ORIGINAL ARTICLE

Lower SES PhD students experience interpersonal disconnection from others both inside and outside of academia

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Abstract

Students from lower socioeconomic status (SES) backgrounds can experience stigma in undergraduate educational settings but little research on this topic has been conducted at the PhD level. Lower-SES PhD students may feel lower levels of social integration as they experience incidents of interpersonal disconnection from others inside and outside of academia. Interpersonal disconnection may be a mechanism by which lower-SES leads to a lower sense of social integration. In this prospective study of first-year PhD students at three North American universities (N = 608), we assessed students' perceived social integration and their interpersonal perceptions inside and outside of academia 2–8 times throughout their first year of graduate school. Relative to higher-SES students, lower-SES students perceived lower levels of social integration. They had difficulty making academic friends, felt dissimilar to their academic peers, and perceived a lack of

understanding about their work in graduate school from non-academic families and friends. They also lost non-academic social ties. These interpersonal disconnections prospectively mediated the association between lower SES and lower levels of perceived social integration. Lower-SES PhD students are at risk of impaired interpersonal relationships. Institutional policies to promote social connections among PhD students may help lower-SES students integrate into academia.

INTRODUCTION

Students from lower socioeconomic status (SES) backgrounds (henceforth, "lower-SES students") can encounter stigma in educational settings (Langhout et al., 2007) because of stereotypes about their intellectual ability (Croizet & Claire, 1998; Durante et al., 2017) and because of their relative unfamiliarity with the cultural norms of academia (Bryan & Simmons, 2009; Stephens, Townsend, et al., 2012). As a result, lower-SES students may feel less socially integrated in academic environments. A lower sense of social integration suggests that one does not see oneself as fitting in socially and may be characterized by doubting one's fit in academic environments, questions of belonging, and perceiving less social support. Lower-SES college students, for example, have reported feeling more isolated (Aries & Seider, 2005; Philbrook & Macdonald-Gagnon, 2021), a lower sense of belonging (Ostrove & Long, 2007), and less social support (Jenkins et al., 2013) than higher-SES college students. In general, students who feel lower levels of social integration tend to have lower levels of achievement, self-efficacy, wellbeing, motivation, and perseverance (Cook et al., 2012; Ostrove & Long, 2007; Rubin et al., 2019; Stebleton et al., 2014; Turetsky et al., 2020; Walton & Cohen, 2007), suggesting that a sense of social integration is important to academic success. Research documenting the detrimental effects of lower SES on perceived social integration in academia has increased in recent years, but more work is needed to determine whether lower SES remains a barrier in higher education beyond college and to identify the longitudinal pathways by which lower SES leads to lower levels of perceived social integration.

To address these gaps, the current research takes a longitudinal approach to study how lower SES affects PhD students' feelings of social integration among PhD students. Doctoral education is critical for training society's next generation of scientists and scholars and presents a path of upward social mobility for students from less-privileged backgrounds, making it important to understand barriers to success at this level of education. Compared to students at earlier levels, lower-SES PhD students may be particularly prone to the harmful effects of class-based stigma. For example, lower-SES students are even more underrepresented in doctoral education than in college (Zhang, 2005) and negative stereotypes about intellectual ability may be amplified for lower-SES students in doctoral education (Lovitts, 2005). As most research focuses on the effects of SES in undergraduate or lower levels of education, we contribute to the literature, in part, by investigating the effect of lower SES on perceptions of social integration at the doctoral level.

We also investigate prospectively how students from lower-SES backgrounds may experience *interpersonal disconnection* from (1) their academic peers and (2) their non-academic family and friends, and how experiencing interpersonal disconnection can contribute to a lower sense of

social integration. We use the term interpersonal disconnection to refer to people's difficulty at connecting to others, for instance in making friends, feeling similar to peers, understanding or being understood by colleagues, or feeling understood by family and close others. For instance, inside academia, unfamiliar cultural norms (Stephens, Fryberg, et al., 2012), stigma (Langhout et al., 2007), and negative stereotypes (Croizet & Claire, 1998; Durante et al., 2017) may create a sense of dissimilarity for lower-SES students that can challenge communication and interfere with forming friendships (Rubin et al., 2019). Outside of academia, lower-SES students may struggle to maintain ties with pre-academic friends and family, who may be inexperienced with the culture of higher education (Bryan & Simmons, 2009) and the commitments that a doctoral education requires. Overall, lower-SES students may confront a compound risk of experiencing a lack of understanding and alienation from people close to them both inside and outside of academia. In turn, these experiences of interpersonal disconnection may be an important, but understudied, pathway through which lower SES diminishes feelings of social integration in academia.

In the sections below, we describe the types of experiences lower-SES students can encounter in academia that could lead them to feel lower levels of perceived social integration. Then, we discuss the interpersonal disconnections lower-SES students may experience inside and outside of academia and how those disconnections can be a mechanism through which lower SES impairs a sense of social integration.

Experiences of lower-SES students in academic settings

Students from lower-SES backgrounds can experience academic environments as stigmatizing and classist given the inherent exclusivity of higher education and the historical underrepresentation of students from lower-SES backgrounds (Langhout et al., 2007, 2009; Lott, 2002). For example, faculty or students may make microaggressions, such as assuming that everyone can pay for social or academic activities (Rubin & Wright, 2017), which can be interpersonally uncomfortable for lower-SES students and reduce opportunities for social integration (Langhout et al., 2007).

Some lower-SES students may experience stress from a *cultural mismatch* between the interdependent values with which they were raised (i.e., being connected to and attending to others' needs) and independent values common in higher education (e.g., being expected to develop an independent program of research; Stephens, Fryberg, et al., 2012; Stephens, Townsend, et al., 2012). People from lower-SES backgrounds, relative to those higher in SES, may endorse interdependent values more frequently, because doing so is advantageous in circumstances of limited economic capital and environmental constraints (e.g., relying on close others in the face of adversities) (Fiske & Markus, 2012; Piff et al., 2010; Stephens et al., 2011).

Students from lower-SES backgrounds may be less accustomed to the cultural norms of higher education if they have not had family members (Bryan & Simmons, 2009; Collier & Morgan, 2008) or other role models to help orient them (Oliver et al., 1985). A lack of role models can negatively affect the social adjustment of lower-SES students in higher education (Herrmann et al., 2016; Shapiro et al., 2013).

Lower-SES students may be more likely to find that their social and cultural values are less valued in higher education and potentially incompatible with university life (Iyer et al., 2009; Jetten et al., 2008). This sense of identity incompatibility can undermine students' social adjustment (Veldman et al., 2019). Moreover, to cope with having a devalued social identity, lower-SES students may conceal their socioeconomic background, a strategy that can have short-term benefits

but negative consequences in the longer-term (Ballinger et al., 2022; Cook et al., 2017; Foster & Talley, 2022; Pasek et al., 2017; Veldman et al., 2022).

In addition, negative stereotypes about intellectual ability can lead lower-SES students to experience *social identity threat*—a concern about being judged negatively or viewed stereotypically because of one's group membership (Croizet & Claire, 1998; Durante et al., 2017; Easterbrook & Hadden, 2021; Steele et al., 2002). Social identity threat can be an additional source of psychological and physiological stress for lower-SES students (John-Henderson et al., 2014) and a cognitive burden (Johnson et al., 2011) that further puts lower-SES students at risk.

Notably, past literature reveals a robust association between SES and a sense of social integration. For example, a meta-analysis of 35 studies found that lower-SES students (compared to higher-SES students) had a lower sense of social integration (e.g., participating in social activities, sense of belonging) (Rubin, 2012). Thus, it is important to understand factors that may hinder lower-SES students' sense of social integration at all levels of academia. Less is known, however, about whether and how lower SES affects doctoral students, who are poised to be the next leaders in scientific and technical innovation.

There are reasons to think that lower SES may pose an even greater risk in doctoral education. Lower-SES students are even more underrepresented at the doctoral level (Zhang, 2005), and the outsider status conferred by a lower-SES background is also likely to undermine a sense of social integration. Moreover, the high value placed on intellectual ability in doctoral education (Lovitts, 2005) may be particularly likely to generate social identity threat for students from lower-SES backgrounds. In addition, doctoral training may be even more likely to emphasize independence (Lovitts, 2005), which may be alienating to lower-SES students who have more interdependent goals (Stephens, Townsend, et al., 2012).

