Should I Start at MATH 101? Content Repetition as an Academic Strategy in Elective Curriculums

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Abstract
How do undergraduates make their first course decisions, and are these decisions fateful? Drawing on serial interviews (N = 200) of 53 students at an admissions-selective university, we show that incoming students with disparate precollege experiences differ in their orientations toward and strategies for considering first college math courses. Content repeaters opt for courses that repeat material covered in prior coursework, whereas novices opt for courses covering material new to them. Content repeaters receive high grades and report confidence in their math ability, whereas novices in the same classes receive lower grades and report invidious comparisons with classmates. These strategies vary with students’ socioeconomic background and prior exposure to institutions of higher education, suggesting the role of content repetition in maintaining class disparities in science, technology, engineering, and mathematics (STEM) pathways. Findings encourage researchers to resist equating content repetition with remediation, attend to the agentic and social-psychological dimensions of academic progress, and recognize that elective curriculums create conditions for the performative reproduction of academic and socioeconomic inequalities.

Keywords
class inequality, cultural capital, higher education, qualitative research on education, STEM

Math 98 is a little slow. I probably maybe should have gone into Math 99. But my first quarter, I don’t think it’s too bad of a thing to have a class that I will not be stressing about all the time.
—Clark (100 percent repetition)

I’m struggling in Math 98 and there is still Math 99 and 100 and Math 101. In a major where there’s a lot of math involved, is that really what I want to get myself into?
—Amelia (0 percent repetition)

Upon entry into college and every term thereafter, students confront the task of selecting courses. Elective curriculums, in which students have some measure of discretion in assembling courses, are common features of U.S. postsecondary academic programs, from community colleges to the Ivy League (Chaturapruek et al. 2021). Elective curriculums reflect enduring U.S. cultural values of individualism and self-discovery (Cech 2021; Mullen 2014), but they also bring challenges and risks to the students who navigate them: They

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often have complicated trees of prerequisites and requirements (Aldrich 2015), hazy or contradictory information about course options, and ambiguity about optimal choices (Chambliss and Takacs 2014).

Educational sociologists have amply documented that students bring different amounts and kinds of cultural understandings, expectations, and organizational know-how with them from high school to college (Aries and Seider 2005; Armstrong and Hamilton 2013; Benson and Lee 2020; Jack 2016; Muller 2010; Nunn 2021; Stuber 2011; Walpole, 2003), so we might expect students from different backgrounds would bring different presumptions and strategies to the task of choosing courses (Bourdieu 1986). We might also expect variations in approaches to navigating elective curriculums to be especially pronounced at college entry, before students have a chance to learn about multiple ways of making decisions and plotting academic pathways.

Utilizing a qualitative longitudinal study of undergraduates moving through a selective university, we observe variation in how students consider, choose, and consequently experience their first math courses in college. We target math courses because math is ubiquitous in science, technology, engineering, and mathematics (STEM) curriculums and because the effects of early math courses can definitively enable or inhibit progress toward particular majors (Ellis, Fosdick, and Rasmussen 2016; Moreno and Muller 1999; Sanabria and Penner 2017; Weston et al. 2019).

A large proportion of the students we studied conscientiously elected to take a first math course whose content was mostly or entirely review for them. We call this phenomenon content repetition. In prospective interviews, content repeaters explained a desire to smooth the transition to college and bolster skills for subsequent STEM coursework; their retrospective interviews indicated the practice worked as intended. Content repetition also has consequences for students in the same math classes for whom the content is largely or entirely new. In prospective interviews, these students, whom we call novices, presumed that proceeding forward into new content was the normal or optimal way to choose college math courses; retrospective interviews indicated these students struggled to keep up with course pace and made invidious comparisons with fellow students. Content repetition is associated with higher grades and positive academic experiences for repeaters, but it exacts costs from novices who occupy the same courses, contributing to inequality in STEM pathways. This is especially true because content repetition is enacted largely by students from more privileged backgrounds, measured by social class and parents’ educational status.

Content repeaters are more likely to have been raised in upper-, upper-middle-, or middle-class families with better educated parents and to have had more experience navigating multiple curricular options in high school. Novices are more likely to be first-generation students from lower-middle- or working-class families and to have no experience with course-taking outside their public high school prior to matriculation. This pattern suggests strategies for making academic choices under elective curriculums is an important but heretofore unrecognized mechanism of the reproduction of inequality in higher education.²

The phenomenon we identify is different from prior treatments in scholarly literature, in which repetition is associated with subpar performance. Studies of K–12 education often use repetition of grade year or coursework as a mark of stalled academic progress (e.g., Chohan 2018; Finkelstein et al. 2012; McFarland 2006). At the college level, researchers tend to view repeated courses as signals of remediation (Attewell et al. 2006; Deil-Amen and Rosenbaum 2002), wasteful “redundancy” (Ngo 2020; Park, Ngo, and Melguizo 2020), or efforts by students to replace low grades with higher ones (Baldwin et al. 1989; Schutte 2016). By contrast, this study finds content repetition is a volitional action by students with prior histories of mathematics accomplishment.

Although our study is based on a small sample of students located at a single, highly selective research university, our data allow us to see the nuance of class-based differences in math course selection strategies. Like many fine-grained case studies, it identifies previously unrecognized empirical phenomena, which raises new research questions and builds theory.

PRIOR WORK AND EMPIRICAL MOTIVATIONS

Course sequences are “‘strands of courses in particular content areas that span a student’s school career’” (Schneider, Swanson, and Riegle-Crumb 1997:25). Educational sociologists have long attended to course sequences because they are
key mechanisms of educational sorting and stratification (Breen and Jonsson 2000; Frank et al. 2008; Hallinan and Sorensen 1986; Sorensen 1984). Within schools, course sequences often differentiate students based on perceptions of student ability or performance, as measured by prior grades or scores on standardized placement tests (Gamoran 2010; Useem 1991). Sequences can be especially fateful for academic progress across students’ school transitions because schools vary in how they structure curricular ordering and evaluation (DeLany 1991; Garet and DeLany 1988).

