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Suspended in Context: School Discipline, STEM Course-Taking, and School Racial/Ethnic Composition

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Abstract

STEM curricula and school disciplinary regimes are both key foundations of the transition to adulthood, and they may be connected within school contexts in ways that reflect and exacerbate the intergenerational transmission of inequality. This study examines such connections with particular attention to student race/ethnicity and the racial/ethnic composition of high schools. Bivariate probit analyses of the High School Longitudinal Study of 2009 and the Civil Rights Data Collection of 2012 revealed that being suspended prior to high school was associated with truncated trajectories of advanced math course-taking by the end of high school while taking Algebra I or above in grade 9 was associated with avoiding suspension across the high school career. Although the proportion of disciplinary cases who were same racial/ethnic peers was associated with the math coursework of boys, various aspects of school racial/ethnic composition did not moderate the associations between suspension and math coursework over time for boys or girls. These results confirm the value of studying the interplay of formal and informal processes of schooling in addition to each on their own.

Math course-taking and school discipline have each received a great deal of attention in educational research and policy in the U.S. (Arum 2005; Frank et al 2008a; Hughes et al. 2017; Riegle-Crumb 2008). Although these topics reflect different processes and have different consequences, studying them in tandem is likely to advance understanding of each. Taking advanced math during high school signals preparation for higher education and success on the job market (Csikszentmihalyi and Schneider 2000; National Science Board 2018), particularly in an economy that increasingly depends on advancements in science, technology, engineering and math (STEM) (Gottffried, Bozick, and Srinivasan 2014; Hallinan and Kubitschek 1999; Hira 2010). Experiencing school discipline—suspension and expulsion, in particular—is perceived by many as a sign that a student is at risk of dropping out of school and even entering the criminal justice system (Fabelo et al. 2012; Kupchik 2016). Both of these processes are dynamic and cumulative, so that experiences early in students' academic career can shed light on where they will stand when they exit high school. Theory suggests that these dynamic processes are unlikely to be independent of each other and likely to be context-dependent, even though they are often studied in isolation and decontextualized (Ferguson 2000; Oakes 2005).

This study, therefore, draws on life course and labelling perspectives to examine the synchronization of students' experiences with school discipline and STEM advancement over the course of high school. Further, this synchronization is contextualized within the racial dynamics of schools' curricular and disciplinary pipelines and tested separately by gender to determine how boys and girls encounter these systems that operate in tandem. The hypothetical phenomenon of interest is that students will be less likely to face disciplinary actions over time when they show early signs of math progress, especially when their own race/ethnicity is overrepresented in upper-level math coursework in their schools. Conversely, they will be less likely to advance in math over time when they have early disciplinary experiences, especially when their own race/ethnicity is overrepresented in disciplinary actions in their schools. These hypothetical phenomena are tested by applying bivariate probit techniques to nationally representative data from the National Center for Education Statistics' High School Longitudinal Study of 2009 and the Civil Rights Data Collection of 2012.

Findings from this study have both theoretical and policy implications. For theory, this research connects the orienting framework of life course theory with the attention to mechanisms in labelling theory to elucidate how students are placed into systems for success or failure that feed off each other to create inequality. For policy, this study can identify critical points of intervention in the academic and disciplinary career while also identifying groups of students within different kinds of schools who might be especially in need of attention.

Life Course Perspective of Math and Discipline

The educational life course is defined by the processes and experiences that unfold as individuals move through the educational system, structuring both opportunities and constraints in ways that connect background to future (Crosnoe and Benner 2016). Life course theory emphasizes how this educational pathway arises from the intertwining of various trajectories that tap into different developmental and systemic experiences that build and intersect over time (Pallas 2002), with key "events" in the life course acting as turning points that shape these trajectories. As such, the theory points to the interplay of the formal and informal processes of school and how this interplay reflects family- and community-based circumstances that prepare or fail to prepare students for life beyond the 12^{th} grade (Alexander, Entwisle, and Olson 2014).

Formally, high schools are academic training grounds where students gain skills that will prepare them for college enrollment and future employment (Schneider and Stevenson 1999).

Due to their hierarchical and sequential structure, math courses particularly illustrate this skill-building process and the separation of students into academic tracks (Frank et al. 2008a; Gamoran and Hannigan 2000). As prior research has shown, this sequence begins with courses like beginning math and Pre-Algebra and ends in courses like Trigonometry and Calculus (Riegle-Crumb 2006; Schiller and Hunt 2003; Schneider et al. 1998). In order for students to have success in higher-level courses in this sequence, they need the skills taught in previous courses. In this cumulative structure, students who begin high school in higher levels of math are much more likely to reach the levels of math that are desired by colleges and employers, a process fundamental to the so-called *STEM pipeline* (Crosnoe and Muller 2014; Riegle-Crumb 2006).

Informally, schools socialize (and control) students for involvement in the larger society (Coleman 1961), as represented by course grades being determined not only by academic performance but also by social psychological performance, such as meeting teacher expectations with regards to attitude and behavior (Catsambis et al. 2012; Farkas 1990; Linn and Kessel 1996). In this manner, schools not only educate youth for the future but also shape their future social and psychological functioning (Crosnoe 2011). When students fail to accurately portray desired behaviors, they can be sanctioned by adults, including through exclusionary processes such as lower grades and harsh discipline (Ferguson 2000; Kupchik 2012). Suspension may initially be a short-term punishment where the student is removed from school, potentially for just a single day. This punishment, however, can have a lasting impact that isolates young people from the educational system, other conventional institutions, and their rewards and supports (Arum 2000; Skiba et al. 2008). Indeed, students who have been suspended in the past are more likely to be suspended a subsequent time than are those who have not yet been suspended, adding to the number of days they miss school. They are also more likely to drop out of school than other students, with some ending up in the criminal justice system (Fabelo 2012), a process often referred to as the *school-to-prison pipeline* (Wald and Losen 2003).

