Teachers' Beliefs About Students' Social Disadvantage and Student Achievement

AUTHORS

Jane Rochmes
Stanford University

ABSTRACT

While progress to close racial achievement gaps has stagnated and income achievement gaps have grown, recent case studies enthusiastically describe "transformational" schools, which claim to establish conditions that enable students—primarily poor students of color—to achieve at levels far higher than their social background predicts. Accounts of such schools highlight a widespread belief among their teachers of empowerment over student outcomes despite students' disadvantages. However, such teacher attitudes have never been analyzed on a broad scale, and many analyses of teacher effects focus solely on teachers' human capital, overlooking their social-psychological traits. I use novel data on teachers from the nationally representative High School Longitudinal Study of 2009 to test whether teachers' beliefs that they can overcome students' social disadvantage are related to higher student achievement, and whether associations are stronger for racial minorities and economically disadvantaged students. Using three-level models, I find a positive association between teachers' beliefs about social disadvantage and students' achievement, which appears to stem from both selection and causal mechanisms. Evidence of heterogeneity contradicts academic and popular theory: rather than mattering most for poor students of color, teachers' beliefs appear especially strongly linked to achievement for the most socioeconomically advantaged African American students.

Teachers' Beliefs About Students' Social Disadvantage and Student Achievement

Jane Rochmes[1]

[1] Stanford University, Stanford, CA.

[*]Please direct all correspondence to Jane Rochmes, Center for Education Policy Analysis, Graduate School of Education, Stanford University, 520 Galvez Mall, CERAS Building, Room 421; jrochmes@stanford.edu; 510-548-7373.

Biography: Jane Rochmes is a Postdoctoral Fellow in the Center for Education Policy Analysis at Stanford University. She holds a Ph.D. in Public Policy and Sociology from the University of Michigan. Her research focuses on the ways in which schooling perpetuates or ameliorates racial and socioeconomic inequality broadly and academic disparities within schools. Her work analyzes how school and district contexts shape the experiences, pathways, and outcomes of both students and teachers. Other research includes projects studying teacher hiring, promotion, and retention; how school-based health service provision relates to students' academic performance; and the influence of for-profit colleges on degree receipt and labor market outcomes.

Teachers' Beliefs About Students' Social Disadvantage and Student Achievement

Key Words: teacher beliefs, teacher effects, school reform, multilevel models, academic

outcomes, racial inequality, socioeconomic inequality, teachers' understanding of inequality

Abstract

While progress to close racial achievement gaps has stagnated and income achievement

gaps have grown, recent case studies enthusiastically describe "transformational" schools, which

claim to establish conditions that enable students—primarily poor students of color—to achieve

at levels far higher than their social background predicts. Accounts of such schools highlight a

widespread belief among their teachers of empowerment over student outcomes despite students'

disadvantages. However, such teacher attitudes have never been analyzed on a broad scale, and

many analyses of teacher effects focus solely on teachers' human capital, overlooking their

social-psychological traits. I use novel data on teachers from the nationally representative High

School Longitudinal Study of 2009 to test whether teachers' beliefs that they can overcome

students' social disadvantage are related to higher student achievement, and whether associations

are stronger for racial minorities and economically disadvantaged students. Using three-level

models, I find a positive association between teachers' beliefs about social disadvantage and

students' achievement, which appears to stem from both selection and causal mechanisms.

Evidence of heterogeneity contradicts academic and popular theory: rather than mattering most

for poor students of color, teachers' beliefs appear especially strongly linked to achievement for

the most socioeconomically advantaged African American students.