Much prior sociological work on course sequences focuses on STEM subjects because of the sequential nature of coursework and enduring demographic disparities in student progress into STEM fields (Aldrich 2015; Beede et al. 2011; Catsambis 1994; Ross et al. 2012). Pathways to and through college math are especially relevant because these curriculums tend to be hierarchically organized (McFarland 2006; McFarland and Rodan 2009; Stevenson, Schiller, and Schneider 1994) and because progress in high school mathematics is implicated in patterns of college entry (Attewell and Domina 2008; Byun, Irvin, and Bell 2015). Overall, this work demonstrates that the curricular structures in which sequences unfold (i.e., the matrix of courses and prerequisites that organize possible sequences in particular organizational contexts) substantially mediate the influence of student demographic characteristics (e.g., social class, race, gender) and measured academic performance on academic progress (Domina and Reyes 2017; Lucas and Good 2001; Riegle-Crumb and Grodksy 2010; Tyson and Roksa 2016).

Early college math courses are among the conduits through which occupational ambitions developed in high school are translated into undergraduate majors (Weeden, Gelbgiser, and Morgan 2020). For example, coursework in calculus is commonly required for majors in physics, computer science, and chemistry. Grades in early math courses, often referred to as “gatekeeper” courses, are consistently related to the likelihood of pursuing STEM majors (Ellis et al. 2016; Moreno and Muller 1999; Sanabria and Penner 2017). Additionally, STEM attrition is highly correlated with the difference between STEM grades and the grades students receive in other courses (Witteveen and Attewell 2020).

Math is also a common arena for the perpetuation of racialized and gendered stereotypes of academic ability (Cvencek et al. 2015; Cvencek, Meltzoff, and Greenwald 2011; Musto 2019). In middle school, white boys are increasingly likely to be labeled “brilliant” as they move through math curriculum (Musto 2019), and such notions also pervade higher education. Disciplines, including mathematics, whose faculty believed raw talent rather than hard work were necessary for success were correlated with lower enrollments of women and African American students (Leslie et al. 2015) and had larger racial achievement gaps (Canning et al. 2019). Students’ and instructors’ cultural beliefs about math learning are often characterized by the notion that mathematical ability is innate rather than learned (Boaler 2016; Dweck 2008). Thus, it is not surprising that students consistently report especially high levels of anxiety around math throughout K–12 and post-secondary education (Betz 1978; Jameson 2014).

Social science research on course sequences typically relies on quantitative data describing academic progress, often captured via academic transcripts (Bailey, Jeong, and Cho 2010; Finkelstein et al. 2012; Riegle-Crumb 2006) and sometimes augmented by panel survey data (Denice 2021; Thompson 2021). From these, researchers measure statistical relationships between courses, grades, demographic descriptors, and survey responses to infer how students navigate curriculums. Yet little empirical research explores how students make sense of their accumulating academic experiences as they move through particular sequences. Despite often explicit recognition “that students are agents in course-taking decisions” (McFarland 2006:183), researchers rarely have access to the fine-grained data required to observe how agency is enacted and subjectively understood and evolves over time. This is an important empirical lacuna because ethnographic research indicates that students’ affective experiences of early coursework can powerfully influence subsequent academic decisions (Chambliss and Takacs 2014). As we will show, students vary substantially in how they approach sequences of math courses, with consequences for both themselves and fellow students in the same classes who enact different sequences.

Some prior scholarship shows that content repetition can have negative consequences for college students’ academic progress. One recent study found that community college students who were mandated to repeat some coursework reported boredom and were more likely to disengage and
do poorly in repetitive courses (Park et al. 2020). However, our work at an elite institution points to alternative outcomes for students who elect to repeat math courses. In another study, students who took high school calculus received a grade boost when repeating content in their college calculus course, and nearly a third of students in a nationally representative sample were content repeaters (Sadler and Sonnert 2018). Although this work is based on survey data and lacks indication of whether students were mandated repeaters or given choice in course selection, it suggests mathematics content repetition may be widespread throughout U.S. higher education.

THEORETICAL MOTIVATIONS

Elite campuses have long been bastions of the nation’s most advantaged families (Gaztambide-Fernández 2009; Karabel 2005; Khan 2011; Stevens 2007), but they are also sites where young people from a wide range of social backgrounds are brought into routine and close physical copresence (Jack 2016; Morton 2019). This proximity allows for the study of how different forms of capital influence trajectories through higher education.

Prior work has focused on how variation in students’ earlier life experiences influences their subjective experiences on elite campuses, but we believe we are the first to consider how privilege and disadvantage are mediated by strategies of college course selection. Whereas some literature focuses on the differences in information available to students when making their decisions (Chambliss and Takacs 2014; Schwartz et al. 2018), we conceptualize course selection as an enactment of habitus: an unconscious expression of style and strategy that varies systematically by social position (Bourdieu 1977, 1984; Bourdieu and Passeron 1990; Lizardo 2004).

The enactment of habitus in education can be observed from children’s earliest school years. Parents and children in upper-middle-class families are more likely to be active agents in relation to educational authorities and routines, whereas those from less advantaged backgrounds tend to defer to educators and bureaucratic rules (Calarco 2014; Lareau 2003; Lareau and Weinner 2008). The pattern is not hard and fast; it is mediated by school context and educational experience. For example, students from disadvantaged backgrounds who attend private schools with long traditions of grooming elites tend to acquire many of the educational orientations common among the more privileged (Jack 2016; Khan 2011). Students then bring these orientations to college and enact them in everyday interactions with peers and faculty (Jack 2016; Lareau and Weinner 2008; Lee and Kramer 2013; Lehmman 2014).