However, it is also possible that any deleterious effects of lower SES have largely been accounted for by the time students reach the doctoral level. For instance, lower-SES students may have become accustomed to the norms of academia as undergraduate students and developed effective coping strategies, such as strategically concealing their lower-SES background to avoid prejudice.

To date, relatively little research has investigated whether and how lower SES may impede PhD students' perceived social integration. Indeed, to our knowledge, only one study has examined this topic. In a cross-sectional survey of PhD students, those from lower-SES backgrounds (compared to those from higher-SES backgrounds) reported lower levels of belonging in graduate school (Ostrove et al., 2011). In turn, lower levels of belonging were associated with lower levels of confidence in academic settings and reduced aspiration to continue their career as a professor at a research university. Thus, there is a need for more research investigating the role of SES in perceived social integration in doctoral education.

Moreover, relatively little research at any level has studied the *interpersonal processes* through which lower SES inhibits a sense of social integration or used longitudinal research to understand how SES affects interpersonal disconnections and perceived social integration over time. We suggest that feeling lower levels of perceived social integration may be due to the growing interpersonal disconnection that lower-SES students experience in higher education.

Interpersonal disconnection experienced by lower-SES students

One potential mechanism by which lower-SES students experience lower levels of social integration may be through experiencing a lack of understanding and alienation from close others inside (e.g., professors and other students) and outside (e.g., family and friends) of academia. We call

this experience *interpersonal disconnection*, which we define within academia as difficulty making friends, having a hard time understanding and being understood by others, and perceiving dissimilarity from colleagues. Outside of academia, interpersonal disconnection may be characterized by a perception that close others do not understand life as a PhD student and difficulty maintaining close friend and family ties. We propose that these proximal factors lead to expected detriments in perceived social integration.

Inside of academia, we suspect that the factors that lead to interpersonal disconnection mirror those that undermine a sense of social integration. Being unfamiliar with cultural norms in higher educational settings and experiencing cultural mismatch can lead to more interpersonal disconnections. For example, lower-SES students who emphasize interdependent values in their interpersonal relationships (e.g., considering others as a crucial part of oneself) may feel dissimilar to higher-SES individuals who are more likely to value independent goals (e.g., relationships can be used for personal gains) (Grant & Ashford, 2008; Stephens et al., 2019). Lower-SES students may view their independent peers as superficial and inauthentic (Williams, 2017), which may create barriers to making new friends and understanding and being understood by their higher-SES peers. These communication barriers may further accelerate feelings of alienation among lower-SES students.

In addition, experiencing stigma inside of academia can negatively impact lower-SES students' interpersonal relationships. For example, experiencing stigma often prevents individuals with stigmatized identities from disclosing their status and seeking help from close others (Cook et al., 2017; Helms et al., 2017). In addition, lower-SES students perceiving chronic social identity threat in higher education may have fewer cognitive resources (Johnson et al., 2011) needed for successful interpersonal relationships (Finkel & Campbell, 2001). Taken together, experiencing stigma and social identity threat may lead lower-SES students to experience more difficulty making friends among their graduate school peers.

Outside of academia, lower-SES students may find that as they become more ensconced in life as a PhD student a cultural divide develops between themselves and their non-academic family and friends. Even when supportive, friends and families may not fully understand what the commitments of being a PhD student entail (Bryan & Simmons, 2009; Collier & Morgan, 2008; Lehmann, 2009). Feeling less understood, lower-SES students may begin to have less contact with close others outside of academia, accelerating social distance. Overall, lower-SES students may face a compound risk of experiencing interpersonal disconnection both inside and outside of academic settings, which in turn may diminish their sense of social integration in graduate school.

Overview of the present study

In the current study, we analyzed longitudinal data from first-year PhD students at three North American universities collected as part of an ongoing study of the psychology of doctoral education. We investigated whether lower-SES students, compared to students higher in SES, feel lower levels of social integration into graduate school (i.e., perceiving higher social isolation, lower belonging in graduate school, and less social support). We then prospectively tested whether interpersonal disconnections experienced earlier in the academic year both inside academia (i.e., perceived difficulty making friends and being understood by and understanding others, perceived dissimilarities from colleagues) and outside of academia (i.e., perceived misunderstandings about doctoral education by close others and difficulty maintaining ties with close others) mediate any

association between lower SES and later feelings of social integration. Compared with higher-SES students, we expected lower-SES students to experience more interpersonal disconnection and lower feelings of social integration.

Further, students' interpersonal disconnection and feelings of social integration were measured multiple times throughout their first year of graduate school, allowing us to investigate whether longitudinal trajectories of interpersonal disconnection and a sense of social integration increased, decreased, or remained unchanged across students' first year as a PhD student. We also tested whether this trajectory differed as a function of SES and other demographic factors.

Given the limited literature utilizing longitudinal study designs, it is not clear how lower SES may affect trajectories of interpersonal disconnection and perceived social integration over time. It is possible that lower SES may be associated with increasing risk, as early experiences of interpersonal disconnection undermine a sense of social integration in a feedback loop. Alternatively, interpersonal disconnections may resolve over time, and perceived social integration improve, as lower-SES students become more familiar with the culture of doctoral education. Or, perhaps any effects of SES on interpersonal disconnections and perceived social integration are baked in and relatively unchanging. Our longitudinal analyses will provide useful descriptive information to better understand students' relational patterns over time.

Transparency and openness

All data, analysis code (including auxiliary analyses) and research materials (including materials associated with the larger study that current study was part of) are available: https://osf.io/w9fq2/. Data were analyzed using SPSS 28.0 and R (R Core Team, 2021) with the ggplot2 (Wickham et al., 2016), dplyr (Wickham & Grolemund, 2016), nlme (Pinheiro et al., 2017), and psych packages (Revelle, 2017).

METHOD

Participants and procedure

Participants were two cohorts of incoming doctoral students at Penn State, Stanford, and Columbia universities during the 2018–2019 and 2019–2020 academic years. All first-year STEM PhD students at these universities were eligible to participate, and a smaller number of non-STEM students were also targeted at Penn State. At Penn State and Stanford, additional non-STEM students who became aware of the study at orientation events were also allowed to participate. The pattern and magnitude of our findings do not change if we control for university or model students as nested in universities.

Participants completed baseline measures before or during the first 1−2 weeks of the first year of graduate school. The baseline survey was designed to capture students' attitudes, behaviors, and beliefs just before, or as, they began graduate school. Students who completed the baseline survey were invited to the longitudinal phase of the study that captured students' experiences in graduate school, in part, with eight surveys in non-consecutive weeks spanning 10 months of students' first year of graduate school. The goal of these surveys was to assess changes from baseline in students' psychological and behavioral outcomes (see Figure 1 for the timeline of the study). More details on the recruitment process are provided below. Overall, 1085 students completed the
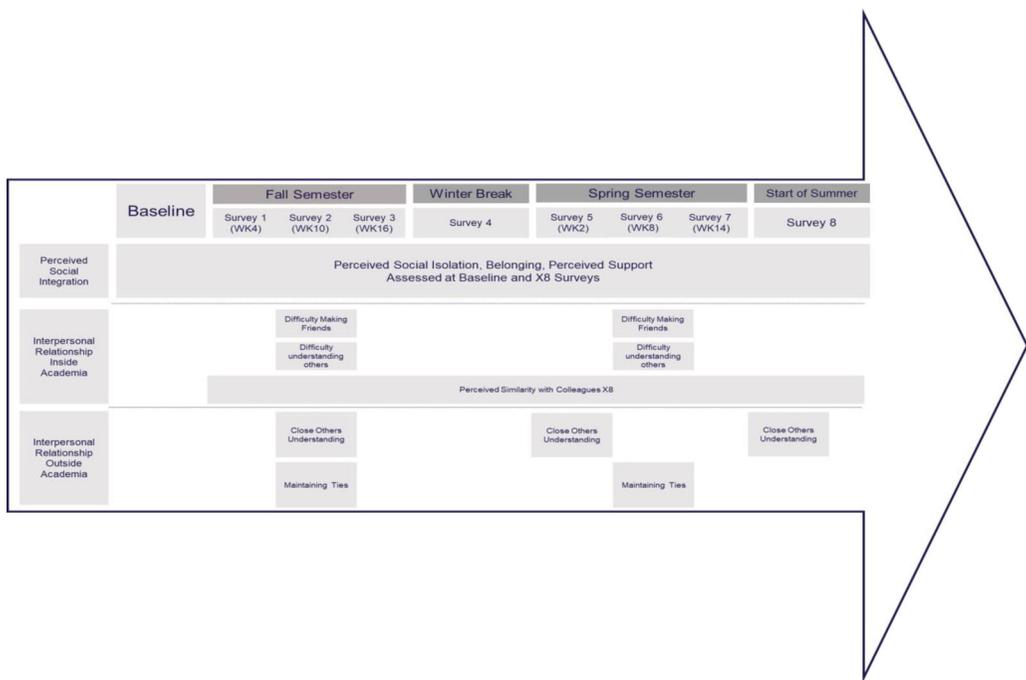
FIGURE 1 Timeline of study activities at semester-based universities. [Color figure can be viewed at wileyonlinelibrary.com]

