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Connecting in Class? College Class Size and Inequality in Academic Social Capital

College students who interact with professors and peers about academic matters have better college outcomes. Although institutional factors influence engagement, prior scholarship has not systematically examined whether class sizes affect students' academic interactions, nor whether race or first-generation status moderate such effects. We conceptualized academic interactions as forms of social capital that are sensitive to institutional characteristics. We analyzed survey data from a random sample of 346 students enrolled at a public research university linked with institutional data on student class size. We employed logistic regression on six dependent variables capturing academic interactions with professors and peers and controlled for precollege characteristics. Compared to students enrolled in smaller classes, students enrolled in larger classes had significantly fewer interactions with professors about course material and with peers about course-related ideas. Social group also moderated some effects of class size. Class size negatively influenced first-generation (but not continuing generation) students' likelihood of talking to professors or TAs about ideas from class. For discussions about future careers, larger classes had profound negative effects on Black students (for interactions with professors) and Latino students (for interactions with peers), but no effect on other groups. We discuss implications for theory and practice.

Keywords: student-faculty interactions, student-peer interactions, college class size, Social Capital, race and ethnicity, first generation college students, organizational characteristics, survey research

The Great Recession has shrunk state support for higher education at the same time that student demand for college attendance is increasing. Since 2008, every state except Wyoming and North Dakota has cut funding for

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public higher education, and 36 states have decreased appropriations by more than 20% (Oliff, Palacios, Johnson, & Leachman, 2013). Campus administrators have responded by seeking efficiency in academic offerings, especially through increasing class sizes. In 1910, researchers were concerned about class sizes over 200 (Carman & Watson, 1910), yet at the University of Colorado, Boulder, some classes recently surpassed six times this figure (Associated Press, 2007). Such changes may have been particularly dramatic in introductory classes: at University of California, Riverside the Physics 020 lecture class size increased from 95 students in Fall, 2008 to 573 students in Fall, 2011 (University of California Budget News, 2012). Campus-wide reports detail similar expansions. For example, the Provost at Arizona State University reported that class sizes increased by 12% between 2008 and 2012 (Capaldi, 2011). These are merely a handful of illustrations of a pervasive national trend. In an era where large class sizes are becoming routine, their effects on student experiences have not been adequately examined.

In this study, we argue that larger classes may hinder a key type of beneficial student engagement—student interactions about academic and career matters with professors and peers across campus. We conceptualize such academic interactions as social capital—relationships of trust and information exchange that can facilitate subsequent social and economic opportunities—that students can gain in college and that are sensitive to institutional characteristics (Bourdieu, 1986; Coleman, 1988; Deil-Amen, 2011). While larger college classes are associated with lower student achievement, attendance, and participation (Arias & Walker, 2004; Fassinger, 1995) no prior study has systematically examined the link between college class size and academic interactions. Further, given that first-generation, Black, and Latino students face particular challenges in college, and there is evidence from elementary schools that smaller classes particularly benefit disadvantaged students, we expected class size variation to especially influence academic interactions for these student groups (Cole, 2007; Finn & Achilles, 1990; Hurtado & Carter, 1997; Pascarella et al., 2004). We sought to fill these gaps in the literature by answering the following questions:

1. Are larger class sizes associated with diminished student social capital, in particular, fewer academic interactions with professors and peers on campus?

And,

2. Are the effects of larger class sizes on academic social capital more negative for first-generation, Black, and/or Latino students?

We employed logistic regression analysis of data from the *Social Interactions and Academic Opportunities* (SIAO) survey. The sample was a stratified (by class year), random sample of 346 first, second, and third year students at “Northern University,” administered in 2011 at a public research university in the United States that was designated as a Hispanic-Serving Institution (HSI). We linked these individual student reports, which included information about how often and what topics they discussed with professors and peers across campus during a particular semester, with institutional data on their average class size that semester.

Student Academic Interactions

Various theoretical models of college success have highlighted the benefits of student interactions with peers and professors about academics (Kuh, 1995; Pascarella & Terenzini, 2005). According to Pascarella and Terenzini (1991, p. 620), “[a] large part of the impact of college is determined by the extent and content of one’s interactions with major agents of socialization on campus, namely, faculty members and student peers.” Tinto (1993) established that academic and social integration facilitate student persistence through college. Student involvement in the form of student-peer and student-faculty contacts improves student learning and academic performance (Astin, 1993; Kuh et al., 2010), and is most effective when it encompasses educationally purposeful activities (Anaya & Cole, 2001; Deil-Amen, 2011; Pascarella & Terenzini, 1991). In sum, talking to professors and peers about academic and career matters improves both subjective and objective measures of college student success, including student achievement, satisfaction, persistence, academic self-confidence, and academic skill development (Astin, 1993; Cole, 2007; Deil-Amen, 2011; Kuh & Hu, 2001; Pascarella & Terenzini, 2005; Tinto, 1993).

While Tinto’s (1993) original model of student retention distinguished between “social” and “academic” integration, his reformulation of the model (1997) recognized that these spheres often intertwined. Deil-Amen (2011, pp. 72–73) built on this notion in her study of community college students to conceptualize academic interactions as “socio-academic integrative moments.” These moments occur when, “*the academic influence is coupled with elements of social integration to provide needed support and enhance feelings of college belonging, college identity, and college competence*” (emphasis in original). She argued that in addition to improving social integration, such moments also facilitate academic integration by providing key informational benefits.

Thus, she contended that socio-academic ties are an important form of social capital.

Building on her argument, we conceptualize student-faculty and student-peer interactions as forms of academic social capital. Social capital is a resource that one gains through relationships and interactions with others in one's social network, facilitating subsequent social and economic action (Coleman, 1988). Acquisition of social capital is often embedded within institutions, depending first on a context which allows access to social relationships, and second on the amount, quality, and transferability of resources held within these network ties (Bourdieu, 1986). Large classes are an institutional factor that can disrupt both features of the development of social capital, since they provide fewer opportunities for initiating interpersonal relationships and may dilute the overall amount and quality of available resources among network ties.

Studies of academic interactions during high school routinely characterize them as forms of social capital that provide long-term educational and occupational benefits (Perna & Titus, 2005; Ream & Rumberger, 2008), but this perspective has not been applied as frequently in the college setting. For college students, academic social capital likely facilitates campus integration while also benefitting students' postcollege economic and social outcomes (Adler & Kwon, 2002). Even a single academic interaction with a professor or peer on campus can profoundly influence student outcomes (Chambliss & Takacs, 2014). Academic social capital is thus an important outcome to study as it can serve as a tangible and portable resource that helps students beyond their college years.