Although they differ in their consequences, the formal and informal processes of school tend to be closely linked. That linkage likely also applies to the pipelines studied here that illustrate each process (Crosnoe 2011; Oakes 2005). Suspension can reflect or lead to poor grades (e.g., through missed instructional time) and related markers of academic value (e.g., undermining teacher perceptions and investments) that then signal a lack of readiness for high-value academic pursuits, such as advanced math (Ferguson 2000). At the same time, academic successes can bond youth to conventional norms (e.g., increasing their stakes in school that discourage problem behaviors) and draw support from others (e.g., eliciting investment from teachers and other adults) that protect them from getting in trouble or being viewed as trouble makers (Holland 2012). Notably, the former scenario can occur regardless of students' actual academic skills and promise, and the latter can occur regardless of students' actual behavior.

Math, Discipline, and Labelling Theory

Following these social psychological mechanisms, a second theoretical perspective can shed light on why these trajectories through the formal and informal processes of schooling can intertwine over time in ways that magnify advantages and disadvantages (Carter 2005). Specifically, labelling theory asserts that formal responses to behavior contribute to expectations and enactment of future behavior (Becker 1963; Bernburg, Krohn, and Rivera 2006). The labels can be positive or negative, and, within schools, both teacher and peer evaluations are fundamental to how youth are labeled and how these labels filter out across domains.

Consider that teachers often evaluate behavior and academic ability together, so that behavior is interpreted through the lens of academic progress and vice versa even when the two are unrelated. For example, research has shown how male students can be labeled as either “schoolboys” or “troublemakers,” with a confirmation bias leading teachers to look for signs of academic promise and success from the former and signs of disruption and recklessness from the latter (Ferguson 2000; Darley and Gross 1983). In this way, a label emerging from one pipeline constrains or protects in the other, limiting access to math achievement for students in the discipline pipeline and limiting experiences of discipline for those who have progressed in the math pipeline. Other evidence suggests that expectations for students differ across academic curricula, with teachers focused on academic criteria when evaluating students in higher-status curricula and behavior when evaluating students in lower-status curricula (Oakes 2005). Similar processes occur among peers, who often label students with singular identities (e.g., brain, rebel) that can then become self-fulfilling to create both the sense and reality of mutual exclusivity (Brown 2013; Cairns and Cairns 1994; Kinney 1993; Milner 2015). Experiences and circumstances lead to the label, and then the label shapes how one is treated, whom one knows, what activities one can access, and even how one views him or herself, reinforcing the label not just in high school but also years after (Eccles, Barber, and Stone 2003; Frank et al. 2008a).

These effects of labelling are channeled through others’ perceptions and how they influence opportunities (Marques et al. 2008). In this way, they are social psychological phenomena that go beyond the more concrete mechanisms of how schooling formally works, such as the fact that suspension often means students miss instructional time (Skiba et al. 2008) or that challenging math coursework can reduce the free time that young people have in which to get in trouble (Gregory, Skiba, and Noguera 2010). The basic application, then, is that labelling, whether positive or negative, confines students to one pipeline; students who are labelled, either through self or other processes, will have less opportunity to move between pipelines.

The first aim of this study, therefore, is to draw on both the life course perspective and labelling theory to test the hypothesis that school discipline early in high school will disrupt students' later progress through the math curriculum across high school, while early signs of math progress will protect against students facing disciplinary actions later in high school.

Racial/Ethnic Representation as a Context of Connections between Math and Discipline

A major emphasis of the life course perspective is that the intertwining of trajectories through different developmental and institutional domains is heavily dependent on the contexts in which both trajectories unfold (Elder, Johnson, and Crosnoe 2003; Pallas 2003), and contexts also shape how labels are generated and applied (Bryant and Higgins 2010). Thus, integrating these two perspectives to shed light on the connection between students' experiences in the STEM and school-to-prison pipelines requires careful attention to context, particularly the school context in which students both accrue academic credentials and are disciplined for their real or perceived transgressions. Although many different features of schools could be studied to capture such contextualization, the racialization of both the STEM and school-to-prison pipelines suggests the value of conceptualizing school context in terms of racial/ethnic dynamics within the school (Benner and Crosnoe 2011; Boggess 2016). These dynamics occur at the intersection of both student and school.

First, students from historically disadvantaged racial/ethnic groups (e.g., Black, Hispanic) are less likely to advance through math than their White and Asian-American peers (National Science Board 2018; Riegle-Crumb 2006), and they are far more likely to face disciplinary sanctions (Fabelo et al. 2011; Kupchick 2016; Smith and Harper 2015). A good portion of these academic disparities reflects lower levels of preparedness at the start of high school based on years of differential opportunities to learn (Condron 2009; Reardon 2011), and at least some share of the disciplinary disparities reflects higher levels of misbehavior among those from disadvantaged racial/ethnic groups (Beaver, Wright, and Delisi 2011). Yet, these disparities are not simply about preparedness and behavior. They also reflect differences in how youth of different race/ethnicities are treated, the resources and supports that inform their decision-making, and what new opportunities are available to or foreclosed from them (Ferguson 2000; Gregory, Skiba, and Noguera 2010).