baseline survey. Of these, 656 students entered the longitudinal phase of the study. Forty-eight students had missing data on the primary variables (noted below) at all surveys after baseline and were thus omitted from analyses, yielding a final sample of 608 students with longitudinal data. Students in the final sample were nearly evenly male and female (291 and 306, respectively, with 11 specifying nonbinary or another gender), and 24.10 years old on average ($SD = 3.14$). See Table 1 for demographic information as a function of "low" and "high" self-reported SES based on a median split (we use a median split for Table 1 for ease of presentation but treat SES as a continuous variable in all other analyses).

We recruited participants by email across all campuses. At Penn State and Stanford, participants were also recruited at in-person orientation sessions for incoming graduate students. Our recruitment process began 1–2 weeks before the start of the academic year and continued through the first 2 weeks of the term. The study's focus was described to prospective participants as aimed at understanding the experiences of PhD students throughout graduate school.

The recruitment email, which included a link to the baseline survey, was distributed to all incoming students in targeted fields by graduate deans at Penn State and Columbia and the dean of the School of Engineering at Stanford. For other STEM departments at Stanford, we sent the recruitment email to department chairs and directors of graduate studies and asked them to forward the emails to incoming PhD students in their departments. Because the emails were sent by university administrators and faculty on our behalf, we could not assess the student-level characteristics of non-participating students. Furthermore, administrators and faculty who assisted with recruitment were not informed which students participated in the study. Participants were also assured that no one outside of the research team (including university administrators and their

TABLE 1 Demographic information of participants

Measure	Total (%) (*N* = 608)	Lower Self-Reported SES (*N* = 218)	Higher Self-Reported SES (*N* = 390)
Age[a]			
M (SD)	24.10 (3.14)	24.2 (3.31)	24.04 (3.05)
Gender			
Male	291 (47.9%)	110 (50.5%)	181 (46.4%)
Female	306 (50.3%)	106 (48.6%)	200 (51.3%)
Gender non-binary	11 (1.8%)	2 (.9%)	9 (2.3%)
Race/ethnicity*			
Asian	69 (11.3%)	23 (10.6%)	46 (11.8%)
Black	14 (2.3%)	7 (3.2%)	7 (1.8%)
Hispanic	17 (2.8%)	10 (4.6%)	7 (1.8%)
Multiracial	27 (4.4%)	9 (4.1%)	18 (4.6%)
Asian/White	8 (1.3%)	2 (.9%)	6 (1.5%)
Other Multiracial identity	19 (3.1%)	7 (3.2%)	12 (3.1%)
Native American	1 (.2%)	1 (.5%)	0 (0%)
White	256 (42.1%)	65 (29.8%) −	191 (49.0%) +
American, race unknown	1 (.2%)	0 (0%)	1 (.3%)
International	223 (36.7%)	103 (47.2%) +	120 (30.8%) −
Region of birth for international students			
Africa	11 (4.9%)	6 (5.8%)	5 (4.2%)
Asia & Pacific	148 (66.4%)	75 (72.8%)	73 (60.8%)
Europe	26 (11.7%)	8 (7.8%)	18 (15.0%)
Middle east	17 (7.6%)	5 (4.9%)	12 (10.0%)
North America	11 (4.9%)	4 (3.9%)	7 (5.8%)
South/Latin America	10 (4.5%)	5 (4.9%)	5 (4.2%)
Parents/Guardians' highest education level*			
Less than high school	28 (4.6%)	20 (9.2%) +	8 (2.1%) −
High school diploma	62 (10.2%)	33 (15.2%) +	29 (7.5%) −
Two-year college degree	41 (6.8%)	25 (11.5%) +	16 (4.1%) −
Four-year college degree	150 (24.8%)	56 (25.8%)	94 (24.2%)
Master's degree	162 (26.8%)	58 (26.7%)	104 (26.8%)
PhD or professional degree	162 (26.8%)	25 (11.5%) −	137 (35.3%) +
Self-reported parents/guardians' household income*			
Below $30,000	123 (20.2%)	72 (33.0%) +	51 (13.1%) −
$30,001–$50,000	84 (13.8%)	47 (21.6%) +	37 (9.5%) −

(Continues)

TABLE 1 (Continued)

Measure	Total (%) (N = 608)	Lower Self-Reported SES (N = 218)	Higher Self-Reported SES (N = 390)
$50,001–$70,000	76 (12.5%)	37 (17.0%)	39 (10.0%)
$70,001–$90,000	65 (10.7%)	21 (9.6%)	44 (11.3%)
$90,001–$110,000	56 (9.2%)	11 (5.0%)	45 (11.5%)
$110,001–$130,000	36 (5.9%)	5 (2.3%)	31 (7.9%)
$130,001–$150,000	31 (5.1%)	3 (1.4%) −	28 (7.2%) +
$150,001–$250,000	56 (9.2%)	9 (4.1%) −	47 (12.1%) +
More than $250,000	30 (4.9%)	1 (.5%) −	29 (7.4%) +
Unsure	51 (8.4%)	12 (5.5%)	39 (10.0%)

Note. For this table, students were categorized into lower and higher SES groups by a median split of scores on the MacArthur Scale of Subjective Social Status. Group differences in age were tested by one-way analysis of variance. Group differences in categorical variables were tested with chi-squared tests. +/− signs indicate that cell proportions were bigger/smaller than expected based on adjusted standardized residuals > |3|. If there were significant group differences, we indicated the significance with asterisks next to the variable name.

[a]Four participants were missing the age variable, and one participant put an invalid number for age (i.e., −1). Thus, mean of age was calculated based on 603 people.

*$p \le .05$.
**$p \le .01$.
***$p \le .001$.

academic advisors) would know if they participated in the study. Participants received a $15 gift card for completing the 45-min baseline survey.

All participants who completed the baseline survey were subsequently invited to participate in the follow-up longitudinal phase of the study.[1] The email inviting students to participate in the longitudinal phase provided information about the study and asked participants to sign up for an in-person orientation using a link embedded in the follow-up email. We held orientation sessions in groups of 2–20 students during the second and third weeks of the academic year. During the orientation sessions, students were provided with details of the longitudinal phase of the study and completed a brief experimental intervention activity described below.

As noted above, students' experiences were assessed over eight non-consecutive weeks in their first year of graduate school (see Figure 1). At Penn State and Columbia, three surveys were administered during each of the fall and spring semesters. At Stanford, which uses a quarter-based academic calendar, two surveys were administered during the each of the autumn, winter, and spring quarters. Finally, at all three campuses, one survey was administered during winter break and the final survey was administered approximately 2 weeks after final exams. Each survey except over winter break was preceded by 7-days of smartphone-based experience sampling surveys; these experience sampling surveys were not analyzed in the present study. Participants were paid per survey at a rate of approximately $25 per hour based on the expected time to it would take to complete each survey (e.g., $7.50 for each 15–20 min survey used in the current study), with bonuses for high survey completion rates.