Here we apply the theory of habitus to the task of course selection. We begin from the premise that elective curriculums present students with concatenating sequences of selection events that are opportunities to varyably enact habitus. Selections made early in one’s undergraduate career can have downstream consequences that students may not fully foresee. We posit that how students approach course choices will likely be inflected by habitus in ways that are especially fateful early in the undergraduate career.

SETTING, METHODS, AND SAMPLE

The study site is a highly selective private research university in the United States, which we call Western University. Western has one of the most admissions-selective undergraduate programs in the nation, and virtually all students who matriculate took academically rigorous curriculums in high school. During the 2019–2020 academic year, Western enrolled approximately 7,000 undergraduates across three 10-week terms. Like most private selective institutions, Western’s students are disproportionately white or Asian and come from relatively affluent families (Chetty et al. 2020), even as the university is explicitly committed to sustaining ethno-racial and socio-economic diversity in its student body. This means that like the elite university studied by Jack (2016), students from a wide variety of backgrounds share social and academic space on Western’s campus.

This article is part of a larger study of undergraduate academic pathways investigating academic decision-making. Beginning in summer 2019, we interviewed students prior to matriculation and then during the add/drop period of each academic term. By the end of the 2019–2020 academic year, we had sustained a continuing cohort of 85 participants, 53 of whom are relevant to the current study. All interviews were conducted via Zoom, transcribed initially by AI software, and
Participants received $20 stipends at the completion of each interview. Interviews were semistructured and focused primarily on students’ academic plans, choices, and experiences. We asked students to talk specifically about each course they were considering, courses in which they were currently enrolled, their motivations for course choices, and their experiences in current and prior courses (for the course-specific questions in our protocol, see Appendix B in the online Supplemental Material). This enabled us to identify which students had enrolled in a math course during their first two (fall, winter) terms at Western ($N = 53$). Appendix A in the online Supplemental Material compares the demographic characteristics of Western’s undergraduate student population with those of our cohort and focal sample.

We rely primarily on two data sources describing these students. The first source comprises 200 interviews with students across four panels (prearrival summer 2019, fall 2019, winter 2020, spring 2020). In total, 42 participants completed all four interviews, 10 completed three of four, and 1 completed two of four.

The second source is transcript data provided from official institutional records. Transcript information, obtained with participants’ permission, enables us to identify official course grades for 50 of the focal students. We also utilize a large body of official campus literature obtained from the university website and an ongoing flow of programming designed to assist students in navigating their academic pathways.

Western has an elective undergraduate curriculum. Students are obliged to fulfill certain academic requirements, but they retain discretion over which particular courses they choose. Official campus literature advocates wide curricular exploration, especially in the first 2 years. Western’s undergraduates do not pay by the credit hour; instead, a single tuition fee covers between 12 and 20 units per academic term. Students need to take an average of 15 units per term to graduate within 4 years.

Students are not expected to enter Western with an intended major. Instead, the university’s professional advising staff and official websites explicitly encourage students to explore the curriculum widely before declaring majors at the end of sophomore year. However, because prior scholarship indicates students bring predilections toward courses of study—particularly STEM—with them from high school (Legewie and DiPrete 2014; Weeden et al. 2020), we asked participants to list all potential majors they were “considering” upon matriculation. Responses ranged in number from 1 to 15 potential majors, with some students reporting none. Based on these responses, we categorized respondents as STEM-considering (if their list contained at least one STEM major), non-STEM (if their list did not include any STEM majors), and unsure (no considered majors reported). Of the 53 students who enrolled in a mathematics course during their first two academic terms, the majority were STEM-considering ($N = 44$).

There is no formal math requirement at Western. Instead, students are required to choose from broad general distribution requirements to fulfill a “formal reasoning requirement” that includes both math and nonmath courses. However, over 60 percent of undergraduate degrees conferred at Western are STEM degrees, the majority of which require a math course for completion. For students considering majors in a wide range of STEM fields, a few specific mathematics courses are virtually unavoidable.

Chemistry, computer science, physics, earth science, and many applied-science majors in engineering require that students complete a multivariable and linear algebra course—here called Math 101—or a course with equivalent content offered by a department in Western’s engineering division (EM 101). Introductory math courses generally take a lecture format, with optional small weekly discussion sections. Evaluation is based on weekly problem sets (“p-sets”) and at least one midterm and a final. Western’s Mathematics Department offers a course sequence through calculus (Math 98, 99, 100), which is designed to prepare students for Math 101 or EM 101. The Mathematics Department requires a placement test for all students who wish to enroll in any departmental offering, but the resulting recommendations are not obligatory. In practice, this means undergraduates pursuing mathematics at Western have considerable agency over course selections.

IDENTIFYING CONTENT REPEATERS AND NOVICES

We learned inductively through our interviews that many students opted to enroll in courses afterward checked by trained research assistants. Participants received $20 stipends at the completion of each interview.
covering material they had studied before arriving at Western. We define content repeaters as students who reported that at least half (50 percent or more) of the content of their first college math course was repeated content. Among the 53 students who enrolled in any math course in their first two undergraduate terms, 24 (45 percent) reported the majority of the material in that course was a review of their studies prior to college entry. We define novices as students who reported that less than half of the content in their first college math course was repeated content. We emphasize that novices are not novices to mathematics; virtually all the students we call novices entered Western with considerable mathematics coursework (see Figure 1).

We recognize that content repetition is a continuous variable. Respondents reported a range of first-course content repetition, from 0 percent to 100 percent. The 50 percent demarcation between repeaters and novices reflects the distribution of student self-reports (see Figure 2). The majority of the 53 students who took math courses during their first two terms reported that either none (N = 17) or all (N = 14) of the material was repetition.5

Table 1 compares key demographic characteristics of content repeaters and novices.6 The composition of the two groups is similar in terms of gender and plans for graduate school, including plans to attend medical and law schools. White students were more likely to be content repeaters, and Asian students were more likely to be novices. Other ethnic/racial categories had too few cases to make comparisons. However, there is a notable difference between content repeaters and novices by social class. Repeaters were relatively more likely to have been raised in middle-class or upper-middle-class households, whereas novices were relatively more likely to come from lower-middle-class or working-class households. Content repeaters were also less likely than novices to be first-generation college students.