Second, the racial/ethnic composition of the school as a whole can influence both academic pursuits and disciplinary experiences. For example, racial/ethnic composition can shape the availability of advanced math courses, as schools with more Black and Hispanic students typically offer fewer classes at the end of the math sequence like Calculus and typically start more students at the lower end of this sequence (National Science Board 2018; U.S. Department of Education 2014). As another example, schools that serve more students of color, especially Black students, tend to use more frequent and harsher discipline for students, including suspension (U.S. Department of Education 2014; Smith and Harper 2015). Again, these differences related to school racial/ethnic composition may reflect such things as demand for academic coursework and the need for more social control of students, but they also are rooted in long traditions in institutional perceptions of what students of different groups need and deserve (James 2010).

Third, student race/ethnicity and school racial/ethnic composition converge in terms of the over- or underrepresentation of students in specific pipelines within the school relative to the overall composition of the school. Students from historically disadvantaged racial/ethnic groups are more likely to be suspended (Crenshaw, Nanda, and Ocen 2015), regardless of their behavior, and attend schools where suspension is a more negatively racialized practice (Skiba et al. 2008; Smith and Harper 2015), thereby increasing the odds that any real or perceived infraction will trigger negative labelling. At the same time, White and Asian-American students are more likely to enroll in and demand advanced math coursework (Riegle-Crumb 2006), regardless of math ability, and attend schools where such coursework is positively racialized (National Science Board 2018), thereby increasing the odds that any math progress or sign of math skills will trigger positive labelling. In these ways, Black and Hispanic students face a double disadvantage in both the STEM pipeline and school-to-prison pipeline as their same-race/ethnicity peers become underrepresented in the first and overrepresented in the second; White and Asian-American students face a double advantage in both the STEM pipeline and school-to-prison pipeline as their same-race/ethnicity peers become overrepresented in the first and underrepresented in the second.

The second aim of this study, therefore, is to examine how school racial/ethnic representation in the two consequential schooling trajectories moderates the association between them. The hypothesis is that the disruptive linkage between early disciplinary actions and later math coursework will increase as the overrepresentation of same-race/ethnicity peers in the school disciplinary pipeline increases, while the protective linkage between early math coursework and later disciplinary actions will increase as the overrepresentation of same-race/ethnicity peers in the school math curriculum increases.

Gender Differences in Contextualized Connections between Math and Discipline

Gender has long been such a fundamental factor in the STEM and school-to-prison pipelines that any consideration of connections between the two, especially in relation to racial/ethnic dynamics, needs to pay careful attention to gender differences. Gender is directly linked with both math coursework and experiences of school discipline. Even with female representation in science and math occupations on the rise (Riegle-Crumb, Farkas, and Muller 2006), STEM coursework continues to be widely perceived as an area of male expertise (Correll 2001; Hyde and Cling 2001), and girls often receive less encouragement for STEM pursuits than boys and are less likely to view themselves as skilled in these domains (Riegle-Crumb 2006; Riegle-Crumb et al. 2006). The behaviors of boys tend to be viewed through a more critical lens, and they are more likely to be disciplined and suspended than girls (Fabelo et al. 2012; Ferguson 2000). Notably, race/ethnicity complicates these gendered patterns. For example, in majority white schools, Black boys often benefit more than Black girls from their minority status by being stereotyped as athletes (Holland 2012). An additional complication is that Black boys face much greater stereotyping and stigma related to behavior than other boys (Rios 2011), but within-gender racial/ethnic disparities in disciplinary actions are greater for Black girls than Black boys (Cooper 2015; Crenshaw, Ocen, and Nanda 2015).

Of greater interest here is how gender shapes the connection between math coursework and disciplinary experiences across diverse school contexts. In other words, is the connection between math achievement and suspension and school-related variation in this connection more pronounced among girls than boys? To answer this question in ways that inform theory, the testing of the hypotheses about the bidirectional associations between math progress and disciplinary actions and the moderation of this association by school racial/ethnic representation will be separated by gender. The expectation is that the connections among math progress, disciplinary actions, and school racial/ethnic representation will be stronger for girls than boys.

Methods

Discipline, Math, and Racial/Ethnic Composition

Data and Sample

Hypothesis-testing drew on two integrated data sets from the National Center for Education Statistics (NCES). The High School Longitudinal Study of 2009 (HSLS) is a nationally representative sample of over 25,000 U.S. grade 9 students from 944 schools in 2009 which interviewed students, parents, and school administrators in addition to collecting student transcripts. These transcripts included a full list of the courses students took in each term of each year they were in high school. Student data from HSLS can be combined with school data from the Civil Rights Data Collection (CRDC), which collects extensive information about racial/ethnic composition from public schools in the U.S., including data on racial/ethnic patterns in coursework and discipline. CRDC collects these data every two years; I used data from the 2011-12 school year, which aligns with the third year of HSLS.

The analytical sample includes all students from public schools who participated in the 2009 and 2012 waves of HSLS (grades 9 and 12, respectively) and for whom parents completed a questionnaire in 2009 (n = 11,300; *sample sizes rounded to nearest multiple of 50, following NCES regulations*). Excluded cases were lost from students who never responded to HSLS requests (3,750 cases) and those from private or religious schools that did not report to CRDC (3,900). Remaining missing cases resulted from parents not completing the HSLS questionnaire in 2009 (5,900). Two-sample t-tests on missing data show that students missing from the analysis had higher rates of suspension ($t = -13.61$, $p < .001$) and lower rates of Calculus enrollment ($t = 16.97$, $p < .001$), suggesting that results that follow may underrepresent the synchronization of these two systems by excluding those most likely to be in the school to prison pipeline and least likely to advance in STEM. Of note, however, is that sample weighting adjusted for differential attrition across interviews.