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[1] At Penn State, incoming PhD students in the College of Medicine were excluded because they were located at a geographically remote campus.

Although, not a focus of this article, the larger project included an experimental intervention with three randomly-assigned conditions—values affirmation (Cohen et al., 2006), social belonging (Walton & Cohen, 2011), or control—delivered during in-person orientation sessions and three additional times throughout the academic year in smartphone surveys. In all analyses, controlling for intervention condition did not change the direction or magnitude of the estimated effects. Additionally, the interaction between experimental conditions and SES did not predict our primary variables of interest except for one variable (i.e., how much students maintained ties with others outside of academia) in an unpredicted and difficult-to-interpret way.[2] In addition, the direction of results did not change, although the magnitude of the effects was smaller, if we examine only participants in the control condition (i.e., testing the role of SES in the absence of intervention). Thus, we do not further consider intervention conditions in the analyses in the main text.

Measures of primary variables

Perceived SES

Participants' perceived SES was assessed in the baseline survey using the MacArthur Scale of Subjective Social Status, which displays a picture of a ladder with 10 rungs representing SES in the United States (Adler et al., 2000). Participants were asked to locate their rung on the ladder based on their income, education, and occupation compared to others. We use self-reported SES as our main predictor because past literature suggests that self-reported SES is a stronger predictor (compared with objective indicators of SES such as parent/guardian income and education) of perceived social integration in academic settings (Ostrove & Long, 2007). The pattern of results is somewhat weaker but overall unchanged if we use an aggregated measure of objective SES indices (parents/guardians' highest education level and self-reported parents/guardians' household income) instead of perceived SES.

Perceived social integration in graduate school

We assessed participants' perceived social integration in graduate school by measuring perceived social isolation, belonging in graduate school, and social support at baseline and in all eight surveys thereafter. For scales that had multiple items (i.e., perceived social isolation and belonging in graduate school), we report the reliability of each measure at baseline and the range across weeks. As noted below, the individual scales showed adequate reliability, and because of this, as well as their high intercorrelation ($rs = .49–.53$), we standardized and averaged the three measures to form a composite measure of perceived social integration. Although, reliability of the composite was lower than typically-recommended alpha levels ($\alpha = .66$ at baseline and $.64–.70$ across weeks), this is largely because the scale only had three items, which constrains maximum reliability (Streiner, 2003). The inter-correlation of the three items is consistent with scales of high reliability (Clark & Watson, 1995). Moreover, analysis of the individual scales separately yields the

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[2] Among those in the control and values affirmation conditions, lower-SES students, relative to higher-SES students, maintained fewer ties with close others outside of academia. However, among students in social belonging condition, SES did not predict the extent to which students maintained ties with close others outside of academia.

same pattern of results (see supplemental online material). The baseline measure and an average of the later assessments were well correlated ($r = .66$).

Perceived social isolation

We did not originally include a dedicated measure of perceived social isolation at baseline, but to create a reasonable facsimile, we used six items assessing social connectedness (e.g., "I am lonely.") from a measure of psychological need satisfaction at baseline[3] ($\alpha = .67$; Sheldon & Hilpert, 2012). Response options ranged from 1 (*Not at all true*) to 7 (*Extremely true*). In the eight post-baseline surveys, we created a scale of perceived isolation by combining three author-generated items (e.g., "To what extent are you isolated in your day to day activities?") with three established items (e.g., "How often do you feel left out?"; Hughes et al., 2004). Participants responded to all items on a scale from 1 (*Never/Not at all*) to 5 (*Almost Always/Extremely*) (αs = .80–.82). The baseline and an average of the longitudinal measures of perceived social isolation were moderately correlated ($r = .40$).

Belonging in graduate school

Participants' belonging in graduate school was assessed using nine items (e.g., "I feel like I belong in graduate school"; Cook et al., 2012; Walton & Cohen, 2007) at baseline ($\alpha = .80$) and throughout the year (αs = .84–.89) with response scales from 1 (*Strongly disagree*) to 7 (*Strongly agree*).

Social support

Social support was measured using one item ("There are people I can count on to support me"; Cook et al., 2017) on a scale from 1 (*Not at all true*) to 5 (*Extremely true*) both at baseline and throughout the year.

Interpersonal disconnection inside and outside of Academia

Inside Academia

Students' perceptions of difficulty making friends and being understood by and understanding others in graduate school were assessed using two items ("Since starting your PhD program, how much difficulty have you experienced for each of the following?" [1] Making friends; [2] Making yourself understood/understanding others; adapted from Ward & Kennedy, 1999). These items were included in Surveys 2 and 6. These items were measured on a scale from 1 (*No difficulty*) to 4 (*Great difficulty*). Students' perceived similarity to colleagues in graduate school was assessed using an author-generated item ("How similar or different to other people in your department do you see yourself?") across all survey weeks. This item was measured using a 0−100 slider anchored at *Very different* and *Very similar*.

Outside of Academia

Understanding from close others outside of academia was assessed using a single author-generated item "How well do the people closest to you (outside of your academic life) understand

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[3] The second cohort (2019–2020) only completed four items to reduce survey length. The items removed were, "I feel a sense of contact with people who care for me, and whom I care for" and "I have disagreements or conflicts with people I usually get along with."

what it means to be a PhD student?" in Surveys 2, 5, and 8 on a scale from 1 (*not well at all*) to 5 (*extremely well*).

We also assessed the extent to which students retained ties outside of academia using one item assessed in Surveys 2 and 6 ("Not including your family, how much do you maintain ties with people outside of academia?"; adapted from Ward & Kennedy, 1999) on a scale from 1 (*Not at all*) to 4 (*Very much*).

Covariates

International status

Because international students may perceive difficulty integrating into doctoral educational settings (Glass et al., 2015), we control for students' international status in our analyses. We classified all participants who were born in the United States (including Puerto Rico) as domestic students. Participants who were not born in the United States but (1) reported being a US citizen or permanent resident and (2) considered the United States their home country (reported in either Survey 2 or Survey 5) were also classified as domestic students. All other participants were classified as international students.

Race/ethnicity

Because students who belong to historically underrepresented racial minority (URM) groups in doctoral education (i.e., Black, Hispanic, or Native American) (National Research Council, 2010) can experience lower levels of perceived social integration in doctoral education (Fisher et al., 2019), we control for students' race/ethnicity.

Race/ethnicity was assessed at baseline. Students first described their race/ethnicity with a free-response item and then selected all races or ethnicities that applied to them from a checklist of pre-defined racial categories (i.e., American Indian/Native American, Asian, Black, Hispanic, White, and other). Students who selected other could provide an open-ended description of their race/ethnicity.

Gender

Because perceived social integration into doctoral education may vary by gender (Fisher et al., 2019), we control for gender in our analyses. Participants reported their gender identity by selecting one or more of the following categories: female, male, transgender female, transgender male, genderqueer, or non-conforming. Participants could also specify a different gender identity in an open-ended response.