Content repeaters and novices also vary in their high school backgrounds and level of mathematics preparation. We divided students by type of high school (public, private, international) and “plus” notes if they co-enrolled in any college classes during their high school careers. As Figure 3 shows, content repeaters were more likely to be from private high schools or public high schools supplemented by college experiences. Figure 4 compares the highest level math course respondents reported completing before arrival at college. Content repeaters were more likely to have completed coursework beyond the high school calculus sequence.7

To summarize our findings so far: When entering Western, students pursuing or at least exploring study in STEM fields confront a choice of when and where to initiate coursework in mathematics. They have considerable agency in making this decision. Among the 53 students who enrolled in math courses during their first two terms, 24 (45 percent) reported that at least half the material in that first course was review. These students were more likely than their novice counterparts to come from middle-class and upper-middle-class families, have parents with 4-year college degrees, have experience negotiating elite high schools or university dual enrollment, and to have been exposed to postcalculus mathematics before arrival at college.

These findings seem counterintuitive when read against prior scholarship on academic progress and STEM pathways, which tends to presume

Figure 1. Students’ highest reported math course prior to matriculation (N = 53).

Figure 2. Distribution of students by proportion of first math course material reported as content repetition (N = 47).
repeated coursework is a function of substandard learning, flawed or discriminatory tracking, or “redundant” decisions made on the basis of poor information. In the next section, we take advantage of the richness of our qualitative panel data to investigate why students opt to repeat mathematics content—or not. In doing so, we find mechanisms of cumulative academic advantage and disadvantage novel to scholarship on academic progress.

APPROACHING COLLEGE MATH

When deciding on their first college courses, some students created spreadsheets ranking every course that appeared in Western’s academic catalog weeks in advance of registration; others logged on to the catalog the night before registration opened. Some students crafted detailed academic plans for their entire 4 years at Western; others were more ad hoc, relying on social-media feeds in which Western undergraduates swap course advice.

Regardless of their overall search strategies (which are beyond the scope of the current article), students pursuing or considering STEM fields almost invariably confront a choice about where and when to begin course sequences in mathematics. We inductively learned about content repetition in mathematics courses; we then identified it in 24 of the 53 cases. Further coding revealed five, nonexclusive reported reasons for repeating a math course (see Table 2; some students reported multiple reasons).

The most common reason for repeating courses was to ensure mastery of the material before taking on higher level coursework, as in Olivia’s case:

I’m going to be taking Math 100. It’s Calculus 2 basically, I feel like I need a more solid base before I get into higher mathematics, because . . . data science gets into things like linear algebra and stuff so I feel like it’s important for me to have a very solid base in calculus before I try to go that far. (Math 100, 100 percent repetition)
Content repeaters often noted that their knowledge fell partially between the content of two courses in Western’s math sequences, and they opted to err in the direction of content review before proceeding. Such was the case for Antonio, an international student, who noted the overlap of the earlier course in Western’s sequence with his prior learning but opted to take the course with repeated content to ease his transition to college:

I was debating doing Math 99 rather than Math 100. I ended up doing Math 99 because over the summer, I went over the course syllabus of Math 99 and I felt that there were quite a few topics that I hadn’t seen. Math 100 assumed that you had all the knowledge from Math 99. I didn’t want to already start my first quarter adapting to Western and the US, besides trying to learn topics from a previous course while doing a course that’s harder. And also, since I finished school in November last year, I had forgotten quite a lot so Math 99 was also a review of other topics I had seen. (Math 99, >50 percent repetition)

The desire to review prior coursework or not cover too much novel material early in college were by far the most common reasons students gave for repeating math content, but a quarter of content repeaters reported major requirements as at least part of their reason for their decisions. As Nico told us:

I took multivariable calculus in high school, so it’s kind of a little refresher course on the information. I got the credit, which I wanted, and I guess I got a little refresher on the material. (EM 101, 100 percent repetition)

Nico did not indicate that he strategically opted to repeat course material: he ‘‘wanted the credit.’’ But he also noted the potential benefit of repetition: ‘‘a little refresher of the material.’’ This finding echoes prior scholarship about how the sheer complexity of elective curriculums and the
anarchic character of academic organization create inefficient redundancies and duplications (Ngo 2020). Even at well-resourced schools with generous informational and advising supports, students find themselves taking courses at least partly to fulfill requirements (Chambliss and Takacs 2014). Yet the preponderance of reports among content repeaters indicates that repetition in math is often a proactive academic strategy.

By contrast, the novices in our sample did what prior research on academic sequences suggests students should do: They enrolled in the next logical sequential course for which the material was entirely or mostly new for them. In interviews, some novices indicated that they presumed math courses should be taken in sequence. They seemed not to have contemplated content repetition. As Ezra put it:

I have to take the entire math series because I might want to major in math, so I gotta take 101, 102, 103. So I had to take 101 this quarter. (Math 101, 0 percent repetition)

Some students (N = 4) reported deferring to the Mathematics Department’s placement exam. Others talked about not wanting to waste time or credits in classes that were mostly repetition. Marco, for example, considered whether to enroll in a course that repeated content he had covered in high school or to enroll in Math 101, which introduced entirely new content:

I took calculus in high school. In theory, I can skip the introductory calculus courses. I could go to Math 101 or I could do the [calculus] series. The last course in the [calculus] series, which is 100, it’s sequences and Taylor series, which I’m not that confident on, so I don’t know if I should take it and then take 101. Or if I could just study by myself and take Math 101. So I’m a bit apprehensive . . . but I guess when I talk to my advisor I’ll be able to figure that out. But I’m a bit apprehensive as to if I take Math 100, am I wasting my time when I could be taking another course or is it going to actually help me in the future?