Teachers' Beliefs About Students' Social Disadvantage and Student Achievement

Social inequality in education prompts debate over the extent to which schools ought to be held accountable for racial and socioeconomic disparities in academic outcomes, or whether highly entrenched inequality in broader U.S. society means some children face challenges too difficult for teachers and schools to overcome. Extensive evidence indicates that non-school factors primarily drive educational inequality (Downey, von Hippel, & Broh 2004; Gamoran 2001), but that particularly when it comes to inequality between black and white children, schools tend to exacerbate rather than ameliorate disparities (Downey, von Hippel, & Broh 2004). Meanwhile, within educational research and the media, substantial enthusiasm has recently surrounded so-called "transformational" or "gap-closing" schools, which claim to establish conditions that enable students—predominantly poor students of color—to achieve at levels far higher than their social background predicts. Accounts of such schools invariably highlight a widespread belief among their teachers of empowerment over student outcomes—a conviction that teachers can ensure students are not precluded from reaching their full potential by family background or social disadvantage (Kopp 2011; Paige and Witty 2010; Wilson 2008). This suggests that such empowered teacher beliefs may be a key aspect of promoting high achievement—or, conversely, that beliefs of helplessness in the face of social disadvantage may be a hindrance.

Researchers have increasingly recognized the importance of teacher effects for explaining how schools impact students (Darling-Hammond and Youngs 2002). Studies demonstrate that teachers' attitudes and expectations are linked to student outcomes (e.g. Lee and Loeb 2000; Lee and Smith 1996; Rist 1970; Tschannen-Moran and Woolfolk Hoy 2001), but research has not fully considered teachers' attitudes about overcoming social disadvantage. Similar concepts have been examined, but drawing on measures that do not actually reference students' social

background or home lives (e.g. Lee and Smith 1996; Lee and Loeb 2000) and typically using small, non-generalizable samples (e.g. Gibson and Dembo 1984; Guskey and Passaro 1994; Woolfolk and Hoy 1990). Studies of teacher effects that have systematically analyzed national data most commonly focus on teachers' human capital characteristics, overlooking social-psychological qualities of teachers, such as their beliefs about students' potential or the nature of teaching. At the same time, descriptions of the success of "transformational" schools exist almost entirely in case studies and personal accounts (e.g. Kopp 2011; Wilson 2008), as well as some quasi-experimental studies of specific educational models where the "intervention" involves multiple educational dimensions besides teacher attitudes (e.g. Angrist et al. 2012; Dobbie & Fryer 2011). Although it has not been conclusively proven that such schools indeed transform educational trajectories, to the extent that they have engaged with altering the entrenched relationship between social background and academic achievement, their apparent success has implications for closing longstanding racial and socioeconomic achievement disparities, and the components of their apparent success should be appropriately scrutinized. Yet the link between teachers' beliefs about social disadvantage and achievement has not been examined outside of these selective contexts.

If teachers' beliefs about students' social disadvantage are a key to success in schools serving a student population that is primarily high poverty and high minority, it raises the question of whether these beliefs relate to achievement for students more broadly, and if this relationship differs depending on students' own social background. On its face, we might expect that a teacher's belief that social disadvantage is a barrier to effective teaching might only be activated if she teaches students who indeed face social disadvantages. Beyond this, research indicates that attitudes and expectations are lowest and matter most for groups of students who

bear some social disadvantage or stigma (Downey & Pribesh 2004; Jussim, Eccles, and Madon 1996; McKown and Weinstein 2008; Tenenbaum and Ruck 2007).

This paper contributes a more systematic and generalizable understanding of how teachers' beliefs of helplessness or empowerment to overcome social disadvantage relate to student achievement. The analysis examines such teacher beliefs in a nationally representative sample by using data from the High School Longitudinal Study of 2009 (HSLS:09), permitting greater generalizability about their role in student success. I use multilevel modeling to isolate the relationship between teachers' beliefs and student outcomes, accounting for numerous potential confounders at each level of analysis. Beyond student background, I introduce several aspects of teachers' human capital in case teachers' beliefs about the nature of teaching merely reflect things like their experience teaching or their academic preparation. And I control for school characteristics that have also been highlighted in accounts of "transformational" schools—as well as academic research on effective schools—that might explain success, rather than teachers' attitudes. Thus, the paper establishes whether a significant relationship exists between teachers' beliefs about students' social disadvantage and students' achievement independent of teachers' human capital traits and in schools broadly, outside of the specific environments described in case studies of "transformational" schools. Further, I exploit variation in when students were tested to gain insight into whether the relationship between teachers' beliefs and achievement is likely to be causal. Then, I analyze whether the relationship between teachers' beliefs and student achievement differs by student race and socioeconomic background.