Measurements

Math coursework. This study drew on the protocol for measuring coursework sequences developed for the transcript studies of the National Education Longitudinal Study (Schneider, Swanson and Reigle-Crumb 1998; Stevenson, Schiller, and Schneider 1994) and the National Longitudinal Study of Adolescent Health (Riegle-Crumb 2006). Unique course names listed on transcripts were coded according to the normative population patterns of students moving through the curriculum: (1) Basic Math, (2) Pre-Algebra, (3) Algebra 1, (4) Geometry, (5) Algebra 2, (6) Advanced Math/Trigonometry, (7) Pre-Calculus, and (8) Calculus. Math non-enrollment was coded as 0. These values led to the construction of two binary variables: 1) Algebra 1 or above during grade 9 vs. not, 2) Calculus at any point during high school vs. never.

Suspension. Grade 9 interviews asked parents if the student had been suspended prior to the interview, meaning any time from the beginning of their academic career until the interview in grade 9. Grade 12 interviews asked parents whether the student had been suspended since their grade 9 interview. Responses led to the construction of two binary variables: 1) suspension prior to first interview vs. not, 2) suspension at any point during high school vs. never. Each variable was dichotomized (1 = any suspension during that time frame, 0 = no suspension).

Racial/ethnic representation. CRDC provides school-level and course-level data on racial/ethnic composition (non-Hispanic White, non-Hispanic Black, Hispanic/Latino, Asian, Pacific Islander/native Hawaiian, American Indian/native Alaskan, and 2 or more races) separated by gender. These reports are required by federal legislation under the 1979 *Department of Education Organization Act* to ensure compliance with civil rights laws. This study collapsed the racial/ethnic categories into five, by combining the Asian and native Hawaiian/Pacific

Islander groups (hereafter referred to as Asian-American) and the American Indian/native Alaskan and 2 or more races groups (hereafter referred to as Other race/ethnicity).

When matched with reports on individual student race/ethnicity, these CRDC data, allowed the construction of a pair of variables specifically related to the STEM and school-to-prison pipelines. For STEM, racial/ethnic representation was measured as the percentage difference between same-race/ethnicity peers in Calculus courses in the school and same-race/ethnicity peers in the full student body. For discipline, the difference is measured between suspended students and the student body.

Gender. Students, parents, and school rosters reported gender as either male or female in 2009 and 2012. When discrepancies existed between reports, HSLS administrators made decisions on the gender of the child based on the students' name.

Covariates. Given the connection between racial/ethnic and socioeconomic stratification in the U.S., analyses controlled for parental education (1 = at least one parent graduated from college, 0 = neither parent did). Additional covariates measured the student's race/ethnicity and age (in years and months) as well as whether the student's parents were married when she or he was in grade 9 (1 = married, 0 = not married). School-level measures included the size of the student body, the percentage of the student body who were White, and the overall racial/ethnic heterogeneity of the student body. This last variable, often referred to as the racial fragmentation index (Alesina and Ferrera 2002), measures the equality of size among racial groups. It represents the probability that two randomly drawn individuals from the school will be from different races. Increasing values reflect increase heterogeneity. The equation for this index is:

$$Race_i = 1 - \sum kS_{ki}^2 \qquad (1)$$

where *i* represents the school the individual resides in and *k* represents the five racial/ethnic categories in my study. S_{ki} thereby represents the share of race/ethnicity *k* in school *i*.

Plan of Analysis

The analyses in this study used a series of bivariate probit functions followed by a test for robustness. These analyses were estimated in Stata (Stata Corp 2009) using its “biprobit” command. This command runs two probit models simultaneously for a bivariate probit regression that includes an analysis of the collinearity between the two probits via the correlation of errors and considers both lagged and cross-lagged effects of each independent variable. In addition, and to maximize available data and reduce the bias that can come with assuming that data are missing completely at random, I imputed missing data using the *mi estimate* suite of commands in Stata. In this imputation, 50 datasets are estimated, and then final parameters are averaged across imputations. Given the nested nature of the data, all models accounted for school-based nesting using Stata’s VCE-Cluster option, along with sampling weights to account for differential attrition and maintain the representativeness of the sample.

The first modeling step regressed grade 12 measures of math enrollment and suspension on grade 9 measures of math enrollment and suspension to gauge the synchronization between these two school mechanisms. A second model then added the school-level and socioeconomic covariates that measured student race/ethnicity, age, parental education and marriage status, school size, school heterogeneity, percent of same-race peers in the school, and percent of the school’s student body that is White. The third model added the more detailed racial/ethnic representation variables which measured the difference between racial/ethnic representation in the school and in each specific pipeline. The fourth and final model included the interactions between racial/ethnic representation and grade 9 suspension and Algebra enrollment, measuring the predictive association for grade 12 outcomes for each grade 9 predictor. Each model was estimated separately by gender, with Wald tests on significant focal coefficients identifying synchronization between STEM and discipline differed between boys and girls.