Marco ultimately opted to enroll in Math 101. In a subsequent interview, he said he found it “demanding and sometimes frustrating” and complained that the course pace was “very rushed and you couldn’t understand it properly.” He also noted that “Math 101 might be the bottleneck in math. I would have to take other math classes to see, but I will not take more math classes.”

Alma, a first-generation college student, reported being encouraged by her mentors in a program for first-generation students at Western to challenge herself in her coursework:

[Their advice] made me realize that I needed to be spending all my time valuably. They talked about choosing classes, and they were talking about how a lot of people tended to go to their comfort zone. Like, “Oh I covered multivariable calc in high school so I’m going to go straight into Math 101.” And nothing else. And, not want to grow. They taught me to put myself out there and take risks with my classes because I have to learn eventually. I think I wanted to be comfortable where I was at. I considered taking [name of computer science class] because I already know how to code. I would breeze through that class and I considered taking classes that would make for a good fun quarter. And then they made me realize that I’m not necessarily supposed to be here for a good fun quarter, I need to be moving forward and fulfilling requirements. (Math 100, 0 percent repetition)

Alma ultimately opted for a course covering material entirely new to her, although her inclinations mirrored that of content repeaters. In subsequent interviews, Alma told us she felt like she was “struggling from day one” in the course and “spending all my time studying.” Alma considered enrolling in a course that repeated content and then opted against it, but most novices (N = 24) did not mention this possibility. These students’ implicit strategies toward course consideration—their habitus—seemed to exclude content repetition.

Course Selection and Habitus

Particularly striking is that no content repeaters reported being advised by a friend or professional authority to repeat math content. By contrast, some novices told us they received advice not to repeat content. This observation suggests content repetition is less a function of social capital—who one knows and from whom one receives advice—
than of differences in students’ assumptions about how to navigate course decision-making.

We have further evidence that presumptions about appropriateness of content repetition are linked with students’ class positions. First, as discussed earlier, many students from upper-middle-class and middle-class backgrounds did not view the recommendations of the Math Department’s placement tests as binding and instead presumed their math course choice was their own. This comports with prior work on class-based differences in children’s interactions with educational authorities. Calarco (2018:24), for example, shows how middle-class students are more likely to negotiate with authority figures in their own interests and “often treated rules as flexible,” whereas working-class students often “treated rules as fixed and adjusted their behavior accordingly.” This presumption of agency allowed some students to see a choice where others did not.

Second, none of the content repeaters gave any negative connotation to repetition. As Table 2 shows, content repeaters consistently viewed content repetition in a favorable light, most commonly by reporting a desire to master content before moving on to new material. By contrast, novices—who tended to be from less advantaged backgrounds—were more likely to lend content repetition a negative cast or not to consider content repetition at all. For example, they equated content repetition with “wasting time” or expressed concern about “being bored” with the repeated content. All four of the working- or lower-middle-class novices who gave reasons for their math course choice mentioned wanting to “get through” or “get started” on the next math course they would need to progress toward their major. Students from working-class and lower-middle-class families were likely to have taken the most difficult curriculums in their high schools, and they may have acquired a different habitus toward course selection: one that emphasizes erring on the side of challenging course work.

**GRADES, TIME/EFFORT, PEER COMPARISONS, AND FUTURE ACADEMIC PLANS**

Our study design enabled us to link student reports of how they considered and chose first math courses with their subsequent grades and retrospective experiences in those courses. These data indicate that repeaters enjoyed important benefits from their progress strategy, whereas novices in the same courses incurred disadvantages, sometimes as a direct consequence of having content repeaters as peers. We report findings about student grades, effort, affective classroom experiences, and peer comparisons.

**Grades**

Content repetition is positively associated with final course grade. Repeaters received a mean grade of 3.8 (A/A–) in their first math classes, whereas the mean for novices was 3.5 (A–/B+). Figure 5 reports the distribution of first-course grades by students’ relationship to the content material.

A few factors at our case school render the grade disparities reported here specific to particular kinds of campuses. First, Western is highly selective in admissions; this means most students arrive having already excelled in competitive academic environments. For example, almost all the students in our study had taken at least calculus before arriving at college. Second, very few students fail to graduate from admissions-selective schools (Stevens 2007). There also is evidence that grade inflation—a secular increase in overall college marks—is a national phenomenon at selective residential institutions (Arum and Roksa 2011; Evrard, Schulz, and Hayward 2021). Our respondents made clear that a B– is often regarded as akin to failure at Western; discourse around grades consistently portrayed anything less than an A in unfavorable light. Finally, our respondents reported the use of grading curves in all introductory math courses at Western. Although we are not privy to the way professors curved assessments, the use of curves may contribute to both grade inflation and the minimization of formal failure.

To the extent that grades in early college math courses are related to academic persistence in STEM, especially for underrepresented groups, these findings are substantively valuable on their own (Ellis et al. 2016; Moreno and Muller 1999; Sanabria and Penner 2017; Witteveen and Attewell 2020). Yet repeaters and novices differ in several other consequential ways.

**Time and Effort**

Students cannot know the counterfactual of their own experiences, but content repeaters often
gave us clues they were spending less time and effort than were novices on their math coursework. Consider Narek, a repeater who enrolled in Math 101 and told us that half the content was review. When we interviewed him approximately a third of the way into the term, he said:

> I thought it would be harder than I expected, I guess it is an introductory class so it’s been easier. I thought we would have more homework. I feel like I have all the resources that I need. If I have any questions, a lot of people are available for office hours. . . . We had a midterm the other day, it felt very straightforward. Maybe later on during the final, it will get a bit more difficult, but at least so far in terms of exams—I’ve only taken the math midterm—but it was easier than I expected it to be. . . . I’m sure it’s going to get much harder as I go into the upper div[ision] classes but I feel like I have a lot more time and just, it has been going rather smoothly, more smoothly than I expected it. (Math 101, 50 percent review)

Another student, Victor, told us Math 101 was mostly review for him, and he was pleased with the pace and flow of the course:

> I feel like it’s going really smoothly, or it feels like it’s just the right pace—so it’s not too fast, but it’s also not too slow.