RESULTS

We first present our strategies for variable coding. Then, we present descriptive analyses and inter-correlations among our primary variables (see Table 2). We then present the results of longitudinal

TABLE 2 Means, standard deviations, and correlations with confidence intervals

Variable	M	SD	>1	>2	>3	>4	>5	>6	>7	>8	>9
1. SES	6.11	1.76									
2. Perceived Social Integration	.00	.70	.23** [.16, .31]								
Interpersonal Relationships Inside of Academia											
3. Difficulty Making Friends Inside Academia	2.13	.83	−.11** [−.19, −.03]	−.64** [−.68, −.59]							
4. Difficulty Understanding Others Inside Academia	2.06	.76	−.18** [−.26, −.10]	−.53** [−.58, −.47]	.54** [.48, .59]						
5. Perceived Similarity	55.12	22.36	.14** [.06, .22]	.63** [.58, .68]	−.42** [−.48, −.35]	−.43** [−.49, −.36]					
Interpersonal Relationships Outside of Academia											
6. Understanding from Close Others Outside Academia	2.81	.90	.13** [.05, .21]	.28** [.20, .35]	−.12** [−.20, −.04]	−.17** [−.24, −.09]	.23** [.15, .30]				
7. Maintaining Ties with Friends Outside Academia	2.88	.75	.20** [.13, .28]	.30** [.23, .37]	−.20** [−.27, −.12]	−.14** [−.22, −.06]	.11** [.03, .19]	.15** [.07, .23]			
Demographic Variables											
8. International Status[a]	−.10	1.45	.24** [.16, .31]	.09* [.01, .17]	−.03 [−.11, .05]	−.07 [−.15, .01]	−.01 [−.08, .07]	−.19** [−.27, −.11]	.14** [.06, .22]		
9. Underrepresented Minority (URM) Status[b]	−.46	.65	−.24** [−.31, −.16]	−.15** [−.23, −.08]	.04 [−.04, .12]	.18** [.10, .25]	−.12** [−.20, −.05]	.03 [−.05, .11]	−.09* [−.17, −.01]	−.54** [−.60, −.48]	
10. Gender[c]	.04	1.00	.01 [−.07, .09]	.03 [−.05, .11]	.00 [−.08, .08]	.05 [−.03, .13]	−.04 [−.12, .04]	−.12** [−.19, −.04]	−.00 [−.08, .08]	.19** [.12, .27]	−.10* [−.18, −.02]

Note. Numbers in brackets represent 95% confidence interval for the correlation coefficient. Variables assessed multiple times (i.e., variables 2–7) were averaged across weeks for each participant for calculating correlations.

[a] International status compares international students (−2) to domestic students (1, URM and non-URM).

[b] URM status compares non-URM (−1) to URM students (1) among domestic students (i.e., international students = 0).

[c] Gender was coded such that male = −1, female and gender non-binary = 1.

*$p \leq .05$.

**$p \leq .01$.

analyses investigating whether lower SES predicts students' trajectories of perceived social integration in academia and their interpersonal disconnection. Then, we turn to mediation analyses to test whether interpersonal disconnection is a pathway through which lower SES leads to feeling a lower sense of social integration.

Data coding strategy

Race/ethnicity and international student status were coded into three categories. The first was international students, who were a standalone group regardless of their reported race/ethnicity. We treated international students as a group, regardless of race/ethnicity, because we reasoned that race/ethnicity is likely to have a different meaning for international students relative to domestic students and because international student status may itself be a predictor of perceived social integration, and thus a confound for testing effects of SES. A second category was domestic students who identified as at least one of Black, Hispanic, or Native American, who we classified as URM because these groups have historically been underrepresented in doctoral education (National Research Council, 2010). Third, domestic students who identified exclusively as White, Asian, or White and Asian were classified as non-URM students, since these groups are not considered underrepresented in doctoral education (National Research Council, 2010). Results do not change if we code international students (primarily Asian; see Table 1) according to their race/ethnicity like the domestic sample. From these three categories, we created two orthogonal contrasts. The first contrast (henceforth international status) compares international students to non-international students and was coded such that international students = −2, non-URM students = 1, URM students = 1. The second contrast (henceforth URM status) compares non-URM to URM students and was coded such that international students = 0, non-URM students = −1, URM students = 1.

Gender was coded as either male or not male. Given the low number of students who identified as nonbinary ($n = 11$; see Table 1) and the potential for both female and nonbinary students to experience heightened gender-based identity threat (e.g., Bower-Brown et al., 2021), we classified women (including transgender women) and nonbinary students into a single group. We coded gender such that male = −1, female and nonbinary = 1. The direction and magnitude of our results do not change if nonbinary students are coded as a third gender category.

Primary analyses: Lower SES as a predictor of perceived social integration into Academia and interpersonal disconnections

In our primary analyses, we tested whether lower SES predicts (1) a lower sense of social integration in academia and (2) interpersonal disconnection inside and outside of academia. SES was included as a continuous predictor and was mean-centered, and we control for baseline measure in analysis predicting perceived social integration in academia to account for individual differences at the start of graduate school.

Because each interpersonal disconnection and perceived social integration variable was assessed multiple times, in a multilevel regression (more details described below), we were able to simultaneously conduct both within- and between-student analyses. Within-student analyses tested whether students' perceived social integration and interpersonal disconnection changed across the academic year. Between-student analyses tested our primary questions as

to whether students' perceived social integration and interpersonal disconnection differed as a function of SES. Last, we tested the interaction between within- and between-student factors—that is, whether within-person trajectories of outcomes differed by demographic factors (i.e., SES, international status, URM status, and gender).

We conducted multilevel regression analyses using the nlme package (Pinheiro et al., 2017) in the R statistical programming software (R Core Team, 2021). At Level 1, the temporal sequence in which the dependent variable was measured during the year was modeled (e.g., first assessment = 1, second assessment = 2). Thus, at this level, we tested the linear trajectory of outcomes across the year (i.e., whether it decreased, increased, or did not change), as well as whether the effects of SES and other demographic characteristics on each outcome varied over time.

At Level 2, SES (a continuous variable) and other between-person demographic covariates, as well as a baseline measure of the outcome variable (if it was assessed at the baseline), were modeled as predictors of Level 1 intercepts. Further, all demographic variables were included as moderators of time (i.e., as Level 2 predictors of Level 1 slopes). Baseline levels of the outcome variables were not included as predictors of Level 1 slopes because we considered them primarily as covariates. However, the direction and magnitude of our results of interest did not change if baseline levels of the outcome variables were included as moderators of time.

Intercepts at all levels were allowed to vary, as were the within-person slopes. Models were estimated using full-information maximum likelihood and an unstructured covariance of random effects. Below, we provide the specification of the complete statistical model. In this model, the subscript t represents the temporal sequence of the assessment, and the subscript i represents individuals. As such, Y_{ti} is the level of the outcome variable in survey week t for participant i. Baseline levels of the outcome variable were modeled as predictors of intercepts where available. We control for the baseline levels of outcome variables to account for baseline individual differences in order to isolate the unique effect of lower SES in doctoral education.

$$\text{Level 1}: DV_{ti} = \beta_{0i} + \beta_{1i}(\text{Week}_{ti}) + e_{ti}$$

$$\text{Level 2}: \beta_{0i} = \gamma_{00} + \gamma_{01}(\text{SES}_i) + \gamma_{02}(\text{International Status}_i) + \gamma_{03}(\text{URM Status}_i)$$
$$+ \gamma_{04}(\text{Gender CC}_i) + \boldsymbol{\gamma}_{05}(\textit{Baseline DV}_i) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{SES}_i) + \gamma_{12}(\text{International Status}_{ii}) + \gamma_{13}(\text{URM Status}_i)$$
$$+ \gamma_{14}(\text{Gender CC}_i) + u_{1i}$$

In analyses throughout this section, to interpret the fixed effects predicting intercepts (i.e., γ_{01}, γ_{02}, etc.) as the typical effects of the predictors across the year, we centered week such that 0 represents the approximate mid-point of the assessment period. Thus, in the following models, the intercept effect of SES, γ_{01}, represents the association between SES and the outcome at the mid-point of the academic year, controlling for international status, URM status, gender, and the baseline level of the outcome. Correspondingly, the demographic variables are tested as predictors at the hypothetical mid-point of the assessment. In all the analyses reported in this section, SES was reverse-coded so that higher scores indicate lower SES in order to facilitate the interpretation of the results focused around lower-SES students. In addition, baseline levels of the outcome variable (when applicable) were centered. Also, we report effect sizes as marginal R-squared

values, which describe the proportion of variance explained by the fixed factor(s) alone (Nakagawa & Schielzeth, 2013).

We also additionally tested our analyses with time centered at the first and last assessment to test whether SES impacts outcomes at these times.[4] Across all outcomes, the pattern of our results remains regardless of how we center time. Also, across all outcomes, the effect of SES remains if we do not specify the time in our model. This model can test the impact of SES on outcomes averaged across time points. In all of these models the direction and magnitude of the model does not change.

In the sections below, we report whether feelings of social integration and interpersonal disconnection differed as a function of SES and other demographic factors. Then, we report how students' feelings of social integration and interpersonal disconnection changed across the year and whether this trajectory was moderated by demographic variables.