A post-hoc robustness index helped to gauge the level of causal inference for the bivariate probit parameters. The Impact Threshold for Confounding Variables (ITCV) does not control for unmeasured confounds but does quantify how powerful any confounds would need to be to negate the causal inference for the association found. The ITCV equation is as follows:

$$R_{x,y} - r^{\#}_{x,y} / (1 - r^{\#}_{x,y}) \quad (2)$$

where

$$r^{\#}_{x,y} = t/\sqrt{[(n - q - 1) + t^2]} \quad (3)$$

t is the critical t-value, n is the sample size, and q is the number of model parameters. The resulting value indicates the minimum product of correlation between predictor and confound as well as the correlation between the outcome and confound ($r^{\#}_{x,cv}$ x $r^{\#}_{y,cv}$) needed to reduce the focal association to nonsignificant (Frank 2000; Frank et al. 2008b). If an unobserved confound were to have a product of correlations that exceeded this threshold, then controlling for that confound would likely alter the potential for causal inference. Confidence would be greater if the product of correlations were smaller than this threshold. For this study, I calculated the ITCV for all significant focal predictors in Model 3.

This two-step process for approaching the question of whether two key pipelines within schools are synchronized and whether student experiences within those pipelines are altered by the racial/ethnic representation in each accounts for observable confounds available in HSLS and CRDC and then checks the degree to which any unknown or unmeasured confounds might also be influencing results. Although this process does not establish causality, it improves the confidence in causal inferences that can be made.

Results

A Basic Comparison of Suspended and High Math Taking Students

Tables 1 and 2 present descriptive results by gender and by focal outcomes, respectively. The sample was 54% White, 21% Hispanic, 12% Black, 8% other, and 4% Asian. There was clear internal diversity in the sample in experiences with both suspension and math coursework.

First, a relatively equal proportion of students were suspended prior (14%) to and during high school (15%). Boys (19%) were more likely to be suspended prior to high school than girls (9%) and also more likely to be suspended during high school (21% vs. 10%). Of all students who were suspended during high school, 67% were male. Black (12%), Hispanic (21%), and students from the other race category (14%) had higher representation among those who had been suspended than they did in the sample overall.

Second, about 84% of students took a math course at or above the Algebra 1 level during grade 9, but only 15% took Calculus during high school. Boys (82%) were slightly less likely than girls (86%) to take Algebra I or higher during grade 9 but enrolled in Calculus at a similar rate to girls (15% and 16%, respectively). Of all students who took Calculus during high school, 49% were male, 63% were White, 12% were Asian-American, 6% were Black, 13% were Hispanic, and 6% were students from the other racial/ethnic category.

Third, connecting the two pipelines, 75% of students who were suspended during high school had taken Algebra I, but only 3% took Calculus. Of the students who enrolled in Calculus during high school, only 3% had been suspended prior to high school, and just 2% were suspended during high school.

These descriptive statistics suggest that the experiences of STEM students and students involved with school discipline are largely separate from one another, with few students experiencing both systems within the school. Furthermore, the low rate of Calculus enrollment among students who were suspended during high school points to potential effects of suspension on academic outcomes, especially when factoring in that a majority of suspended students were enrolled in Algebra I or higher during grade 9. Next, biprobit analyses address confounding factors that could be contributing to the separation of these systems.

Examining Bidirectional Linkages among Math Coursework and Suspension

The first aim of this study was to address the synchronization of two systems that heavily influence student trajectories. Table 3 presents the results from the cross-lagged path models simultaneously estimating all associations among math coursework and suspension over the course of high school. These tables include unstandardized *b* coefficients in the probit function, so the interpretation is that a one-unit change in the independent variable is associated with a change in the dependent variable equal to *b*.

Recall that Model 1 included only the focal variables representing each pipeline, Model 2 added covariates, Model 3 added the racial/ethnic representation variables, and Model 4 included interaction terms between focal variables and the racial/ethnic representation variables. Because results for the lagged and cross-lagged effects are consistent in their direction and significance in all models, I focus here on Model 4. In this model, grade 9 suspension negatively predicted grade 12 Calculus enrollment for boys (b = -.58, $p < .001$) and girls (b = -.77, $p < .001$). At the same time, grade 9 Algebra I enrollment negatively predicted being suspended during high school for both boys (b = -.35, $p < .01$) and girls (b = -.29, $p < .05$). According to the Wald test, the differences in the link between suspension and Calculus enrollment ($\chi^2(4)$ 27.14, $p < .001$) and between Algebra I enrollment in grade 9 and later suspension ($\chi^2(4)$ 160.72, $p < .001$) were significant between boys and girls. These results show that, although bidirectional linkages emerged for both genders, suspension was a more negative indicator of Calculus enrollment for girls while Algebra I enrollment in 9^{th} grade was a more negative indicator of later suspension for boys.

Notably, ITCV calculations boosted confidence in these results. For the early suspension coefficient predicting later math coursework, the ITCV was -.11 for boys and -.12 for girls. These values suggest that any correlation between unobserved variable and both early suspension *and* later math coursework would need to exceed -.34 and -.35, respectively, to reduce these coefficients to nonsignificance. For the early math coursework coefficient predicting late suspension, the ITCV was -.11 for boys (requiring -.34 correlations of that unknown confound with predictor and outcome) and -.10 (-.30 correlations) for girls. Compared to correlations with other variables in the model, these ITCV scores were large. The only variable in the model more strongly correlated with suspension during high school was suspension prior to high school, and no variable had a correlation with Calculus stronger than -.30.

In line with the hypothesis for this aim, therefore, students who were suspended prior to high school were significantly less likely to reach the highest end of the math sequence than other students, and students who showed early signs of math progress were less likely to be suspended from school. Partially supporting the hypothesis that girls would experience stronger bidirectional effects between these systems, models for girls revealed slightly stronger associations between early suspension and later math coursework. Contrary to this hypothesis, associations between Algebra I coursework in grade 9 and later suspension were slightly stronger among boys. These patterns appeared to be somewhat robust to the potential impact of unobserved confounds.