We’re covering enough content, but not too much where we’re being overwhelmed with the material. So, I think the pace is really good. I mean, it’s going to get harder as the quarter progresses. But so far, the pace has been very good.

*Interviewer:* And are classes generally what you expected, or have you found anything surprising thus far?

Not really. I mean, maybe Math 101 is a little bit less work than I was expecting. Maybe it just got a bad rap. And it’s definitely a significant amount of work, but I think it’s just blown out of proportion. . . . I mean, I don’t go to Math section. But if I did, I’m sure it’d be great. (Math 101, 80 percent review)

By contrast, many novices felt the pace of their first math class at Western was challenging or even overwhelming. As Audrey put it:

*Math 101*, it’s just very fast I think. I think the first couple days of it, I was like, “Oh my god, what is this?” And it’s not the professor’s fault because she only has one hour to get through a chapter. So the pace we’re going, we’re doing three chapters in three hours per week. And then I have my midterm in three weeks, based on nine chapters. . . . And then I’ve also been going to office hours, which is actually helpful. When I first saw my professor teach, I

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**Figure 5.** Proportional distribution of letter grades in first math course at Western by student relation to course content (*N* = 53). CR indicates a non-letter grade pass (credit).
was like, oh my god, what is this? But I went to office hours and she was actually really good. She explains it to us, and she explains it really well. I think during class, when the information is thrown at you for the very first time, it’s really fast. It’s like, oh my god. Ah! (Math 101, 0 percent repetition)

Many novice students were surprised and overwhelmed by the pace of their math courses. They also described the challenge of adjusting from high school math instruction to the college-style teaching of mathematics they encountered at Western (which they were generally underwhelmed by). The same was true of some content repeaters as well. Of the seven content repeaters who received grades lower than an A—in the relevant course, the majority seemed to have made an instructionally appropriate choice to repeat, even given their prior background in the subject. Consider Fatima, who discussed the difficulty of Math 99 despite her prior math experience:

I got a B in Math 99. I think it’s just a matter of getting used to how they do math here. Because that was for sure different. I’d taken calculus previously, so I was thinking I was gonna be fine, I already took it. But the style of grading . . . just grading, the way that they grade homework and all that stuff. . . . I feel like I can’t judge [the teaching] because I already knew a lot of what he was teaching. So regardless of how he was teaching I would have been able to get it. But I definitely see how if you weren’t familiar with the information he was teaching you could have been very confused. Because my math teacher would start at the solution to the problem then work his way back. It was very circular and I definitely think if I didn’t have a previous introduction to it I would have been much more confused. (Math 99, 100 percent repetition)

When we asked Alma, another novice, what she might have done differently during her first term at college, she said:

I wish I would have been able to mentally prepare. Because coming into Western I really expected the professors to really, really teach you because they are really, really great, very accomplished people. So I expected to not have a hard time learning. I thought, “These professors are going to be great. I’m going to learn so fast and so much.” And I’m realizing that it’s a 10-week course and it’s super, super fast. We’re learning in 10 weeks what people usually do in 20 weeks. It’s two times the speed. That’s what I wished I would have prepared for, because I was more worried about fitting in than I was about the actual classes. (Math 100, 0 percent repetition)

Like many novices, Alma sought resources outside of the course to support her math study:

I’ve had to look outside of my professor and the TAs. The TA that I was given and the section that I go to, I really feel like he goes through it really, really fast and then barely explains anything . . . I ask some of my friends for help who have also gone to tutoring and so they understand it from a different perspective. And then last night we had a study night at the Latinx community center, and there were five of us just working through some of the problems that were on the practice test for the midterm. I’ve looked outside of the classroom and so I feel like I’m really learning a lot of math. But with the class itself, it’s not as great of an experience as I would have hoped. I had such great math teachers in high school, I feel like my expectations were set really high . . . I was able to get a really deep understanding of Calculus AB. So now, jumping into the next part of it, which is Math 100, has been really hard for me but I feel like I have a handle on it so far. But it’s just taking a lot more work than I wanted. (Math 100, 0 percent repetition)

Whereas repeaters reported skipping optional class sections and office hours, novices reported relying heavily on these resources and seeking out others to keep up with coursework, which they often experienced as speedily presented and thinly explained by instructors.10
Peer Comparisons

College courses are deeply social experiences, and the definition of situation is inherently evaluative: Students presume their performance is being formally judged by instructors and simultaneously surveilled by other students. The technique of grading on a curve, in which the distribution of formal evaluations is relative to the performance of other students in the same course, exaggerates a climate of comparative self-assessment that is already pervasive in competitive academic contexts (Seymour and Hewitt 1997; Weston et al. 2019). Our interviews provide strong evidence that content repetition further exacerbates peer comparison, resulting in benefits for content repeaters and costs for novices.

Content repeaters reported they came away from their first college math courses with confidence in their math abilities. Linda, a 100 percent repeater in Math 101, told us subsequent to the class:

I like [math] a lot more than I thought I would. I mean, I always thought after I was done with Math [101] I would be, ‘‘okay, I’ll never take a math class again,’’ but I really enjoy it and I like the problem-solving aspect.

Evidence that content repeaters gained confidence at least partly in relation to their fellow students is provided by Blake, another 100 percent repeater of Math 101, who said he ‘‘was also able to help people if they were struggling and I understood the material. So that was a nice experience.’’ Experiencing the challenge of early college course-taking alongside others who were ‘‘struggling’’ gave Blake the opportunity to perform his own ability by assisting peers.

Although we did not directly ask about their sense of the math experiences of their peers, some novices seemed aware of classmates who were content repeaters. Nathan, for example, a novice to Math 101, said,

Math 101 honestly has been probably my toughest class. I think a lot of kids—I think it’s about 50 to 75 percent of the kids have already taken linear algebra, and I haven’t. In that sense, a lot of the terminology, a lot of the frameworks are a little different. So I’m kind of playing catch-up in that sense. But it hasn’t been too bad because a lot of people have been really nice and have offered to help on a lot of the conceptual items.