A sense of social integration into academia

Lower SES was associated with lower levels of perceived social integration at mid-year, $\gamma_{01} = -.04$, $t(602) = -3.05$, $p = .002$, 95%CI $[-.06, -.01]$, $R^2 = .008$. Perceived social integration did not differ by international status ($\gamma_{02} = .01, p = .48$), or gender ($\gamma_{04} = .001, p = .97$). URM students (compared to non-URM students) had marginally lower levels of perceived social integration ($\gamma_{03} = -.07, p = .09$). Baseline perceived social integration predicted higher levels of perceived social integration later in the academic year, $\gamma_{05} = .59$, $t(602) = 21.32$, $p < .001$, 95%CI $[.54, .65]$, $R^2 = .31$.

However, perceived social integration did not change linearly over the year ($\beta_1 = -.001, p = .75$), and the longitudinal trajectory did not vary as a function of SES or other demographic variables except for international status, $\gamma_{12} = -.007$, $t(3897) = -2.24$, $p = .03$, 95%CI $[-.01, -.001]$, $R^2 = .0004$. For international students, perceived social integration increased across the year, $\beta_1 = .01$, $t(3897) = 1.97$, $p = .049$, 95%CI $[.0001, .02]$, $R^2 = .0002$, while it did not change across the year for domestic non-URM ($\beta_1 = -.01, p = .17$), and domestic URM students ($\beta_1 = -.01, p = .42$).

Interpersonal relationships with others inside of academia

Overall, as described below, lower-SES students experienced more interpersonal disconnection inside of academia. We found some evidence that experiencing a lack of understanding and alienation from others inside of academia increased across the year. This linear trajectory did not differ as a function of demographic variables.

Difficulty making friends in academia
As expected, lower-SES students, compared with higher-SES students, experienced more difficulty making friends inside of academia at mid-year, $\gamma_{01} = .05$, $t(603) = 2.61$, $p = .01$, 95%CI $[.01, .09]$, $R^2 = .009$. The difficulty of making friends did not differ by international status ($\gamma_{02} = .004$, $p = .89$), URM status ($\gamma_{03} = .02, p = .72$), or gender ($\gamma_{04} = .01, p = .84$). Students' difficulty making

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[4] The Level 2 effects represent the predicted (conditional) associations between each predictor (e.g., SES) and the outcome when Week equals 0. In other words, they indicate the effects of each predictor at whichever time point is specified as Week 0, which may vary depending on which time point is Week 0. Thus, centering time at different points would alter the Level 2 effects.

friends did not change linearly over the year overall ($\beta_1 = -.02$, $p = .69$), nor did the slope vary as a function of SES, international/URM status, or gender.

Being understood by and understanding others

Lower-SES was associated with more difficulty being understood and understanding others in academia (i.e., interpersonal understanding), $\gamma_{01} = .07$, $t(603) = 3.81$, $p < .001$, 95%CI [.03, .10], $R^2 = .018$. Additionally, URM students perceived more difficulty than their non-URM peers in interpersonal understanding, $\gamma_{03} = .21$, $t(603) = 3.73$, $p < .001$, 95%CI [.10, .32], $R^2 = .017$. Students' interpersonal understanding did not differ by international student status ($\gamma_{02} = .03$, $p = .23$) or gender ($\gamma_{04} = .05$, $p = .13$). Students' difficulty understanding others and being understood by others increased linearly over the year on average, $\beta_1 = .13$, $t(536) = 2.68$, $p = .008$, 95%CI [.03, .22], $R^2 = .003$, but this increase did not differ as a function of demographic variables.

Perceived similarity to others in department

Lower SES predicted less perceived similarity to others, $\gamma_{01} = -1.67$, $t(603) = -3.18$, $p = .002$, 95%CI [−2.70, −.64], $R^2 = .012$. In addition, international students perceived less similarity to others compared to domestic students, $\gamma_{02} = -1.82$, $t(603) = -2.43$, $p = .02$, 95%CI [−3.29, −.35], $R^2 = .007$, and URM students perceived less similarity to others compared to non-URM students, $\gamma_{03} = -5.51$, $t(603) = -3.34$, $p = .001$, 95%CI [−8.75, −2.28], $R^2 = .014$. Perceived similarity did not differ as a function of gender ($\gamma_{04} = -.75$, $p = .41$). Students' perceived similarity to other people in their department decreased over the year, $\beta_1 = -.31$, $t(3588) = -2.04$, $p = .04$, 95%CI [−.60, −.01], $R^2 = .0004$, but this trajectory did not differ as a function of demographic variables.

Interpersonal relationships with others outside of academia

Overall, as noted in detail below, lower-SES students (compared to higher-SES students) experienced higher levels of interpersonal disconnection outside of academia. In general, students' close interpersonal relationships with people outside of academia improved across the year. This linear trajectory did not differ as a function of demographic variables.

Understanding from close others outside of academia

Lower SES was associated with less perceived understanding from close others outside of academia, $\gamma_{01} = -.09$, $t(603) = -4.38$, $p < .001$, 95%CI [−.13, −.05], $R^2 = .021$. Additionally, international, URM, and female/nonbinary students perceived less understanding from close others outside of academia compared to domestic, $\gamma_{02} = -.16$, $t(603) = -5.53$, $p < .001$, 95%CI [−.22, −.11], $R^2 = .032$, non-URM, $\gamma_{03} = -.11$, $t(603) = -1.68$, $p = .09$, 95%CI [−.24, .02], $R^2 = .003$, and male students, $\gamma_{04} = -.07$, $t(603) = -1.84$, $p = .07$, 95%CI [−.14, .004], $R^2 = .004$, respectively. Across demographic groups, students' perception of understanding from close others outside of academia increased over the year, $\beta_1 = .07$, $t(1087) = 2.13$, $p = .03$, 95%CI [.01, .13], $R^2 = .002$. This trajectory did not differ as a function of demographic variable.

Maintaining ties outside of academia

Relative to higher-SES students, lower-SES students maintained fewer close ties with close others outside of academia, $\gamma_{01} = -.08$, $t(603) = -4.59$, $p < .001$, 95%CI [−.11, −.05], $R^2 = .025$. Also, international students kept fewer ties with friends and close others than domestic students did, $\gamma_{02} = .06$, $t(603) = 2.22$, $p = .03$, 95%CI [.01, .10], $R^2 = .006$. No differences in maintenance of

non-academic ties emerged based on URM status ($\gamma_{03} = .01\ddot{y}$ $p = .87$) or gender ($\gamma_{04} = -.01\ddot{y}$ $p = .73$). The extent to which students kept ties with close others outside of academia increased marginally over the year, $\beta_1 = .08$, $t(537) = 1.70$, $p = .09$, 95%CI [$-.01, .18$], $R^2 = .002$, but did not differ as a function of demographic variables.

Mediation of perceived social integration by interpersonal disconnection

We tested whether interpersonal disconnections inside and outside of academia mediated the association between lower SES and lower feelings of social integration in academia. All five variables assessing interpersonal disconnections (noted above) assessed from earlier in the semester (i.e., measurements up to Week 2, aggregated) were simultaneously included as mediators in models predicting perceived social integration later in the semester (i.e., measurements from Weeks 3−8, aggregated). Due to missing data at various survey assessments, the final sample size for mediation analyses was 582 students. In all analyses, international status, race/ethnicity, gender, and the baseline measure of the dependent variable were controlled. We control for the baseline levels of the dependent variable to account for individual differences in the outcome at baseline and capture the effect of lower SES on the outcome during students' doctoral education. As in the primary analyses, SES was reverse coded (i.e., higher scores indicated lower SES) to facilitate interpretation of the results.

Indirect effects were evaluated using 95% confidence intervals estimated from 10,000 bootstrapped samples. Because the mediator variables temporally preceded the outcomes, these analyses allow us to robustly test whether experienced interpersonal disconnection is a mechanism through which lower SES leads to lower levels of perceived social integration. Overall, as described below, results revealed that interpersonal disconnections significantly explained the association between lower SES and lower levels of perceived social integration.