Because these analyses separated students only by gender and did not test by race, some concerns may be warranted over the potential masking of important differences related to racial background. Further statistical tests not shown here suggested that the decision to test these processes separated only by gender was unlikely to be problematic. Although some coefficients did lose significance when the sample was further broken down into six race-gender categories, the direction of these coefficients remained and *t*-tests showed that coefficients of the focal variables were not different by race, suggesting that the changes in significance were more likely tied to drops in sample size than to different experiences of STEM and discipline processes within school based on race. Indeed, not only were differences across same gender racial groups found to be nonsignificant, but in the case of black girls the bivariate probit analysis did not converge, making separation by race-gender a poor choice for full representation and supporting the decision to separated students only by gender.

Racial/Ethnic Representation in the Two Pipelines

The second aim of this study was to evaluate the moderating role of racial/ethnic representation in both STEM and discipline systems within the school. The hypothesis here was that being in a school that overrepresented a student's race/ethnicity in either suspension or Calculus course-taking would decrease the likelihood of involvement in the opposing system. Model 4 shows that racial/ethnic representation in suspension was significantly and negatively associated with enrollment in Calculus during high school for boys (b = -.878, p < .01), so that students were less likely to enroll in Calculus when their same-race/ethnicity peers were overrepresented in their school's suspension cases. This coefficient had an ITCV of -.07 (meaning that some unknown confound would have to be correlated with both the racial/ethnic representation variable and the math outcome at a level of -.26 or higher to reduce it to nonsignificance). This same pattern did not hold for girls (*b* = -.416, n.s.). Moreover, the representation of same-race/ethnicity peers in Calculus was not associated with the odds that boys (*b* = .393, n.s.) or girls (*b* = .265, n.s.) would be suspended during high school.

The main focus of this aim, however, was not on the direct linkages between racial/ethnic representation and the outcomes, but instead on the potential for racial/ethnic representation to moderate the cross-path associations between math coursework and suspension over time. Neither interaction estimated to explore such moderation (i.e., the percentage of same-race/ethnicity peers in upper-level math x grade 9 suspension predicting Calculus enrollment during high school, the percentage of same-race/ethnicity peers in suspension x grade 9 Algebra I enrollment predicting suspension during high school) was significant for boys (*b* = - .451, n.s.; *b* = -.521, n.s.) or girls (*b* = -.089, n.s.; *b* = 1.45, n.s.). In other words, in terms of the interplay of math coursework and disciplinary experiences, racial/ethnic representation only mattered one way and only for one group of students. As boys' race/ethnicities were overrepresented in the school-to-prison pipeline, they were less likely to persist in the STEM pipeline. These findings are not in line with the second hypothesis, but they are informative in other ways.

Discussion

The STEM pipeline and school-to-prison pipeline are each significant issues of educational research and policy in their own right (Arum 2005; Frank et al 2008a; Hughes et al. 2017; Kupchik 2016; Riegle-Crumb 2008), and so too is the connection between them. This study attempted to examine this connection with special attention to the racial/ethnic dynamics of schools that may influence both and how they intersect. Integrating the dynamic and contextualized emphasis of life course theory (Crosnoe and Benner 2016; Pallas 2003) and the insights into social psychological mechanisms of labelling theory (Bernburg et al. 2006; Bryant and Higgins 2010), the general argument was that experience in suspension could color how students were treated (and viewed themselves) in the math curriculum and disrupt their accumulation of highly valued credentials. Similarly, progress in math could protect students from self- and other-perceptions that could lead to suspension and trigger its many long-term consequences. Lastly, both processes could depend on how much fellow students in each pipeline “looked” like the student in question.

The first aim of this study was to evaluate the synchronization of school discipline and STEM coursework. Findings supported the hypotheses that students who were disciplined early in their academic career would be less likely to reach the highest level of math coursework, while those who exhibited ability in math early in their academic career would be less likely to be suspended. A second aim considered the racial/ethnic representation of STEM and discipline mechanisms within the school, hypothesizing that having more same-race/ethnicity peers in either system would reduce involvement in the opposing system. The findings partially supported the hypothesis, with higher representation same-racial/ethnic peers in suspension appearing to have adverse effects on Calculus enrollment for boys but not girls. The representation of same-racial/ethnic peers in Calculus was not associated with suspension for either boys or girls. For both aims, I was interested in differences between these systems for boys and girls, hypothesizing that girls would respond more negatively to their own racial/ethnic representation in suspension and more positively to their own racial/ethnic representation in Calculus than boys; in other words, the predictive power of racial/ethnic representation in one school mechanism for outcomes in the opposing system would be stronger for girls. The findings did not confirm this hypothesis, and, in the case of racial/ethnic representation in suspension, boys had worse outcomes than did girls. Together, these results raise three important questions to consider when evaluating the contributions of this study and to pursue in future research.