Nathan felt beneficence from his more experienced classmates and appreciated their help and experience. Yet other novices felt isolated by these discrepancies in math preparation and suggested that students coming with different amounts of prior learning had very different experiences of the same course:

Especially for [Math 101], a lot of them have taken a multivariable and a linear algebra class before. It kind of just feels like while you’re learning this for the first time, they already understand the gist of it. Their main struggle is trying to figure out what the problem’s asking, they already have all the tools to solve that problem, where I’m still kind of developing those tools. For me, I mostly just found students from a similar high school background to me and worked through building those tools first before attempting the problems and the concepts. I think that definitely helps it to be more approachable and less intimidating. And then all the other classes, people generally are from the same level of knowledge in those subjects, so I don’t really have trouble talking to people in those. (Vijay, Math 101, 0 percent repetition)

Another novice said:

That class definitely kicked my butt. It was definitely very hard. I did IB in high school and I’m not sure if the reason it was hard is because the classes I took were different than AP classes, but I know I was talking to some kids who said, ‘‘Yeah, we don’t know all this stuff but some of it is review.’’ And I thought, ‘‘Oh, I have no idea what any of this stuff is,’’ but I got placed into it anyway so I don’t think I was stretching too far. But it was definitely a wakeup call for me. (Hannah, Math 100, 0 percent repetition)

Students assessed their skill and accomplishment in math not only in relation to the course material but also relative to each other. As content
repeater and novices worked side-by-side in the same classrooms, some students came away with reciprocal lessons about their math abilities as superior or wanting.

**Forward Academic Plans**

At this writing, students are still making their way through their second undergraduate year; it is too early to assess whether or how their first math courses might be related to their major declarations. Yet retrospective interviews provide suggestive evidence of ongoing consequences for these students’ subsequent academic decisions. Olivia, who reported that Math 100 was 100 percent review, later told us the course “helped me to decide that I would take another class from that same professor and it made me feel more confident about math class this year.” Linda noted:

> I don’t think I could solely do a humanities major anymore. I don’t think I could do that. I might still want to study literature, English, or something like that, but I wouldn’t just study that on its own. Just because I’m enjoying Math 101 so much this quarter and I think that is where my strengths are. (Math 101, 100 percent repetition)

By contrast, Justin, for whom Math 101 was entirely new content, confessed to the interviewer:

> Math was a nightmare. Hated it. It was definitely my fault, so nothing against the professor. Yeah, it was just kind of hard to keep up because they just move so fast. But I pulled off a grade that was slightly better than I expected. So I was really happy about that. But overall, that was definitely going to be the last math class I have to take for the foreseeable future.

It is noteworthy that this student took responsibility for this experience—further evidence that students tend to meaningfully interpret their academic performances as reflections of self (Seymour and Hewitt 1997). Justin also suggested his experience in Math 101 would shape his subsequent academic decisions in the near future.

Another novice, Amelia, recognizing the sequential character of academic progress and the importance of math in prerequisite chains, indicated that her early math experiences might influence her major choice:

> I’m kind of struggling with [whether to choose] Economics because I’m struggling in Math 98 and there is still Math 99 and 100 and Math 101, in a major where there’s a lot of math involved, is that really what I want to get myself into? (Math 98, 0 percent repetition)

**DISCUSSION**

Educational sociologists have long understood that students bring different conceptions of their own agency with them to college, yet they have rarely directly observed how students variably make sense of this agency and enact it when selecting courses under elective curriculums. Doing so is especially important for understanding how students navigate progress in STEM fields because these academic domains tend to take a tiered structure in which advanced study is dependent on successful completion of specific coursework and facility in core skills.

Our qualitative panel design provided an uncommon empirical window into how college students navigate an elective curriculum. We learned inductively that students approached their choice of first college math courses with one of two distinct strategies. Content repeaters chose courses with content they had covered in previous schoolwork, whereas novices chose courses with content that was mostly or entirely new to them. Content repetition was a strategy pursued by the relatively privileged: students from upper-middle- and middle-class families with college-educated parents and who had experience navigating educational institutions. These different strategies were fateful. Content repeaters received higher marks in first math courses. They reported greater comfort and pleasure with their coursework and manageable academic workloads in these courses. Content repeaters also talked about enhanced confidence in their math abilities, sometimes through assisting struggling students in the same courses. By contrast, novices tended to receive lower marks even after expending more time and effort on their math coursework. They reported lower overall satisfaction with their math courses and
made invidious comparisons between themselves and higher achievers in their classes. These findings have important implications for sociological theory and research in at least three substantive domains.

First and most generally, our findings demonstrate that students exercise the agency afforded them by elective curriculums in variable but stratified ways. Content repeaters began college knowing they did not necessarily have to take the next course in a sequence or follow the recommendation of a placement test. Instead, they chose first math classes that would be largely review for them. Novices often seemed not to realize this was an option. Instead, they followed the recommendations of the Math Department’s placement exam to take the next course in a sequence; sometimes they heeded explicit encouragement from advisors and mentors to stretch themselves and take academic risks in college. To the extent that these different strategies were consequential for students’ grades and overall math experiences, this finding suggests social scientists interested in academic progress should incorporate into their research designs observation of how students consider and select courses.

Second, our findings have specific implications for the study of STEM pathways. In contrast with prior research that tends to view content repetition as a sign of academic weakness or a flaw of academic planning or advising, we discovered that content repetition can be a canny strategy for strengthening skills and building confidence in a new educational environment. This empirical finding is, to our knowledge, novel to the literature on STEM pathways; it should encourage scholars of STEM education to revisit their presumptions about what constitutes timely, efficient, or even optimal academic progress. That we observed this practice among some of the most academically well prepared and carefully screened undergraduates in the nation should further encourage researchers to consider the conditions under which content repetition is an enactment of privilege, not a mark of remediation or faulty curricular design.