As a block, the interpersonal disconnection variables significantly mediated the association between lower SES and lower levels of perceived social integration, total indirect effect = $-.02$, 95%CI [$-.03, -.0001$]. Although, not all the indirect paths were significant, they were all directionally consistent (see Figure 2). Among all the mediating variables, only keeping fewer ties with non-academic friends significantly mediated the association between lower SES and lower levels of social integration, indirect effect = $-.004$, 95%CI [$-.009, -.001$].

DISCUSSION

Using longitudinal data from incoming PhD students at three North American universities, we aimed to better understand the role of socioeconomic status in doctoral students' feelings of social integration in academic settings and interpersonal experiences inside and outside of academia. Over and above other demographic factors (i.e., international, URM status and gender), we found that PhD students starting their graduate careers with relatively low SES experienced a lower sense of social integration into academia (i.e., higher perceived social isolation, lower belonging in graduate school, and less perceived support). These results are consistent with one study that investigated the impact of SES on belonging at the doctoral level (Ostrove et al., 2011) and past findings from lower educational levels (Ostrove & Long, 2007).

Our results revealed that lower-SES PhD students experienced less understanding and more alienation from people close to them inside and outside of academia, contributing to greater risk
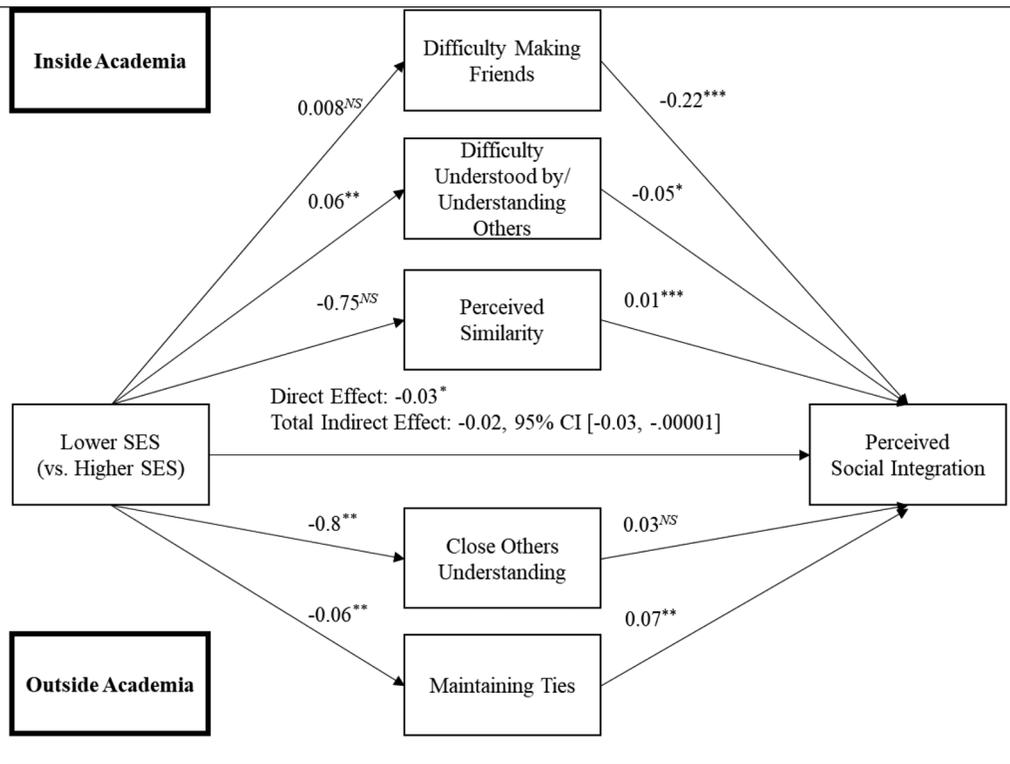
FIGURE 2 Mediation model predicting the effect of SES on perceived social integration via interpersonal disconnection.

Note. All coefficients are unstandardized. Mediating variables were measured and aggregated (if applicable) across Weeks 1 and 2. Perceived social integration was measured and aggregated across Weeks 3−8. Results control for race/ethnicity, international status, gender, and baseline social isolation.

NS = not significant ($p > .05$). *$p \leq .05$. *$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

of interpersonal disconnection. Lower-SES students found it more difficult to make new friends in academia and had a harder time than higher-SES students feeling understood and understanding their academic colleagues. They also felt less similar to their colleagues. Lower-SES students, relative to their higher-SES peers, also felt more that close others outside of academia did not understand what it meant to be a PhD student and they kept fewer ties with their non-academic friends. These signs of interpersonal disconnection were robust to the inclusion of competing demographic characteristics that could explain greater risk of interpersonal disconnection, including URM status and gender. Thus, the role of SES in interpersonal disconnection was not merely an artifact of lower-SES students coincidentally belonging to other high-risk groups.

These results suggest that lower-SES doctoral students face a compound risk of experiencing interpersonal disconnection in graduate school. They are at risk of heightened disconnection from their academic and non-academic connections, a pattern that aligns with past literature suggesting that lower-SES students at undergraduate levels may experience interpersonal disconnection inside of academia (Rubin et al., 2019) and outside (Bryan & Simmons, 2009). More generally, our findings are notable because they suggest that having a stigmatized identity in doctoral educational settings can similarly lead to interpersonal disconnections inside and outside of academia.

We further discovered that the association between lower SES and lower levels of perceived social integration was mediated by interpersonal disconnections. Thus, interpersonal disconnection is one pathway through which lower SES leads students to experience a lower sense of social integration. As a sense of social integration in academic settings can be associated with important outcomes such as academic performance, well-being, motivation, and perseverance (Cook et al., 2012; Rubin et al., 2019; Stebleton et al., 2014; Turetsky et al., 2020; Walton & Cohen, 2007), it is important to better understand pathways that can hinder lower-SES students' sense of social integration in their academic environment.

Across demographic groups, PhD students' academic interpersonal relationships worsened slightly over the course of their first year in graduate school, as evidenced by increased difficulty being understood by and understanding academic colleagues as the year progressed. Furthermore, although students did not perceive a change in the ease/difficulty of making friends over the year, they did come to see themselves as progressively more dissimilar from their colleagues. Among lower-SES students, a decrease in perceived similarity with others may be due to social identity concerns as evidence of lower SES being devalued became salient during the course of the academic year (Branscombe et al., 1999). Alternatively, given that higher-SES students also experienced a decline in perceived similarity, there may be a more general normative process of adjustment, in which students initially feel similar to their peers but then either through processes of optimal distinctiveness (Leonardelli et al., 2010) or as part of typical group development (Tuckman, 1965), they begin to differentiate themselves more from their academic colleagues. More prosaically, PhD students may start to feel alienated from their colleagues simply because doctoral education often requires spending long periods conducting research alone, with minimal time for social interaction. In other words, being in graduate school may, paradoxically, impede the development of PhD students' academic relationships.

In contrast to the patterns found for within-academia relationships, PhD students' interpersonal relationships with close others outside of academia tended to strengthen across their first year in graduate school. Specifically, students felt that their close others' understanding of what it means to be a PhD student improved with time, as did students' ties with their non-academic close others. Considering the stressful and potentially threatening nature of doctoral education, students may have increasingly reached out to their close friends and family outside of academia to bolster their self-integrity by reflecting on important aspect of themselves (i.e., close friends and family) outside of the threats posed by the graduate school environment (Sherman & Cohen, 2002; Steele, 1988). These findings resonate with past findings that family and close friends can serve as a source of affirmation in threatening situations (Sherman & Cohen, 2002). Last, students' levels of perceived social integration into academia remained stable.

We further examined whether trajectories of interpersonal disconnection and perceived social integration across the year differed as a function of SES. Lower social class might exacerbate risks over time if lower-SES students continue to find academic settings hostile, but the risk among lower-SES students could also instead be mitigated over time as lower-SES students become more familiar with their settings. However, we did not find evidence that linear trajectories across students' first year were moderated by SES or any other demographic variables. Lower-SES students reported relatively poor interpersonal connections and perceived social integration on average, but over time, their perceptions of their interpersonal relationships and their place in academia followed the same trajectories as their higher-SES peers. This pattern suggests that any adverse effects of lower SES on interpersonal connections and perceived social integration do not worsen during students' first year of graduate school. Notably, although lower SES was not linked with heightened risk over time, it also was not linked with progressively diminished risk:

The risk "penalty" associated with lower SES in doctoral education may not escalate, but it does persist.

