidance of help-seeking. This pattern suggests that persistent, often implicit norms about individual genius and intellectual self-sufficiency may undermine the very collaborative learning strategies that foster persistence, belonging, and well-being, particularly for women navigating stereotypically masculine academic environments. This indirectly supports the idea that in STEM fields—where beliefs in innate "brilliance" are especially pronounced—the perceived risk of appearing less competent when seeking help may be particularly salient. For female students, this risk can be further intensified by stereotype threat and the fear of confirming negative gender stereotypes, contributing to help-seeking avoidance (e.g., Zander & Höhne, 2021). Considered together with our second main finding, this pattern illuminates a cultural paradox in STEM: many women in STEM believe in the value of

cooperation, yet dominant beliefs about individual "brilliance" discourage them from enacting these beliefs through help-seeking, thus undermining the very behaviors that support academic engagement and, ultimately, academic success.

Importantly, our findings go beyond direct associations and shed light on the potential psychological pathways through which cooperative mindsets translate into academic engagement. In line with our mediation hypotheses, we found that for male students in both STEM and HEED fields, autonomy-oriented help-seeking significantly mediated the relationship between cooperative mindsets and academic engagement. This raises the question of why male students, who are typically more reluctant to seek academic help due to concerns about self-esteem and perceived competence (Brown et al., 2021; Sheu & Sedlacek, 2004; Zander & Höhne, 2021), would engage in help-seeking at all. Our results suggest that cooperative mindsets may serve as a cognitive and motivational reframing mechanism that helps male students overcome these barriers.

When collaboration is perceived not as a weakness, but as a valued and legitimate component of academic success, seeking help becomes more psychologically acceptable. In this context, autonomy-oriented help-seeking aligns well with core motivational needs in that it preserves the sense of agency and competence that is especially important for male students navigating performance-oriented academic environments (Brown et al., 2021). Rather than signaling dependency, this form of help-seeking may be experienced as agentic, strategic, and self-directed, allowing access to peer support without violating internalized norms of self-sufficiency or competence. The fact that this indirect effect emerged among male students in both STEM and HEED suggests that the underlying mechanism does not depend solely on the cultural climate of the academic field. Instead, it may reflect a broader psychological dynamic: For male students, the ability to engage with others without compromising their autonomy appears to be a key condition for turning collaborative values into effective academic action. Female students, in turn, reported higher levels of cooperative mindsets overall, suggesting that they may be more attuned to the value of collaboration in academic settings. At the same time, our findings for female STEM students underscore that the benefits of cooperative mindsets are contingent on cultural contexts: when norms of individual "brilliance" and stereotype-based concerns are salient, they can effectively block the translation of cooperative values into academic engagement.

Given their positive associations with academic help-seeking and engagement, cooperative mindsets emerge in our study as a potential psychological resource for navigating the demands of higher education across domains and gender groups. In this way, cooperative mindsets function as an "intraindividual cultural compass"—orientations that help students seek support, stay socially connected, and remain engaged, especially when academic challenges arise, but whose effectiveness depends on the signals they receive from their learning environments. These benefits appear to complement, rather than replace, the well-established effects of academic self-efficacy (Zander et al., 2018). If educators make these cooperative mindsets visible and actionable, such as by legitimizing collaboration and help-seeking, as well as embedding opportunities for genuine collaboration in courses, they can create more inclusive and engaging learning environments.

Limitations and Future Directions

As with any research, this study comes with several limitations that are important to consider when interpreting the findings. First, our data rely on

students' self-reported help-seeking strategies and academic engagement, which may not always translate into actual help-seeking behavior and course engagement. While self-reports offer valuable insight into students' perceptions and intentions, they are vulnerable to biases such as social desirability and may not fully capture the complexity of enacted help-seeking or cooperation in real academic contexts (for a study in the school context, see Ross & Cousins, 1994).

Second, although our findings emphasize the role of social dynamics in fostering academic engagement, engagement itself is a multifaceted construct shaped by a broader ecology of influences, including individual time investment (Kuh et al., 2008), institutional structures such as team teaching or student-teacher ratios (Bryson & Hand, 2007), and the socio-political context of higher education (Xerri et al., 2018). Future research should consider including these relevant aspects as covariates.