Third, our findings contribute to the sociology of elites, elite education, and the ongoing understanding of how privilege is embodied and enacted in school. In educational settings where students are given considerable leeway to navigate their own academic paths, the lessons of prior experience and default orientations to tasks, captured by the idea of habitus, are likely to influence student decision-making. Content repetition is a heretofore unrecognized aspect of this phenomenon, in which relatively privileged students enact their agency in the course selection process to gain mastery in the subject matter and smooth their transition to college.

Content repetition appears to be a technique for the production of a key performative attribute of privilege: ease (Khan 2011). For students with the awareness and sense of agency to engage it, content repetition can be a powerful means of convincing other people and themselves that they can succeed and thrive at challenging tasks. Simultaneously, content repetition reinforces feelings of inferiority among other students in the same classes, who may not have realized this academic progress strategy was even available to them. In this way, the elective curriculum itself creates conditions for the performative reproduction of academic and socioeconomic inequalities.

Our work has uncovered a dimension of academic habitus in U.S. higher education heretofore undocumented in social science literatures. We offer this study of a single institution to identify this phenomenon and begin scholarly exchange about its importance for postsecondary stratification and inequality. Western’s admissions profile precludes our ability to make more general statements about the empirical reach of our findings. Future research should investigate whether and how content repetition is evident in schools with less restrictive admissions and on campuses where academic accomplishment, socioeconomic background, and ethno-racial identity combine in different ways than at our case school.

**Implications for Curriculum Planning and Instructional Practice**

And now I’m super miserable because I don’t want to be in this math class because it’s way too hard for me, but I also really don’t want to drop it because math is my thing and I love math with all my heart, but I feel like there’s no class that is both hard enough, and also doesn’t just take over my life. . . . So one thing that happened to me last quarter is that I really lost my confidence when it came to math. Sofia (Honors Math 101, 0 percent repetition)
Our work has three implications for postsecondary STEM instruction and advising. First, instructors in introductory STEM courses should reconsider the practice of curved grading, which puts students into direct competition with each other for high marks. Our research shows students arrive at the same courses with very different amounts of exposure to course content. Curved grading meant content repeaters were systematically rewarded and novices systematically punished on the basis of their different presumptions of how to choose their first math courses. We suspect this dynamic is not unique to Western University. Although it would not resolve the problem of differential preparation, mastery-based grading—in which students are evaluated based on demonstrated performance of specified skills and knowledge—would at least not exacerbate the unequal relationships to course content that students bring with them to class (Collins et al. 2019).

Our findings also suggest academic program directors should consider how to message and advise students in how to select courses early in their college careers. Institutional advising might explicitly encourage students to consider taking at least some of their early coursework as review—in recognition that the transition to college can itself be overwhelming, especially for first-generation college students (Nunn 2021). They might be especially cognizant that many students from working-class and lower-middle-class families may take their advice, placement tests, and university messaging at face value, more so than their more privileged counterparts, who may be more likely to receive official advice as more suggestive than directive (Calarco 2018; Jack 2020). Researchers and instructors of STEM pathways should sustain an open dialogue about what makes for optimal navigation of undergraduate course sequences, avoiding a priori assumptions about appropriate progress strategies and observing variation in what strategies seem to work well for which kinds of students in particular curricular programs.

Ultimately, there is no simple fix to the tensions inherent in bringing together students from a wide range of educational backgrounds, educating them side-by-side in the same classrooms, and holding them all to the same standards. Nor is there an obvious way to optimally balance the virtues of individual academic choice and discretion with the ideal of optimizing learning environments for all students. An important step in making deliberative progress on these tensions would be to recognize that freedom of choice under elective curriculums is not a neutral or innocent curricular technology.

RESEARCH ETHICS STATEMENT

All research has been approved by the authors’ university Institutional Review Board committee. All subjects gave their informed consent prior to their participation in the research, and confidentiality is maintained through selective anonymization.

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SUPPLEMENTAL MATERIAL

Supplemental material for this article is available online.

NOTES

1. All names are pseudonyms.
2. The term "elective curriculum" does not imply that courses are electives. Schools with elective curriculums often have distribution requirements in which students are expected to take courses in specific academic domains and choose a major. Elective curriculums give students a wide range of latitude in assembling their academic programs.
3. The extreme version of this phenomenon is tracking, in which students are placed on divergent strands of courses with little opportunity for transit across tracks (for a recent review and synthesis, see Domina et al. 2019).

4. The COVID-19 pandemic surfaced at scale in the United States at the very end of Western’s winter term. Spring 2020 courses were almost entirely online, and the university administration temporarily changed its grading policies. For these reasons, we limit the temporal window of this study to fall 2019 and winter 2020 terms.

5. We found evidence in our sample that students with at least 30 percent repeated content benefitted similarly to content repeaters. However, we chose a content-repetition definition of at least 50 percent review to conservatively estimate the pervasiveness of the phenomenon. Further research would be helpful in discerning precisely what amount of content repetition confers the advantages we describe.

6. Counts are based on qualitative coding of data from respondent interviews; see Appendix A in the online Supplemental Material.

7. Only 15 percent of students nationally take any calculus in high school (National Center for Education Statistics 2012).

8. Although none of our respondents mentioned the cost of course credits or concerns about optimizing cost, this does not preclude our low-income students from having a sense of precarity around course credits that was implicit in their course-taking decisions.

9. These grades are based on a 4.3 scale. Two of the 53 students (both novices) in the study sample opted for credit/no-credit grades; both received credit and were excluded from GPA calculations.

10. Our protocol did not specifically ask about utilization of academic-support services outside of class. Approximately half of our respondents volunteered whether they made use of such services. We saw no differences by class or race in utilization of outside resources or formal/informal study groups, as reported by Johnson (2019).

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