First, what does the apparent synchronization of disciplinary actions and math coursework mean for how schools work and the impact of schooling on students' futures? One potential explanation for why these two systems are linked is that schools continue to conflate misbehavior with low academic skills and academic performance with being well-mannered (Figlio 2006; Oakes 2005). Although this school-based explanation hints at one mechanism that maintains student positioning in either system, theory hints at new angles that need to be evaluated. More specifically, life course perspective suggests that turning points, like experiencing suspension, can shape student trajectories (Carkin and Tracy 2017; Mowen and Brent 2016), with these changes in student trajectories likely have lasting implications for the credentials students will earn during high school. If increasing enrollment in high-level STEM courses remains a goal for U.S. schools (National Science Board 2018; National Science Board 2015), policy makers, school administrators, and teachers will need to do a better job of moving students from the disciplinary system into the STEM pipeline *and* keeping students from entering the disciplinary system—with its long-lasting implications—in the first place (Fabelo et al. 2012, Kupchik 2016). One previously evaluated strategy that has been effective is School-Wide Positive Behavior Interventions and Supports (Childs et al. 2016; Waasdorp, Bradshaw, and Leaf 2012). This program focuses on supporting students' social and emotional needs through school-wide initiatives and may act to reduce potential for labelling, as it is applied to all students, not select students who could then be perceived as troublemakers. A limitation of this study is that it did not address the specific behaviors that lead to suspension, which could be contributing to whether discipline becomes a turning point that leads to lower STEM enrollment later in the academic career or has no meaningful effects. Although the initial rise in suspension was geared to target specific violent transgressions (Arum 2000; Kupchik 2012), suspension is now commonly discretionary and for smaller offenses (Fabelo et al 2012; Skiba et al 2008). This change allows for a wide variety of behavior leading to suspension, and the underlying reason for that behavior (e.g., lack of social support) could shape the synchronization between STEM and disciplinary processes and the effects of this synchronization. Future research should evaluate the behavior that has led to suspension and whether specific types of behavior better predict the linkage between these two systems.

Second, why does racial/ethnic representation only seem to matter for one kind of connection across systems (e.g. representation in discipline → math coursework) and not others, and why does it not moderate these connections? One mechanism through which the association between representation in discipline and future math coursework may be operating involves peer groups. Previous research has addressed the importance of peer groups for advancing in STEM education (Frank et al. 2008a; Riegle-Crumb 2006; Reigle-Crumb et al. 2006) and how peer groups are commonly racialized (Mikami et al. 2010; Tatum 1997). Further, differential treatment by race can contribute to educational outcomes (Jussim and Harber 2005) through the context that the treatment creates (Elder, Johnson, and Crosnoe 2003; Pallas 2003) and the labelling that context can influence (Bird 1980; Bryant and Higgins 2010; Hempel-Jorgensen 2009). The negative implications of same racial/ethnic peers being overrepresented in school discipline may operate through a bad apple effect (Lazear 2001; Sacerdote 2011), whereby an individual disrupts opportunities for those who are associated with—or look like—him or her, or because the racial composition of low-status students within a school sends a signal to all members of the student body about who is and is not a “good” student or a “good” kid (Blau

2003). Calculus course-taking among same-racial/ethnic peers may not be able to offer benefits that match the negative externalities of suspension, potentially due to a burden of high-achievement (Tyson, Darity, and Castellino 2005) that keeps students from enrolling in the highest levels of coursework. Future research should incorporate peer group dynamics to further investigate why racialized suspension may be associated with changes in math coursework more than racialized math curricula. As for the lack of moderation, the explanation may connect to the strong confounding variable thresholds reported here, which suggested the robustness of synchronization between STEM and discipline systems to unobserved confounds. In other words, the lack of a moderation may say more about the intertwined nature of discipline and STEM than it does about the importance of racial/ethnic representation within these systems.

Third, why do boys seem more responsive to racial/ethnic representation than girls? Prior research has highlighted that having academically successful female friends is positively associated with advanced math course-taking for girls (Riegle-Crumb, Farkas, and Muller 2006). Considering that adolescent peer groups continue to be organized by gender (Hilliard and Liben 2010; Halpern et al 2011), girls may rely more on signals from same-gender peers than from same-race peers. Thus, peer representation may be equally important for each gender, but the influence of same-race representation may be stronger for boys. Furthermore, boys have similar rates of Calculus enrollment (Freeman 2004; Riegle-Crumb 2006; Xie and Shauman 2003) but higher rates of suspension than do girls (Fabelo et al 2012; Skiba et al 2008). This pattern suggests that boys may have more exposure or access to the discipline *and* STEM pipelines. Their own behaviors and their peers' experience may, therefore, better predict outcomes for boys than for girls because suspension is relatively less common among girls (Smith and Harper 2015), which could hold even when same-racial/ethnic peers experience more discipline. Future research should look at specific peer group composition to determine how individuals rely on racial and gendered likenesses in evaluating peer experiences. Although this study did not show racial/ethnic representation in either the STEM or discipline systems to be a moderator of the synchronization of discipline and math coursework within the full sample, a better understanding of how students see their peers at the intersection of race/ethnicity and gender could reveal stronger moderating effects.

These three questions reveal the limitations of this study and point to future extensions of it. Extending this research is important because the stakes are high. Specifically, Calculus enrollment during high school is a strong predictor of future outcome within and beyond college (National Science Board 2015; National Science Board 2018). Involvement with school discipline can be as negatively predictive of future outcomes as Calculus enrollment is positive (Fabelo et al 2012; Kupchik 2016). With a better understanding of how the type of infraction contributes to our understanding of suspensions effects, as well as knowledge of specific peer group and racial experiences, researchers and policymakers alike will be better able to address the problematic synchronization of these systems. Theoretically, this research pointed to how experiences (e.g. being suspended) in the life course can shape the opportunities students have at their disposal or, in the case of high math course taking, the protections students will have from potential adversity via positive labelling. Turning to policy, as the education community continues to consider ways in which schools can get more students into advanced math courses, they should look to address the students who are being barred from these courses as a result of their discipline history while maintaining the protections that early achievers in mathematics are receiving. We need to continue building our understanding of how discipline and STEM systems are synchronized. Doing so will better assist the educational community in reaching their goals of putting students in places to succeed and bolstering future employment opportunities for U.S. students.