There is evidence that academic interactions are particularly beneficial for college success and satisfaction among first-generation and minority college students (Anaya & Cole, 2001; Antonio, 2004; Cole, 2007; Deil-Amen, 2011; Fischer, 2007; Lundberg & Schreiner, 2004; Pascarella et al., 2004). Particularly for first-generation college students, entering college can be a major disjuncture in their lives that separates them from their family and friends (Terenzini et al., 1994). First-generation students report fewer interactions with professors and peers compared to those with college-educated parents (Kim & Sax, 2009; Pascarella et al., 2004). Black and Latino students experience racism and racial tension, which negatively impact their academic and social integration (Allen, 1992; Hurtado, 1992; Nora & Cabrera, 1996). Thus, integration on campus "can mean something completely different to student groups who have been historically marginalized in higher education" (Hurtado & Carter, 1997, pp. 326–327) and academic interactions are an important mechanism of such integration (Fischer, 2007;

Terenzini et al., 1994). For example, Latino students who talked about course material with peers reported a greater sense of belonging on college campuses than those who didn't (Hurtado & Carter, 1997). And when Black and Latino students have more ties to professors they report greater college satisfaction (Fischer, 2007). Even in models that account for selection into college, Black, Latino, and socioeconomically disadvantaged students have better graduation rates at highly selective institutions than broader access ones (Melguizo, 2010). Alon and Tienda (2005) suggested that underrepresented students at selective institutions may particularly benefit from smaller classes and more opportunities for interaction with faculty in these contexts. Taken together, prior research suggests that variation in class size may have differentiated effects on academic interactions for Black, Latino, and first-generation students.

Academic social capital can be captured in many ways. We focused on academic interactions with professors and peers about three distinct topics that are known to be important to student success. First, we examined the prevalence of interactions about course material and/or assignments. Such interactions are a minimal form of academic engagement and can improve student grades, satisfaction, and confidence (Anaya & Cole, 2001; Kuh, 1995). Second, we examined student interactions about future careers with their professors and on campus peers. Given the importance of social network connections for obtaining employment—particularly “weak ties” with individuals outside of one’s familial or community network—these interactions may provide important resources related to postcollege career success (Granovetter, 1995). Third, to tap into more intellectual (and less instrumental) dimensions of academic social capital, we examined how frequently students discussed ideas from readings or classes with professors (or TAs) and peers outside of class. Such discussions likely enhance student learning, critical thinking, and/or academic skill development (Arum & Roksa, 2011; Kuh, 1995).

Prior research has largely focused on establishing the benefits of academic interactions for student outcomes and has included measures of such interactions as part of aggregate scales capturing student involvement, engagement, or integration (Astin, 1993; Kuh, 1995; Pascarella & Terenzini, 2005; Tinto, 1993). Other work has examined the individual and institutional factors that predict student academic interactions, providing important control variables to consider for establishing the link between class size and academic social capital. At the individual level, student-faculty and student-peer academic contact varies by gender, race, first-generation status, academic preparation, year in school, and area of study (Astin, 1993; Cole, 2007; Kim & Sax, 2009; Kuh &

Hu, 2001). Institutional influences are most often conceptualized as between-institution differences, such as Kuh and Hu's (2001) study, which showed that students had fewer interactions with faculty at public, research oriented campuses than at private colleges or non-research universities. Low faculty-student ratios on a campus are positively associated with nearly all aspects of student experience, including student satisfaction with teaching quality and student-teacher relationships (Astin, 1993). Such between-campus variation hints that within-campus variation in class sizes may structure student interactions.

College Class Size

Organizational aspects of campus life are critical for shaping student experiences. Institutional features have been shown to matter for explaining differences *between* campuses (Kuh & Hu 2001), but more attention to variation *within* a given campus is needed. Given that the level of student engagement varies more within an institution than between institutions (Pascarella & Terenzini, 2005), class size differences on a campus may influence academic interactions between students and their professors and peers. Organizational characteristics are known to shape social capital acquisition in the workplace (Adler & Kwon, 2002). Although prior work has not systematically examined how class size influences academic interactions, we build on suggestive evidence from focus group and interview studies which indicates that larger classes hinder student interactions (Cotten & Wilson, 2006; Deil-Amen, 2011).

Prior research examining the effects of class size on other outcomes has found mostly negative influences. For example, economics and business students enrolled in larger classes have significantly lower exam scores, grades, and future earnings than peers in smaller classes (Arias & Walker, 2004; DeGiorgi, Pellizzari, & Woolston, 2012). One study on an entire campus that controlled for student- and classroom-level fixed effects found that grades declined as class size increased (Johnson, 2010). In addition to hindering academic performance, large classes have been negatively associated with other student behaviors. In a study at a small, liberal arts college (where classes ranged in size from 3 to 50 students), students in larger classes reported lower levels of participation during class, including commenting, asking questions, and expressing personal opinions (Fassinger, 1995). Further, larger classes have been linked to higher rates of student absenteeism and lower student evaluations of professors and courses (Bedard & Kuhn, 2008). Prior research on college class sizes has not considered whether race or first-generation status moderate their effects. However, studies of class

size in elementary schools have found that minority youth benefit more from small classes than do white youth in terms of achievement outcomes, which the authors speculated stems from enhanced opportunities for student-teacher interactions (Finn & Achilles, 1990).

Prior work on college class size has suggested that larger classes are associated with a variety of negative student outcomes, but has not examined whether class size influences student-peer and student-faculty interactions or whether effects are moderated by race or first-generation status. Beyond addressing this gap our study offers some methodological improvements over prior studies. Most importantly, several prior studies included a very small range of class sizes. For example, the largest classes in several prior studies enrolled fewer than 100 students (and many much smaller than that), which is incompatible with most students' experiences in this era of increasingly large classes at publicly funded universities. Students in our sample took classes that encompassed a much broader range: from 7 to 318 students. Further, most prior studies only looked at students in a few academic disciplines—most often economics and business. We considered the effects of class size among a representative sample of students across an entire campus, enhancing generalizability.

Finally, prior research has largely focused on outcomes for a single course in college, yet student campus experiences are likely shaped by the average size of classes across their full schedule. Kuh and colleagues (1994) characterized the compartmentalization of student experiences as either “inside” or “outside” of class as an “artificial boundary” to be transcended. Colleges best foster student success by helping students integrate ideas across different classes and by promoting discussions with professors and peers both inside and outside the classroom (Kuh et al., 2010). As such, our study focused on how students' average class size across their full schedule influenced their academic interactions in a given semester, not only interactions confined to a single class.

In sum, the college classroom is a key, if understudied, site for the occurrence of student integration in the form of academic social capital (Deil-Amen, 2011; Tinto, 1997). Classes serve as the institutional glue that solidifies academically-oriented network ties between students and their professors and peers (Thomas, 2000; Tinto, 1997). As they grow in size, however, student opportunities for socio-academic integrative moments may diminish (Deil-Amen, 2011). Further, the negative effects of large classes may be magnified for traditionally disadvantaged students, such as first-generation, Black, and Latino students, since their experiences with marginalization may present unique challenges for developing academic relationships.