Third, our focus on cooperative mindsets provides a valuable lens, but captures only one aspect of students' interpersonal orientation. Prior research suggests that it is often the interplay between competition and cooperation—what has been termed "coopetition" (Nalebuff & Brandenburger, 1996)—that promotes beneficial academic outcomes such as intrinsic motivation (Tauer & Harackiewicz, 2004). Future studies would benefit from simultaneously assessing both cooperative and competitive mindsets to explore how their interaction shapes students' academic engagement across gender and disciplinary lines.

Fourth, the cross-sectional nature of our design limits the ability to capture how cooperative mindsets, help-seeking strategies, and academic engagement unfold over time. Engagement is not static; it fluctuates in response to changing academic demands and social experiences across the semester. Longitudinal designs are needed to illuminate how students' cooperative beliefs evolve and how they dynamically contribute to, and are shaped by, ongoing engagement and help-seeking behaviors.

Finally, because STEM and HEED students were recruited from different universities and via somewhat different teaching and survey formats (computer science lectures with mixed in-person/paper-and-pencil and online participation vs. humanities courses surveyed online only), we cannot conclusively attribute group differences solely to disciplinary context. Differences may partly reflect institutional characteristics or cohort-specific experiences, so future research should replicate these findings across multiple disciplines within the same institutions and include more detailed controls for university-level and demographic factors.

Practical Implications

While our findings clearly warrant replication, we would like to suggest several practical implications worth considering. One of the most important findings is that cooperative mindsets are positively linked to adaptive help-seeking strategies and academic engagement. Moreover, we found that cooperative mindsets are higher in STEM than in HEED fields. Given the documented positive effects of adaptive, autonomy-oriented help-seeking as a self-regulated learning strategy on academic outcomes, our findings suggest that there is a substantial reservoir of potential support within peer groups that is likely not fully mobilized. This pattern is consistent with a pluralistic ignorance process (Miller & McFarland, 1991) among first-year STEM students: although many students may privately endorse the value of cooperation for academic learning and progress, they may assume that others do not, and therefore refrain from seeking help or making

use of available peer support. This effect may be particularly salient in environments where "brilliance" and competition are normatively emphasized (De Souza & Schmader, 2022; Leslie et al., 2015).

Our results also indicate that nurturing cooperative mindsets could be a promising leverage point to disrupt such dynamics. If instructional cues and interventions communicate that collaboration is both normatively endorsed and academically legitimate—by instructors and peers alike—adaptive behaviors such as academic help-seeking and engagement may become more socially validated and more widely adopted. Beyond normalizing cooperation in the classroom, it may be especially useful to explicitly challenge the enduring myth that success in STEM is primarily the product of isolated individual genius and to highlight instead the inherently collaborative nature of contemporary STEM research and careers. Making this link between students' current learning environments and their future professional roles could both strengthen collaborative mindsets and provide a forward-looking rationale for engaging in peer support. To be effective, such efforts are likely to require an open discussion of the challenges of cooperative work and concrete strategies to address them, as well as the integration of structured peer-support formats (e.g., reciprocal teaching, peer mentoring) that frame cooperation as a strategic academic resource rather than a compensatory last resort.

Finally, our results point to a different strategy for educators and faculty who aim to increase the share of female students and enable them to unfold their potential: Rather than asking women to adapt to highly competitive, individually oriented norms that emphasize solo performance and effortless "brilliance," it may be wise to deliberately design and signal learning environments in which collaboration, mutual support, and shared success are normative. Making cooperative work structures visible, legitimizing help-seeking and peer guidance, and highlighting the societal relevance of STEM are concrete ways to foster cooperative mindsets and, in turn, reduce the goal incongruence that likely pushes many women out of these fields (Diekman et al., 2010; Diekman et al., 2015; Leslie et al., 2015).

Conclusion

In our study, cooperative mindsets were positively associated with autonomy-oriented help-seeking across all groups. Importantly, for male students in both STEM and HEED fields, this help-seeking strategy significantly mediated the link between cooperative beliefs and academic engagement. This indirect pathway suggests that valuing collaboration may enable students—particularly men—to seek help in ways that preserve their sense of agency and competence, ultimately supporting their academic engagement. At the same time, cooperative mindsets were more strongly endorsed by female students. Among female STEM students, cooperative mindsets were associated with more adaptive help-seeking despite the presence of strong field-specific ability beliefs, suggesting that such mindsets may offer a psychological counterweight to cultural norms that discourage visible reliance on others. These findings highlight the importance of how students, especially those underrepresented in their field, interpret the normative culture of academia, particularly with regard to support and help exchange.