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Table 1. Descriptive Statistics for Study Variables

	Full Sample		Girls		Boys	
	Mean	SD	Mean	SD	Mean	SD
Suspension Variable						
Suspended prior to grade 9	0.139	*0.346*	0.091	*0.288*	0.186	*0.389*
Suspended during high school	0.154	*0.360*	0.096	*0.294*	0.210	*0.407*
Math Attainment						
Algebra I or higher in grade 9	0.837	*0.369*	0.855	*0.353*	0.820	*0.384*
Calculus during high school	0.152	*0.359*	0.156	*0.362*	0.148	*0.356*
Demographic Variables						
Age in August 2009	14.563	*0.533*	14.510	*0.501*	14.617	*0.559*
White	0.541	*0.498*	0.532	*0.499*	0.552	*0.497*
Hispanic	0.214	*0.410*	0.202	*0.402*	0.225	*0.418*
Black	0.120	*0.325*	0.140	*0.347*	0.100	*0.300*
Asian	0.041	*0.198*	0.040	*0.196*	0.041	*0.199*
Other	0.084	*0.278*	0.086	*0.280*	0.082	*0.274*
Family Variables						
Parent has Bachelor's degree	0.379	*0.485*	0.374	*0.484*	0.393	*0.486*
Parents are married	0.714	*0.452*	0.706	*0.456*	0.722	*0.448*
School Composition						
Total enrollment	1444.817	*828.838*	1432.083	*831.375*	1457.528	*826.176*
% school of same-race/ethnicity	0.565	*0.324*	0.562	*0.324*	0.567	*0.323*
% school White	0.571	*0.311*	0.570	*0.312*	0.573	*0.310*
Heterogeneity index	0.402	*0.212*	0.403	*0.212*	0.402	*0.212*
Racial/Ethnic Rep. in Pipelines						
Same-race/ethnicity in suspension	-0.025	*0.132*	-0.103	*0.127*	0.078	*0.130*
Same-race/ethnicity in Calculus	-0.002	*0.138*	-0.006	*-0.007*	0.007	*0.119*
n	11300		5650		5650	

* All *n*s rounded to nearest multiple of 5

Table 2. Descriptive Statistics by Outcome

	Full Sample		Suspended in High School		Students who took Calculus	
	Mean	SD	Mean	SD	Mean	SD
Suspension Variable						
Suspended prior to grade 9	0.139	*0.346*	0.455	*0.500*	0.034	*0.181*
Suspended during high school	0.154	*0.360*			0.022	*0.147*
Math Attainment						
Algebra I or higher in grade 9	0.837	*0.369*	0.670	*0.471*	0.940	*0.238*
Calculus during high school	0.152	*0.359*	0.022	*0.149*		
Demographic Variables						
Gender (male)	0.500	*0.500*	0.692	*0.462*	0.488	*0.500*
Age in August 2009	14.563	*0.533*	14.780	*0.501*	14.381	*0.432*
White	0.541	*0.498*	0.439	*0.490*	*0.628*	0.483
Hispanic	0.214	*0.410*	0.221	*0.393*	0.134	*0.341*
Black	0.120	*0.325*	0.191	*0.415*	0.056	*0.230*
Asian	0.041	*0.198*	0.010	*0.100*	0.121	*0.327*
Other	0.084	*0.278*	0.139	*0.346*	0.061	*0.239*
Family Variables						
Parent has Bachelor's degree	0.379	*0.485*	0.228	*0.420*	0.632	*0.482*
Parents are married	0.714	*0.452*	0.564	*0.496*	0.841	*0.365*
School Composition						
Total enrollment	1444.817	*828.838*	1438.951	*808.1319*	1490.480	*826.534*
% school of same-race/ethnicity	0.565	*0.324*	0.521	*0.340*	0.583	*0.313*
% school White	0.571	*0.311*	0.514	*0.319*	0.602	*0.300*
Heterogeneity index	0.402	*0.212*	0.401	*0.212*	0.407	*0.207*
Racial/Ethnic Rep. in Pipelines						
Same-race/ethnicity in suspension	-0.025	*0.132*	0.081	*0.109*	0.061	*0.131*
Same-race/ethnicity in Calculus	-0.002	*0.138*	-0.008	*0.121*	0.021	*0.118*
n	11300		1700		1700	

* All *n*s rounded to nearest multiple of 5

Table 3. Results from Bivariate Probit Analysis of Calculus Enrollment and High School Suspension, by Gender

	Girls		Boys	
	Suspension	Calculus	Suspension	Calculus
Suspended prior to grade 9	1.143***	-0.675**	1.152***	-0.560***
	(0.219)	(0.202)	(0.126)	(0.106)
Algebra I or higher in grade 9	-0.310*	0.547***	-.377**	0.372***
	(0.130)	(0.133)	(0.114)	(0.105)
Same-race/ethnicity in suspension	-0.434	-0.416	-0.194	-0.878**
	(0.587)	(0.388)	(0.373)	(0.284)
Same-race/ethnicity in Calculus	0.265	1.662+	0.393	-0.945
	(0.833)	(1.011)	(0.556)	(0.957)
Constant	-4.073	1.363	-3.298	1.241
	(1.250)	(1.323)	(1.210)	(1.053)

n = 11,300

Note: Standard errors in parentheses. Models controlled for race/ethnicity, parent education, parental marriage status, school size, and age % of schools peers who are same-race/ethnicity, % of school peers who are White, and racial/ethnic heterogeneity index