Data and Methods

Survey Instrument and Participants

To examine the association between college class size and academic social capital along with variation by race and first-generation status, we analyzed data collected from the *Social Interactions and Academic Opportunities* (SIAO) Survey. In spring 2011, a random sample of 403 college students completed the SIAO survey at “Northern University,” a public research university in the United States. The campus has a large share of underrepresented minority and first-generation college students, and is designated as a Hispanic-Serving Institution (HSI). Over half of the undergraduate population receives Pell grants. Nearly all of the students hail from the state in which Northern is located. About 80% of first year students live on campus and the majority of other students live in the surrounding community. Only a handful of students commute from their family homes (citations to campus reports excluded to conceal campus location).

The SIAO survey included approximately 70 questions focused on interactions with various significant others prior to and during college attendance, as well as institutional, academic, financial, and personal factors that might influence college success. It largely centered on campus experiences during the previous semester (Fall 2010). To enhance the survey’s validity, questions were generally patterned after prior surveys, including the National Educational Longitudinal Study (NELS: 88), for questions about precollege experiences, and the National Survey of Student Engagement (NSSE), for questions about experiences during college.¹ We administered the survey online via the *Qualtrics* web-based survey tool and appended survey responses to institutional data from campus administrative records, including demographics, precollege academic achievement, and college experiences (e.g. transcript data). The first author conducted the SIAO survey with assistance from 15 undergraduate students enrolled in an advanced research methodology class. This author obtained funding and oversaw the design and administration of the questionnaire, and students assisted in all phases of the data collection.

Our survey design and implementation procedures followed Dillman, Smyth, and Christian (2008). We contacted a stratified (by class year), random sample of 1000 participants using official campus email addresses provided by the registrar. As incentives for participation, participants entered into a lottery for gift certificates to the campus bookstore (ranging from \$5 to \$75 and provided by grant funds). We sent up to 4 reminder emails prompting students to participate. Four hundred

and three students completed the online survey, yielding a 40% response rate. This response rate is consistent with other widely used surveys of college student populations, such as the NSSE, which has an average institutional response rate of about 30% (NSSE).

Of the students who completed the survey, our analytic sample included 346 respondents who attended classes on campus during the Fall 2010 semester with non-missing data on all dependent and key independent variables. To assess representativeness, we compared characteristics of our sample to the overall student population at Northern University using available institutional data. Across several key dimensions—including student major choice, race-ethnicity and first-generation status—our sample did not significantly differ from the overall student population. However, like most surveys of college students, our sample overrepresented female and higher achieving students relative to the campus population (Porter & Whitcomb, 2005). We established the validity and reliability of the SIAO instrument in various ways. First, supplemental analyses have indicated that individual survey items have predictive validity in logical ways as established by prior research.² Second, by using factor analysis on all created scales, we established that the Cronbach's α Reliability coefficient was greater than 0.80. We confirmed the assumption of normality using tests on analytic variables for skewness and kurtosis, with all values falling in the acceptable range of -1.00 to $+1.00$.

The combined SIAO dataset is uniquely suited to this study because it included information on academic social capital in both high school *and* college, as well as institutional data on college course-taking *and* pre-college achievement. Focusing on a single campus allowed us to control for cross-institutional variation that might influence college interactions. We were also able to isolate the relationship between malleable factors that vary within a given campus—particularly class size—and student interactions. Existing national datasets often include measures of academic interactions, but are not typically linked with data on student class size or precollege social capital.

Measures

The dependent variables measuring academic social capital were six dichotomous dummy variables indicating student reports of frequent discussions about the following topics with either professors or peers during the Fall 2010 semester: course material and assignments, ideas from class or readings outside of class, and future career plans. Three variables captured each type of interaction with professors and three measured them with peers. We used different cut-points to capture in-

interactions with faculty and students both because of prior research indicating an overall greater frequency of student-peer interactions (Chambliss & Takacs, 2014) and based on supplemental analysis establishing variable thresholds that included at least 10% of the sample in each category. For interactions with professors, students were coded “1” if they reported talking to professors 1–2 times per semester or more frequently, and “0” if they indicated never having such an interaction during the entire semester.³ For discussions with peers on a given topic, respondents were coded “1” if they reported monthly/almost monthly (or more frequent) discussions, and “0” if they never discussed it or only discussed it 1–2 times per semester.⁴ We opted for dichotomous (rather than ordinal) measures because recent work has demonstrated that even a single interaction can have a lasting influence on a college student’s motivation and success (Chambliss & Takacs, 2014).⁵ Table 1 reports means and standard deviations for analytic variables.

We calculated the key independent variable, average class size, using the average student enrollment numbers from all the classes in which an individual student was enrolled during the Fall 2010 semester, excluding labs and discussion sections. We calculated this value using student transcripts linked with public institutional data on the actual number of students enrolled in each course. The overall average class size for students in our sample was one hundred and four students.⁶ To control for the fact that labs and discussion sections for larger courses are intended, in part, to provide opportunities for student interaction with instructors and peers, we included a count of the total number of labs or discussion sections in which students were enrolled during the Fall 2010 semester. We included dummy variables for the subject area of the student’s major (undeclared majors are the omitted category) to control for variation in class size by major. We included a dummy variable capturing first year status (with second and third year students omitted), since first year students may be less likely to interact with professors and peers. We created controls for individual characteristics using institutional data on student demographics. These included dummy variables indicating whether the student was: female, a first-generation college student (neither parent received a BA/BS degree), Black, Latino, Asian, or other⁷, with white as the omitted category.

We also controlled for high school educational background. Because precollege student aptitude, effort, and academic support might shape academic interactions during college, we included measures of the student’s Composite SAT score (divided by 100 so effects are visible), the student’s high school GPA, and a scale capturing school-based social capital ($\alpha = 0.83$) which included four items capturing how much help

TABLE 1
Means and Standard Deviations of Variables Used in the Analyses

Dependent Variables	Mean	SD
Interactions with College Professors about...		
Course material and assignments	0.791	0.407
Ideas from class (includes TAs)	0.780	0.415
Future career plans	0.422	0.495
Interactions with College Peers about...		
Course material and assignments	0.890	0.314
Ideas from class	0.688	0.464
Future career plans	0.667	0.472
Independent Variables	Mean	SD
College Experiences		
Average class size	103.954	43.499
First year	0.344	0.476
Number of lab/sections	2.133	1.024
Natural sciences major	0.312	0.464
Engineering major	0.141	0.349
Social sciences or humanities major	0.444	0.498
Individual Characteristics		
First-generation college student	0.555	0.498
Latino	0.408	0.492
Black	0.075	0.264
Asian	0.243	0.429
Other	0.081	0.273
Female	0.640	0.481
High School Background		
SAT composite score /100	13.382	5.888
High school GPA	3.495	0.344
School social capital scale	0.049	3.073
Family Background		
Two parent family	0.802	0.399
Number of siblings	1.994	1.422
Family social capital scale	0.159	4.388

Note. $N = 346$. Source: Social Interactions and Academic Opportunities Survey at "Northern University" (2011).

the student had from high school teachers or guidance counselors during the college application process. We also controlled for family background characteristics, including a dummy for a two-parent family (1 if yes), since students from two parent families may have developed superior interaction skills due to the presence of two adults (Coleman, 1988). We controlled for the number of siblings in the student's family during their senior year of high school since more siblings might increase interactions with peers. To account for different levels of precollege family-based academic social capital, we included a scale which captured how frequently the student talked about five educationally-related topics with their parents during the senior year of high school ($\alpha = 0.85$). All of these variables were based on student self-reports on the SIAO survey, with the exception of SAT score and high school grades which were appended from institutional data.