Taken together, our results call for a shift toward reimagining the cultural scripts regarding interpersonal dynamics that shape academic life—particularly in STEM. If cooperation and help exchanges are reframed as markers of competence and future-oriented professional skill rather than signs of weakness or dependency,

those working in higher education may be better positioned to cultivate academic environments that are not only more inclusive but also more engaging for all.

ENDNOTES

Author Contributions: Lysann Zander: Conceptualization; Resources; Writing – Original Draft; Samer Halabi: Writing – Review & Editing; Elisabeth Höhne: Conceptualization; Methodology; Investigation; Data Curation; Formal Analysis; Writing – Original Draft; Visualization; Project administration.

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APPENDICES

Appendix A.1. *Items for Academic Engagement*

1. I am enthusiastic about my studies.
2. My studies inspire me.
3. I am fully immersed in my studies.

Appendix A.2. *Items for Help-Seeking Strategies*

Autonomy-oriented help-seeking

1. When I experience difficulty learning something new, I usually ask other students who understand it to explain the general principle, so that I can try to solve the problem better on my own.
2. I tend to seek the kind of academic help from other students that allows me to deal with a problem better on my own.
3. When I encounter an academic problem, I talk to other students to improve my ability to cope with it.
4. When I encounter an academic problem, I usually ask other students who have had a similar problem how they solved it and try to learn from their experience.

Avoidance of help-seeking

1. I usually do not ask other students for help, even if this may hinder my performance.
2. It is more important for me to accomplish things on my own, even if I would be better off receiving help from other students.
3. I believe that if you did not do something completely on your own, you did nothing at all.
4. When I try to solve an academic problem, I count on myself alone and not on anyone else.

Appendix A.3. *Items for Cooperative Mindsets*

1. To succeed in this field of study, one has to cooperate well with fellow students.
2. The start and end of project tasks in this field of study are inseparably connected to cooperation among fellow students.
3. In this field of study, one has to be able to rely on fellow students in order to achieve good academic results.
4. I am convinced that academic performance benefits more from cooperation than from competition.

Appendix A.4. *Items for Field-Specific Ability Beliefs*

1. In this field of study, the most important factors for success are motivation and sustained effort; raw ability is secondary.
2. To succeed in this field of study, one must have a specific aptitude, which just can't be learned.
3. In this field of study, anyone can be successful as long as they put in enough effort.
4. If you want to succeed in this field of study, hard work alone is not enough; you also need an innate gift or talent.

Appendix A.5. *Items for Field-Specific Academic Self-Efficacy*

1. I am confident that I have the competencies to perform well in this field of study.
2. I can cope with difficult situations and challenges in my studies when I try hard.
3. I believe that I will be able to master even complex content in lectures.

Appendix B.1. *Measurement Invariance Testing across Subject Domain*

	χ^2	*df*	*p*	RMSEA	CFI	SRMR
Academic engagement						
Configural	0.000	0	.000	.000	1.000	.000
Metric	0.306	2	.858	.000	1.000	.012
Scalar	3.159	4	.532	.000	1.000	.025
Metric vs. configural	0.306	2	.858	-	-	-
Scalar vs. metric	2.853	2	.240	-	-	-
Autonomy-oriented help-seeking						
Configural	2.961	2	.228	.040	.999	.006
Metric	7.219	5	.205	.039	.998	.037
Scalar	13.047	8	.110	.046	.996	.051
Metric vs. configural	4.257	3	.235	-	-	-
Scalar vs. metric	5.828	3	.120	-	-	-
Avoidance of help-seeking						
Configural	0.000	0	.000	.000	1.000	.000
Metric	2.787	3	.426	.000	1.000	.024
Scalar	22.484	6	.001	.097	.980	.035
Partial scalar	3.353	4	.501	.000	1.000	.022
Metric vs. configural	2.787	3	.426	-	-	-
Scalar vs. metric	19.698	3	.000	-	-	-
Partial scalar vs. metric	0.566	1	.452	-	-	-
Cooperative mindsets						
Configural	4.386	4	.356	.018	.999	.015
Metric	8.467	7	.293	.027	.998	.041
Scalar	13.350	10	.205	.034	.994	.039
Metric vs. configural	4.081	3	.253	-	-	-
Scalar vs. metric	4.883	3	.181	-	-	-
Field-specific ability beliefs						
Configural	4.982	2	.083	.071	.996	.012
Metric	5.606	5	.346	.020	.999	.016
Scalar	7.862	8	.447	.000	1.000	.017
Metric vs. configural	0.624	3	.890	-	-	-
Scalar vs. metric	2.256	3	.521	-	-	-
Field-specific academic self-efficacy						
Configural	0.000	0	.000	.000	1.000	.000
Metric	0.395	2	.821	.000	1.000	.018
Scalar	2.872	4	.580	.000	1.000	.032
Metric vs. configural	0.395	2	.821	-	-	-
Scalar vs. metric	2.476	2	.290	-	-	-