Overall, our findings strongly suggest that lower SES, over and above other potential at-risk demographic factors based on nationality, race/ethnicity, and gender, can lead students to feel threatened in doctoral education. Our research also indicates a need for institutional support that fosters students' interpersonal connections, both inside and outside of academia. In the past, the relative lack of support toward lower-SES students may have been because stigma around social class can be relatively concealable and thus less obvious to university administrators. Supporting the social integration of lower-SES doctoral students has the potential to help these students flourish and thus, promote an increased diversity of ideas in academia and greater social mobility for students from underprivileged backgrounds. These policies could include expansion of existing supports for students from marginalized groups (e.g., based on race/ethnicity or gender) to include students from lower-SES backgrounds. For example, many graduate schools have mentorship programs for URM PhD students in which URM students are paired with URM professors or senior graduate students to help URM students to adjust and thrive in doctoral educational settings. These mentoring programs could be expanded to more explicitly include students from lower-SES backgrounds. In such programs, lower-SES students can learn from mentors from similar socioeconomic backgrounds about how to navigate social interactions and relationships both inside and outside of academia. At minimum, universities should routinely document how SES background affects doctoral attrition rates to understand more clearly how and when SES might impede PhD students' success in graduate school.

It is possible that lower-SES individuals may also encounter greater interpersonal disconnection in white-collar non-academic settings. For instance, many organizations expect their employees to use independent approaches to interpersonal interactions in the workplace (Grant & Ashford, 2008; Stephens et al., 2019), which as noted, may be at odds with lower-SES individuals' more interdependent orientation (Stephens et al., 2019) and increase the potential for interpersonal disconnection at work. Similarly, if friends and families of lower-SES individuals are more likely to work in blue-collar jobs, they may not have exposure to the norms and expectations of white-collar jobs to provide understanding and relevant support. More research is needed to support these ideas, but considering that a substantial proportion of PhD students will ultimately pursue non-academic careers (Turk-Bicakci et al., 2014), fostering a better sense of social integration during graduate school may confer downstream benefits in academic and non-academic settings alike.

In addition to social class, our research also identified other demographic factors that may lead to interpersonal disconnection and a lower sense of social integration in academic settings. Within academia, URM students (compared to non-URM students and controlling for SES, gender, and international student status) perceived relatively high difficulty being understood by and understanding others; they also felt more dissimilar than non-URM students to their colleagues. Similar to lower-SES students, URM students, compared to non-URM students, also felt that their close others outside of academia did not understand what it means to be a graduate student. In turn, URM students (compared to non-URM students) had marginally lower levels of perceived social integration. These findings align with past literature suggesting that URM students at doctoral levels experience difficulty with social integration (Fisher et al., 2019). In addition, in line with past literature on international students' experience (Glass et al., 2015), international students (compared to domestic students and controlling for SES and gender) perceived less similarity with their colleagues inside academia. Outside of academia, international students perceived less understanding from close others and kept fewer ties with their close

others. Further, women and gender non-binary participants (compared to males and controlling for SES and international student status), perceived less understanding from others outside of academia. Taken together, among doctoral students, being a member of a URM group, an international student, or a female/non-binary student poses risks for maintaining interpersonal connections.

Effect sizes were relatively small across analyses, though it should be noted that small effect sizes can have robust effects in a population (Greenwald et al., 2015; Rosenthal, 1990). The effect sizes reported here are comparable to those found in previous research on the association between lower SES and a sense of social integration in academic settings, suggesting their stability. For example, in a meta-analysis across 35 studies, Rubin (2012) found a relatively small effect size between lower SES and a sense of social integration ($r = .08$).

Limitations and future research

Because this study relied on measured data, we cannot conclusively establish a causal link between interpersonal disconnection and perceived social integration among lower-SES students. However, evidence for causality is bolstered by the longitudinal design of our study, which allowed temporal precedence in our mediation model (Fairchild & McDaniel, 2017). We tested whether interpersonal disconnection prospectively predicted reduced perceived social integration later in the academic year. As such, the predictor (SES) preceded the mediator (interpersonal disconnection), which in turn occurred before the outcome (sense of social integration). The timing of assessment helps strengthen the case that experienced interpersonal disconnection is a plausible causal mechanism through which lower SES leads to a worse sense of social integration.

Our study was conducted at academic institutions in North America, so our results may not generalize strongly to higher educational settings outside of North America. Additionally, our participants were students at three highly prestigious universities (e.g., all three are members of the Association of American Universities [AAU], an organization of the most prominent research universities in North America). Lower-SES students may have found their SES to be a more salient characteristic in these institutions than they would at others, since lower-SES students may be even more underrepresented (Bastedo & Jaquette, 2011), and more emphasis may be placed on intellectual abilities at elite universities, generating greater social identity threat for lower-SES students. Future studies can also investigate whether lower-SES students experience lower levels of perceived social integration and interpersonal disconnection in less selective PhD programs.

We also used perceived SES, rather than objective indicators of SES (e.g., parental education and income), as the main indicator of students' socioeconomic background; however, students' self-reports of their SES may have been biased by their social surroundings. Particularly at the prestigious institutions where this study was conducted, students may perceive their SES to be lower than objective measures would indicate because their social surroundings do not reflect the distribution of wealth and education across the United States in general. However, as the measures of SES was assessed before the start of graduate school, it is less likely that their social surroundings in doctoral educational settings strongly affected their perceived SES. Also, students in our sample who reported lower levels of perceived SES (i.e., below the mean) also had lower levels of objective SES. For example, 51% of self-reported lower-SES students were from households that are classified as low-income (i.e., annual income below $50,000) (Pew Research Center, 2020). Furthermore, past literature suggests that perceived SES is a stronger predictor

of perceived social integration in academic settings than parent/guardian income or education (Ostrove & Long, 2007). Consistent with this research, in our study, we found that perceived SES was a stronger predictor of perceived social integration than objective SES, and the direction of the effects in analyses of perceived SES were consistently the same as in analyses of objective SES.

Notably, the measure of perceived social isolation used in the baseline survey differed from the measure used in the subsequent survey waves. As such, we could not fully control for baseline differences in perceived social isolation in our analyses. However, the baseline and post-baseline indicators of perceived social isolation were reasonably well correlated ($r = .40$), partially alleviating this concern.

We proposed several reasons why lower-SES students may experience more interpersonal disconnections, but we are not able to definitively answer which was exerting an influence. It will be helpful in future research to clarify the specific mechanisms that lead to interpersonal disconnection. For instance, although we proposed that one factor that leads to lower-SES PhD students experiencing interpersonal connection might be a cultural mismatch, it is also possible that the familiarity with academia that a college education provides may reduce any mismatch at the doctoral level. If so, other proposed mechanisms may have been more at play. Future research should also explore other mechanisms through which lower SES might lead to worse perceived social integration. For example, lower-SES students may be worried about being perceived as disloyal by friends and family, or even as disparaging them by choosing to engage in an activity like doctoral education, where one is likely to enhance social mobility. These concerns have been demonstrated in other marginalized populations (e.g., African Americans who move to a predominantly White neighborhood) (Postmes & Branscombe, 2002). Such concerns may exacerbate the interpersonal disconnections that lower-SES students experience with their family and close others outside of academia.

In addition, in future research, it would be critical to investigate whether it is the relative advantage of higher-SES students or the disadvantage of lower-SES students that is driving the association between SES and perceived social integration. Because this study used a fully observational design, it is difficult to parse whether the detected effects were driven by advantages that higher-SES students receive or disadvantages that lower-SES students confront.

Conclusion

The current study contributes to understanding the interpersonal disconnections lower-SES students experience inside and outside of academia. Further, this interpersonal disconnection may be a pathway through which lower SES leads to feeling a diminished sense of social integration. The present findings suggest that students from lower-SES backgrounds are at risk of social isolation in doctoral educational settings, which may contribute to intergroup disparities in completion and, ultimately, in the highly skilled workforce.

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SUPPORTING INFORMATION

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