Analyses

For each of the six dependent variables, we conducted logistic regression analyses to examine the influence of class size on academic interactions during college. To control for background characteristics, we included precollege measures of academic achievement, family background, and social capital. We also controlled for variation in student campus experiences when predicting academic social capital. To examine whether underrepresented race or first-generation status moderated the effects of class size on any of our six outcomes, we interacted the dummy variables capturing those characteristics with our measure of average class size.⁸ When any of these interaction terms was significant, in the tables below we present the full model including the interaction term; if neither was significant we present the model without them. All of the key significant direct and interactive effects of class size discussed below remain whether or not control variables were included in the models (supplemental analyses available). We examined variable correlations and variance inflation factors to rule out multicollinearity in the data and used multiple imputation for missing data on control variables.

Limitations

There were some key limitations to this study. First, the analyses were not causal and thus any influence of class size could be due to other, unobserved influences. Selection bias may have occurred; students more prone to academic interactions may self-select into smaller classes. We included controls for precollege social capital and other factors to minimize such bias, but some element of selection may drive these results.

Second, the psychometric properties of the SIAO survey instrument have not been extensively tested and the sample was somewhat small. Although survey questions were patterned after established surveys (NELS: 88 and NSSE) and diagnostics performed indicated that the survey was valid, reliable, and produced measures consistent with the normality assumption, these findings could be further validated using a variety of instruments. The small sample size may present challenges to finding significant effects and estimates of subgroup variation could be unstable, thus future research may want to investigate larger samples to consider whether these analyses underestimated the effects of class size.

Third, the data originated from a particularly diverse campus environment, which could limit generalizability. We argue, however, that our analyses likely offered a relatively conservative test and that other campuses are likely to exhibit more pronounced effects of class size on academic social capital. First, when we compared Northern University's institutional data on class size to other campuses within the same state university system, we found that the campus offers a far lower proportion of classes with fewer than 20 students (24% at Northern; 44% at comparison campuses) as well as a smaller share of classes with 100 or more students enrolled (9% at Northern; 14% at comparison schools).⁹ This relatively constrained variance in class sizes meant that finding significant effects was less likely at Northern than at similar campuses with more varied class sizes. Second, the composition of our sample also likely led to more conservative estimates of moderation in the effects of class size by underrepresented race and first-generation status than on campuses with fewer students from educationally disadvantaged groups. Members of such groups are less isolated at Northern than at predominantly white campuses with fewer first-generation and minority college students. Northern also has special programming geared toward fostering academic success among marginalized students. Students from these groups on less diverse campuses may be even more negatively affected by large classes due to being surrounded by fewer similar peers and having less targeted on-campus support.

Results

Table 2 presents results of the logistic regression analyses. Larger class sizes were negatively associated (directly or interactively) across all six of the academic social capital measures and these effects were significant for five of the six dependent variables. Increased class sizes had a significant negative association with students talking about course material and assignments with professors, regardless of race or first-

generation status. For discussing ideas from class with professors or TAs, larger class sizes had a significant negative effect only for first-generation college students (as indicated by the significant interaction term). For talking to professors about careers, class size had a significant and negative association only for Black students. Class size was a significant and negative predictor of discussing ideas from class with peers. Further, for Latino students (but not other racial-ethnic groups), larger classes were linked with fewer interactions about future career plans. Average class size was not significantly associated with talking to peers about course materials and assignments.

To illustrate the magnitude of the significant effects of class size on academic social capital, we calculated the predicted probability of a student's likelihood of talking to professors and peers about each of the topics depending on their average class size. We calculated these probabilities using the coefficients in each corresponding model on Table 2, holding all variables except class size at their mean or median value (we also vary race or first-generation status as appropriate to illustrate significant interaction effects). Thus, these predictions control for all variables in the models on Table 2. For the significant direct effects of class size, we discuss these probabilities in the text. For the significant interactive effects of class size (with race or first-generation status), we also illustrate the probabilities in a series of figures (Figures 1–3) to ease interpretation.

With respect to ever discussing course material and assignments with any faculty member during the semester, students whose classes averaged about 60 students (about 1 standard deviation below the mean) had an 86% probability of ever discussing course material and assignments with any faculty member during the semester. Those whose classes averaged 150 students (about 1 standard deviation above the mean) had only a 74% probability of engaging in these discussions. Asian and Latino students were significantly less likely than white students to report such conversations with professors (but there were no significant differences in the effect of class size by race or first-generation status). The only other significant variables in the model were SAT composite scores and precollege familial social capital, which were positively linked with interactions.

Figure 1 presents the predicted probability of discussing ideas from class with professors or teaching assistants, illustrating how first-generation status moderated the influence of class size on such interactions. Among first-generation college students, those whose classes averaged around 60 students had an 86% probability of discussing ideas with professors or TAs outside of class, while those whose classes averaged around 150 students had a 73% probability of engaging with professors or TAs in such ways. Among students who had at least one parent who

TABLE 2

Logistic Regression Analyses Predicting Academic Interactions with Professors and Peers

Independent Variable Key Variables	Dependent Variable					
	Interactions with College Professors about:			Interactions with College Peers about:		
	Course Material	Ideas from Class	Career Plans	Course Material	Ideas from Class	Career Plans
β	β	β	β	β	β	
Average class size	-0.008* (0.003)	0.007 (0.005)	-0.003 (0.003)	-0.004 (0.004)	-0.008** (0.003)	0.000 (0.004)
First-generation * Average class size	—	-0.014* (0.007)	—	—	—	—
Black * Average class size	—	—	-0.028* (0.017)	—	—	—
Latino * Average class size	—	—	—	—	—	-0.017** (0.006)
College Experiences						
Number of labs/sections	-0.220 (0.155)	-0.112 (0.152)	0.104 (0.132)	0.269 (0.202)	0.147 (0.137)	0.145 (0.136)
First year	0.222 (0.370)	-0.409 (0.362)	-0.338 (0.297)	-0.102 (0.512)	-0.093 (0.312)	0.084 (0.318)
Natural sciences major	-0.396 (0.614)	0.855 (0.532)	0.890* (0.485)	1.140 (0.747)	0.005 (0.463)	0.452 (0.481)