Note. Configural models with *df* = 0 are just-identified: for academic engagement and field-specific academic self-efficacy due to three items, for avoidance of help-seeking due to the estimation of correlated residuals. For field-specific ability beliefs, RMSEA decreased from the configural to the metric model (ΔRMSEA = −.051). This is consistent with the parsimony correction built into RMSEA, which indexes model discrepancy per degree of freedom and is known to be upwardly biased in models with few degrees of freedom (Kenny et al., 2015). A negative ΔRMSEA indicates that the metric model provides a better approximation of the data, supporting measurement invariance. Scalar invariance was established for all variables except avoidance of help-seeking, for which partial scalar invariance was achieved by freely estimating the intercepts for items 2 and 3. To improve model fit, the error terms of the relevant items were correlated (items 1 and 2 for autonomy-oriented help-seeking, items 2 and 3 as well as items 3 and 4 for avoidance of help-seeking, and items 1 and 3 for field-specific ability beliefs), resulting in acceptable to good fit across all models.

Appendix B.2. *Measurement Invariance Testing across Gender*

	χ^2	*df*	*p*	RMSEA	CFI	SRMR
Academic engagement						
Configural	0.000	0	.000	.000	1.000	.000
Metric	0.350	2	.839	.000	1.000	.014
Scalar	0.726	4	.948	.000	1.000	.013
Metric vs. configural	0.350	2	.839	-	-	-
Scalar vs. metric	0.376	2	.829	-	-	-
Autonomy-oriented help-seeking						
Configural	4.358	2	.113	.063	.998	.006
Metric	5.411	5	.369	.017	1.000	.019
Scalar	10.039	8	.262	.029	.999	.032
Metric vs. configural	1.053	3	.788	-	-	-
Scalar vs. metric	4.628	3	.201	-	-	-
Avoidance of help-seeking						
Configural	5.675	2	.059	.079	.995	.015
Metric	9.041	5	.107	.052	.995	.028
Scalar	11.382	8	.181	.038	.996	.032
Metric vs. configural	3.367	3	.339	-	-	-
Scalar vs. metric	2.340	3	.505	-	-	-
Cooperative mindsets						
Configural	5.489	4	.241	.036	.998	.016
Metric	9.539	7	.216	.035	.996	.037
Scalar	15.513	10	.115	.043	.991	.031
Metric vs. configural	4.050	3	.256	-	-	-
Scalar vs. metric	5.974	3	.113	-	-	-
Field-specific ability beliefs						
Configural	1.023	2	.600	.000	1.000	.005
Metric	3.515	5	.621	.000	1.000	.024
Scalar	4.527	8	.807	.000	1.000	.020
Metric vs. configural	2.492	3	.477	-	-	-
Scalar vs. metric	1.011	3	.799	-	-	-
Field-specific academic self-efficacy						
Configural	0.000	0	.000	.000	1.000	.000
Metric	1.514	2	.469	.000	1.000	.034
Scalar	2.299	4	.681	.000	1.000	.029
Metric vs. configural	1.514	2	.469	-	-	-
Scalar vs. metric	0.786	2	.675	-	-	-

Note. Configural models with *df* = 0 are just-identified for academic engagement and field-specific academic self-efficacy due to three items. For autonomy-oriented help-seeking and avoidance of help-seeking, RMSEA decreased from the configural to the metric model (ΔRMSEA = −.046 and −.027, respectively). This is consistent with the parsimony correction built into RMSEA, which indexes model discrepancy per degree of freedom and is known to be upwardly biased in models with few degrees of freedom (Kenny et al., 2015). A negative ΔRMSEA indicates that the metric model provides a better approximation of the data, supporting measurement invariance. Scalar invariance was established for all variables. To improve model fit, the error terms of the relevant items were correlated (items 1 and 2 for autonomy-oriented help-seeking, items 2 and 3 for avoidance of help-seeking, and items 1 and 3 for field-specific ability beliefs), resulting in acceptable to good fit across all models.