TABLE 2 (continued)

Logistic Regression Analyses Predicting Academic Interactions with Professors and Peers

	Dependent Variable					
	Interactions with College Professors about:			Interactions with College Peers about:		
	Course Material	Ideas from Class	Career Plans	Course Material	Ideas from Class	Career Plans
Engineering major	-0.605 (0.684)	-0.413 (0.588)	0.689 (0.568)	-0.377 (0.770)	-0.583 (0.541)	0.617 (0.566)
Social Sci./Humanities major	-0.579 (0.591)	0.088 (0.496)	1.123** (0.475)	0.194 (0.647)	0.043 (0.450)	0.119 (0.463)
Individual Characteristics						
First-generation college student	-0.415 (0.343)	1.538* (0.791)	0.530* (0.295)	-0.167 (0.444)	-0.259 (0.299)	-0.047 (0.302)
Latino	-0.823* (0.461)	0.175 (0.432)	-1.370*** (0.377)	0.212 (0.614)	0.525 (0.384)	1.732* (0.767)
Black	0.517 (0.851)	0.995 (0.834)	3.327* (1.892)	0.034 (0.899)	0.175 (0.539)	0.952 (0.640)
Asian	-0.764* (0.460)	-0.257 (0.415)	-1.211*** (0.364)	-0.563 (0.565)	0.249 (0.369)	-0.401 (0.365)
Other	0.458 (0.737)	0.955 (0.719)	-0.059 (0.490)	-0.334 (0.746)	1.207* (0.570)	1.197* (0.631)
Female	0.224 (0.323)	0.113 (0.333)	0.051 (0.275)	0.463 (0.420)	-0.039 (0.287)	0.606* (0.287)

(continued)

TABLE 2 (continued)
Logistic Regression Analyses Predicting Academic Interactions with Professors and Peers

	Dependent Variable					
	Interactions with College Professors about:			Interactions with College Peers about:		
	Course Material	Ideas from Class	Career Plans	Course Material	Ideas from Class	Career Plans
High School Background						
SAT composite score	0.047* (0.027)	0.050* (0.027)	0.004 (0.024)	0.057 (0.035)	0.064** (0.024)	0.003 (0.025)
High school GPA	0.053 (0.437)	-0.545 (0.424)	-0.104 (0.375)	0.472 (0.592)	0.545 (0.379)	-0.435 (0.387)
School social capital (scale)	0.083 (0.051)	0.044 (0.051)	0.060 (0.045)	0.078 (0.064)	0.062 (0.046)	0.102* (0.045)
Family Background						
Two parent family	0.163 (0.354)	0.351 (0.349)	0.261 (0.317)	-0.481 (0.513)	-0.050 (0.315)	-0.702* (0.346)
Number of siblings	-0.078 (0.105)	-0.130 (0.107)	-0.197* (0.095)	-0.013 (0.149)	0.097 (0.097)	0.015 (0.098)
Family social capital (scale)	0.060* (0.034)	0.061* (0.035)	0.064* (0.033)	0.090* (0.043)	0.010 (0.031)	0.052 (0.032)
R-Square	0.154	0.149	0.161	0.080	0.114	0.169

Note: Logistic regression estimates are coefficients. Numbers in parentheses are standard errors. The dependent variable capturing discussions about ideas from class with professors also included interactions with TAs. $N = 346$. Source: Social Interactions and Academic Opportunities (SIAO) Survey at "Northern University" (2011).

* $p < .05$. ** $p < .01$. *** $p < .001$ (one-tailed test).

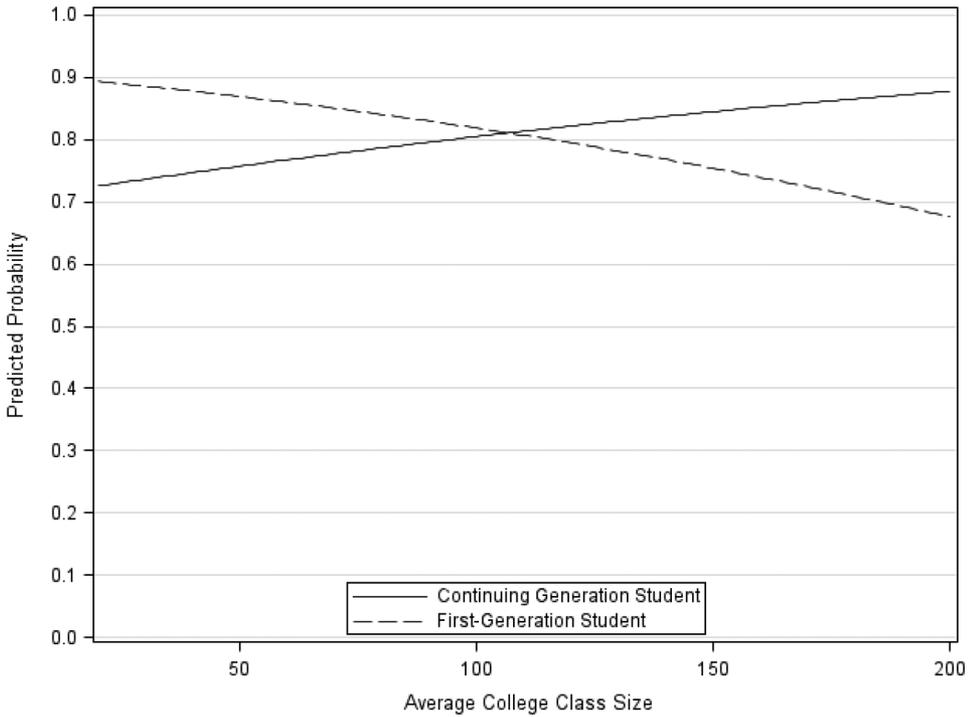


FIGURE 1.
Predicted Probability of Talking to Professors or TAs about Ideas from Class,
by Class Size and First Generation Status

completed a Bachelor's degree, the pattern was starkly different and not predicted by prior research. If enrolled in an average class size of 60, these students had about a 76% likelihood of discussing ideas with professors or TAs, while those enrolled in 150 person classes actually had a significantly *increased* probability (85%) of this same outcome.¹⁰ Larger classes decreased interactions about ideas for first-generation students, but increased them for continuing generation students.¹¹ We speculate that this finding was due to the fact that the question included talking with professors *or* TAs. Continuing generation students may have been more comfortable interacting with TAs in large classes and discussion sections or labs than were first-generation students. However, smaller classes did not have TAs, which could be why first-generation students actually had a higher likelihood of interacting than do continuing generation students in such settings. We return to this unexpected

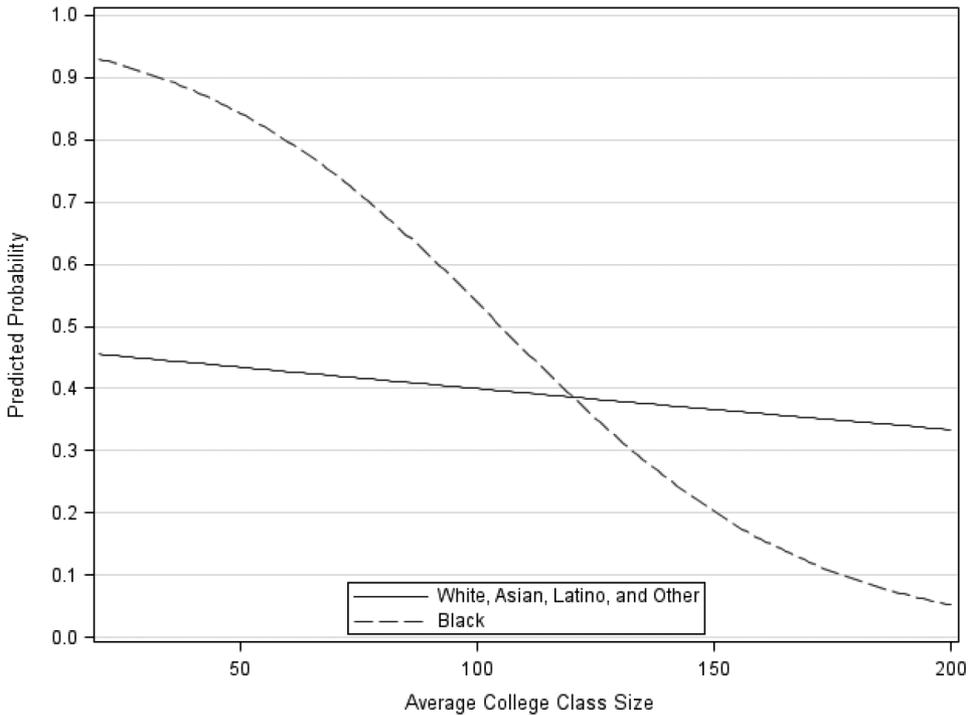


FIGURE 2.
Predicted Probability of Talking to Professors about Future Careers,
by Class Size and Race

pattern in the discussion. As in the previous model, greater family social capital and higher SAT scores had a significant positive effect on these interactions.

For predicting student interactions with professors about future careers, the significant interaction term indicated that class size had a negative influence on Black students but not other groups (see Figure 2). In smaller average class sizes (60 students), Black students have a 75% probability of ever discussing future careers over the course of the semester. This was much greater than the 42% probability for other racial-ethnic groups enrolled in the same size courses. However, when the average class size was greater (150 students), Black students had only a 20% probability and other racial-ethnic groups had about a 38% probability of engaging with faculty about careers. Students whose majors were in the social sciences, humanities, or natural sciences were

more likely than undeclared majors to discuss careers with professors, as were those who had more family-based social capital in high school. First-generation students were significantly more likely than continuing generation students to discuss careers with their professors, while Latino and Asian students were significantly less likely to do so than their white counterparts. As the number of siblings in a student's family increased, their probability of discussing careers with professors declined.

We now turn to academic interactions with campus peers. Class size was not significantly related to student discussions of course material and/or assignments with peers. The only significant predictor in this model was precollege family social capital, which improved a student's likelihood of discussing course material with other students. As with professors, discussing ideas from courses or readings outside of class with peers was significantly related to class size. For peers, however, this association was not moderated by first-generation status. Those in smaller classes talked about ideas with other students on campus significantly more often than students in larger classes: a student enrolled in an average class size of 60 students had a 76% probability of discussing course-related ideas with other students, while one in an average class size of 150 students had only a 60% probability of doing so. Students of "other" racial-ethnic origins (Native American, Pacific Islander, multiracial, international, and unknown) were significantly more likely to have these forms of interactions than white students. The only other significant variable in the model was the student's SAT score, which was associated with a higher probability of discussing ideas with peers (as it was for discussing ideas with professors and TAs).

Variation in college class size also significantly influenced the likelihood of discussing future careers with friends on campus, but only for Latino students. Figure 3 illustrates the predicted probability of discussing future careers by class size and race. Latino students in class sizes well below the mean (60 students) had a higher probability of engaging in career discussions with peers (80% probability) than students in other racial-ethnic groups (70% probability). However, Latino students whose average class size was above the mean (150 students) were substantially less likely (50% probability) than other racial/ethnic groups (70% probability) to report such discussions. As with interactions with peers about careers for Black students, this racial/ethnic gap in effect of class size was a strong one, suggesting that for key forms of academic social capital that may facilitate future career success, Black and Latino students may be much more dramatically affected by class size than students from other racial/ethnic groups. Female students, those of "other" racial-ethnic backgrounds as well as those with higher school-based so-

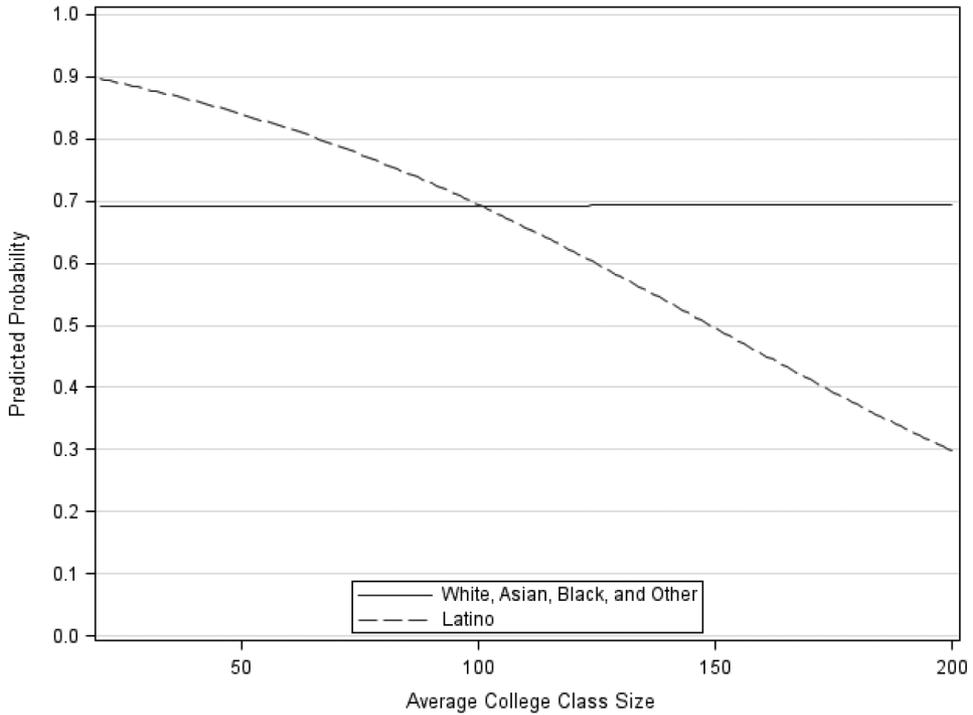


FIGURE 3.
Predicted Probability of Talking to Peers about Future Careers,
by Class Size and Race

cial capital during high school or who lived with a single parent were also more likely to have reported these forms of interaction.

In sum, average class size had significant direct or interactive effects on five of our six student outcomes capturing academic social capital. For all students, regardless of race or first-generation status, the likelihood of academic interactions about course material and assignments with professors was diminished in larger classes, as was the probability of talking to peers about ideas from classes or readings. First-generation students were more sensitive than continuing generation students to the negative effects of large class sizes for talking to professors and TAs about ideas from class. Black students were less likely to discuss future career plans with professors in larger class sizes compared to other students, but more likely to do so in smaller ones. Similarly, Latino students were more likely than other students to discuss career-related matters with their peers when enrolled in lower-than-average class sizes,

but significantly less likely to do so in larger classes. No other predictor in our models was significant for more outcomes than class size. However, the scale controlling for family-based precollege social capital improved interactions across four of our six outcomes. These findings illustrate the importance of conceptualizing academic interactions as a form of social capital and controlling for student variation in prior social capital.¹²

Discussion and Conclusion

We conceptualize student interactions with professors and peers about course and career matters as a form of academic social capital. Although such interactions are central to student success in college, this research is the first we know of that systematically analyzes how college class size shapes academic social capital among a random sample of students, and considers how race and first-generation status moderate this association. Our results indicate that the recent widespread expansion of class sizes on public university campuses is likely linked with significant reductions in student interactions with professors and peers, and that Black, Latino and first-generation students may shoulder an undue proportion of these negative effects. This variation demands additional inquiry, especially given that students from such groups are already relatively disadvantaged in college settings, yet actually benefit the most from the kinds of academic interactions we examine (Anaya & Cole, 2001; Cole, 2007; Lundberg & Schreiner, 2004; Pascarella et al., 2004).

Theoretically, the results illustrate how classroom experiences may contribute to student social networks. As Thomas (2000) argued, peer network ties not only benefit students depending on the network size, but also the structural location, diversity, and reciprocity of ties. He proposed that student affairs personnel, campus activities, and residence halls should be structured to facilitate student peer networks that are broad and diverse. Academic spaces should also be considered sites for developing beneficial cross-clique social ties. For example, cohorts of students who progress through similar courses in their major may have more opportunities to develop reciprocal relationships (Deil-Amen, 2011), especially in smaller classes. Given our findings that career networking opportunities between Black and Latino students and their professors and peers were especially sensitive to class size variation, additional research should examine whether other facets of classroom organization are also linked with such racial variation. Effect sizes in our study were stronger for predicting interactions with peers than professors, suggesting that student-peer academic social capital may be es-

pecially sensitive to class sizes, even on a four-year residential campus where students have other opportunities to foster connections with one another.

Our research also illustrates that social capital theory may help us understand how institutional factors influence college student experiences. Only a handful of studies other than ours have considered the causes and consequences of social capital *within the college environment itself* (Deil-Amen, 2011; Harper, 2008; Martin, Simmons, & Yu, 2013; Ream et al., 2014). Their findings suggest that social capital may be particularly important for underserved populations. While academic interactions can be fruitfully characterized as forms of engagement, involvement, and integration, social capital theory provides new insight into how these relationships link with organizational characteristics, precollege social capital, and postcollege outcomes. Notably, our control for precollege family social capital (interactions with parents about academics in high school) had a significant, positive influence on all but two of our outcomes. This illustrates the importance of including pre-college social capital measures as controls when predicting institutional and interpersonal relationships developed in college. One challenge to such research is that existing national college student surveys do not include measures of pre-college social capital, and measures of social capital during college are relatively limited. This theory could be used to develop survey measures capturing elements of trust and informational resources embedded in relationships on campus (Ream et al., 2014), facilitating new lines of inquiry.

Why might Black and Latino students be more sensitive to class size variation for discussions about future careers? First, large classes might magnify preexisting racial marginalization in important ways that undermine opportunities to interact with professors and peers (and small classes might especially diminish the effect of these processes). Differential effects of class size for underrepresented minorities may thus vary depending on campus racial climate and other institutional factors (Cole, 2007). In particular, the effects of class sizes may differ for minority students at predominantly white institutions: the experience of tokenism in small classes in such settings may make them less beneficial for fostering student-peer academic interactions than at the Hispanic-Serving Institution which served as the setting for our study. In such settings, underrepresented racial/ethnic groups could experience some benefits to forming relationships in larger classes with same-race peers. Further, supplemental examination of group means suggest that Black and Latino students are underrepresented among Engineering majors and overrepresented among Social Science and Humanities majors.

Career discussions may be less common in Engineering due to a more well-defined career path. Further, the organization of instruction may systematically differ across fields in ways that especially affect minority students, such as more classroom discussions in the social sciences or more competition in sciences or engineering. Also, if certain academic programs that provide more small classes attract particularly interactive students, this could drive the findings. These factors may help explain why Black and Latino students have significantly greater probabilities of discussing careers in smaller classes, but significantly lower probabilities in larger classes. While we include controls for student major, future research should investigate these and other possible mechanisms driving the observed variation by race, and how the effects vary by institutional factors (including the racial climate).

One limitation is that we cannot identify with whom students interacted. Given that racial segregation continues on university campuses (Lewis, 2012) and that peer groups exert a heavy influence on student outcomes (Antonio, 2004; Astin, 1993), additional research is needed to explore these issues. Another limitation is that there may be unobserved influences that drive the findings. For example, particularly student-friendly professors may account for many student-faculty interactions on a given campus (Chambliss & Takacs, 2014). If these professors are more likely to teach smaller classes, the effects may be driven by the type of professors that teach small classes rather than by small classes themselves.

Although most of our evidence suggests that larger classes negatively influence academic interactions, we had an anomalous finding that continuing generation students significantly *increased* their out-of-class interactions with professors and TAs about course-related ideas as their classes increased in size. In contrast, first-generation college students experienced the predicted negative effects of large classes. We note that this finding was only present in logistic regression (but not supplemental ordered logit) models, so it relates to *ever* discussing ideas during the semester, but not variation in frequency among those who report any interactions. We speculate that these unexpected effects stem from this being the only dependent measure that includes interactions with TAs along with interactions with professors. Since larger classes were more likely to have TA-taught discussion sections or labs, this finding may be picking up a “TA-effect.” Continuing generation students may have been more comfortable approaching TAs in large classes than first-generation students, and/or TAs may have been less effective at connecting with first-generation students. But smaller classes (below 50 students) only rarely have TAs and first-generation students may find connecting

with faculty easier in such settings. It also could have something to do with variation by first-generation status in which types of small classes a student takes. Future research should gather data that allows for a systematic examination of how the use of TAs in college classrooms relates to inequality in student academic social capital.

Our findings identify class size as a key mechanism through which institutional-level variables investigated in prior research—like lower student-teacher ratios, private, and liberal arts colleges—positively influence student academic interactions (Astin, 1993; Kuh & Hu, 2001). The organizational features of student classroom experiences thus deserve greater attention, especially for shaping stratification in access to academic social capital. Notably, our study demonstrates that a student's average class size across their full schedule significantly influences their overall propensity for engaging in academic interactions, not only those confined to a single class. Thus, effects of classroom organization should be conceptualized in terms of how they relate to student experiences writ large.

There are several other implications of this research for practice. While there is strong evidence that smaller classes are superior for various student outcomes, pedagogical changes in large classes that employ active learning and opportunities for interaction may enhance student learning and engagement (Kuh et al., 2010). However, more research is needed to understand whether such changes improve student interactions in addition to their achievement, and whether the benefits are equivalent regardless of race and first-generation status. Further, class sizes, and their effect on inequality in student opportunities for interaction, may be relevant to assessment efforts on campuses. Program and campus-wide assessment should examine readily available institutional data on class sizes to more fully consider their role in shaping student success.

Another implication is that college reporting of class sizes for institutional comparison and public accountability should be overhauled. This study motivates changes in the Common Data Set (CDS), which collects uniform institutional data from campuses nationwide that are used in guidebooks (e.g. Peterson's Guides) and online rankings ("Common Data Set Initiative," 2014). In the CDS, campuses report the number of classes in seven different size categories. There are currently six reporting categories for class sizes under 100, but only one category for those 100 or larger, even though most public university students are routinely enrolled in classes with several hundred students. Campus web sites report this data and they are used to calculate campus quality rankings, such as U.S. News and World Reports list of "Best Colleges."¹³ Addi-

tional reporting categories should be developed to better capture variation in the concentration of class sizes, particularly at the higher end of the distribution. This will help students and their parents make more well-informed decisions and help the research community better assess how variation in class size influences student experiences.

Recent funding constraints have reshaped classroom experiences for students enrolled in public research universities, leading to a vast and rapid expansion in class sizes (Capaldi, 2011). This pervasive trend has emerged with little consideration of the consequences to students. Our study demonstrates that students in larger classes have fewer academic interactions with professors and peers, and that these negative effects can be more pronounced among Black, Latino and first-generation students. Our research supports the notion that after decades of attention to student affairs and nonacademic aspects of college student experiences, campuses could improve student learning and engagement by investing in the academic aspects of student experiences (Arum & Roksa, 2011). Unlike specialized programs or particular campus organizations which may reach only a handful of students, classes are a ubiquitous institutional feature. Importantly, class size and the organization of instruction are malleable, relatively inexpensive to change, and under control of faculty and administrators. Creating smaller college classes could enhance academic social capital for all students, but especially among Black, Latino, and first-generation students. Increasing class size may save campuses some money, but such savings are likely undermined by real costs to students in the form of lost opportunities for academic connections with their professors and peers.

Notes

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¹ Using cognitive interviews with members of our population, we pretested the survey to ensure validity and reliability of the instrument. We found that students understood our questions and had consistent interpretations of them, but determined that some of the answer choices employed in the NSSE to gauge frequency (very often, often, sometimes, never) were confusing to our respondents and might undermine the reliability of our instrument. To improve the SIAO instrument, our answer choices included concrete references to frequency (Never, 1–2 times per semester, monthly or almost monthly, weekly or almost weekly, daily or almost daily), roughly following Arum and Roksa (2011).

² For example, in OLS, ordered logit, and logistic regression models each of our six measures of academic social capital (our dependent variables) included as independent variables predict how much time a student spends studying and on extracurricular activities. Further, three or more of the six measures of academic social capital were positively associated with students' satisfaction with the campus and their plans to attend graduate school.

³ The measure of interactions about ideas from class or readings was based on a question that asked about the frequency of such interactions "with professors or TAs," which may have implications for interpreting the findings since the other questions only query about professors.

⁴ To test whether each dependent variable taps distinct types of academic interactions, we examined the correlations between the measures. The average Pearson Correlation Coefficient for dependent variables in the analyses was about 0.25, suggesting the variables each captured distinct interactions.

⁵ To check the robustness of our findings, we also ran ordered logit analyses on ordinal dependent variables with five categories which confirmed our substantive results in all models presented except one (available from the first author). We discuss this difference when presenting the findings. In addition to aligning with prior research (Arum & Roksa, 2011; Chambliss & Takacs, 2014), we report logistic regression results because the dichotomous measures are more straightforward to interpret and transform into predicted values than are ordinal measures (Menard, 2010).

⁶ Supplemental analyses (available from the first author) using different specifications of the class size measure ruled out nonlinear and outlier effects, confirming our chosen measure.

⁷ Included Native American, Pacific Islander, multiracial, international, and race unknown.

⁸ In supplemental analyses, we also interacted gender and prior social capital with class size, but the measures were not significant. Future research should further examine these factors.

⁹ Data obtained from public Common Data Set reports on each campus. Citations omitted to conceal campus location.

¹⁰ In supplemental ordinal logit models predicting a range of interactions from "Never" to "Daily," the direct effect of class size was negative and significant, but the interaction term between class size and first-generation status was not significant. This suggests that class size differentially affects first- and continuing generation students' likelihood of having any interactions compared to no interactions about ideas with professors and TAs, but these group differences did not appear to be present across the full range of interaction frequencies.

¹¹ This pattern is replicated in supplemental analyses that excluded control variables, albeit with the slope for continuing generation students slightly less pronounced, suggesting it was not simply an artifact of the controls.

¹² As an additional validity check on these results, we ran supplemental analyses examining whether class size significantly affects academic interactions with parents and peers from home about future careers and course material (measures regarding interactions about ideas with these individuals were not included in the survey). As we would expect if these findings are driven by institutional rather than individual characteristics, college class size was not significantly related to any of these four outcomes (either directly or interactively), further bolstering our confidence in the results.

¹³ Campuses with more "small" classes—under 19 students enrolled—and fewer "large" classes—with 50+ students enrolled—are ranked as being of higher quality.

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