In the remainder of the paper, I first describe the case studies that suggest teachers' beliefs may be a crucial aspect of successful "gap-closing" school reform and highlight why they point especially to teachers' beliefs about the extent to which students' social disadvantage is an obstacle. I then discuss existing research on teacher effects on students, particularly how

5

teachers' human capital, expectations of individual students, and other beliefs relate to students' educational outcomes, noting how each of these literatures has overlooked teachers' beliefs about social disadvantage. Next, I describe the dataset, HSLS:09; my sample, which is nationally representative of high schools and specific to math teachers and ninth grade students taking math; and my modeling approach before describing my findings. My results indicate that there is some selection in the schools and students that have teachers with more empowered or more helpless attitudes toward overcoming disadvantage, but that there is also likely to be a causal effect of teachers' beliefs on achievement. I find that the relationship between teachers' beliefs and achievement is strengthened after longer exposure to the teacher. The findings on heterogeneous effects are surprising, contradicting the story implied by "transformational" schools: teachers' beliefs are more strongly associated with achievement for African American students, but mainly those of higher socioeconomic status. While less clearly causal, my estimates suggest that for higher SES black students, having a teacher with the most empowered beliefs predicts achievement at least a half a standard deviation above the average among black students, while having a helpless teacher predicts achievement that is roughly a quarter of a standard deviation below the black mean. My conclusion discusses potential explanations for the average and differential effects results, and the implications of these findings for inequality.

Teachers' Beliefs in "Transformational" Schools

Although racial and ethnic disparities in educational outcomes narrowed during the 1970s and 1980s, progress toward closing these gaps has slowed considerably; meanwhile, the achievement gap between children from high-income and low-income families widened substantially over the latter half of the twentieth century (Gamoran 2001; Reardon 2011). Recent case studies have raised the profile of what are often termed "gap-closing" (Paige and Witty

6

2010; Wilson 2008) or "transformational" (Kopp 2011) schools—terms that stem partially from the schools' approach and partially from their results. These are schools that enroll primarily students of color from high poverty backgrounds, that have high levels of academic achievement, and that appear to enable their students to improve swiftly, so their presence in the educational marketplace could have important implications for equality of educational opportunity. Some highlighted schools have been charters (Angrist, Pathak, and Walters 2011; Wilson 2008), leading to questions about the results of some "transformational" schools because they may have selective enrollments (Ravitch 2010). But some traditional public schools have shown remarkable success as well. Chenoweth's (2007) book on schools that are closing long-standing achievement disparities, for example, describes only open enrollment neighborhood schools. Unresolved criticisms preclude firm conclusions about the extent of "transformational" schools' success. Yet to the extent that such schools embrace the challenge of overcoming hardships in students' lives, they have at least engaged with one of our educational system's most entrenched dilemmas. Thus, I draw attention to them not because this paper focuses specifically on these settings, but because their methods emphasize teachers' attitudes in a way that is worthy of more systematic attention.

A condition commonly ascribed to such schools is a widespread belief among teachers of empowerment over student outcomes—a conviction that teachers can ensure students are not precluded from reaching their full potential by family background or social disadvantage. The "transformational" or "gap-closing" approach assumes that students possess unrealized potential and that schools must alter the educational trajectory that a child's socioeconomic background predicts. For example, Kopp (2011) describes leaders in "transformational" schools as having "an unshakable belief in the potential of children" (Kopp 2011: 71). Similarly, one aspect of the "No Excuses" moniker at schools like KIPP (Knowledge Is Power Program) is that the "founders

and staff steadfastly reject explanations from any quarter for low achievement, whether a district apologist's appeals to demographic destiny or a child's excuse for failing to complete an assignment" (Wilson 2008: 7). These sentiments suggest that "transformational" schools actively dissuade personnel from forming expectations for students' outcomes based on their past achievement or social conditions. School effects research confirms the benefit of a school culture broadly akin to this model, showing that a school's academic emphasis and collective efficacy of its faculty—the common belief that the organization as a whole is capable of influencing learning—are influential for achievement (Hoy, Sweetland, and Smith 2002; Teddlie 2010). But despite both case study evidence on "transformational" schools and school effects research suggesting that within-school attitudes about whether teachers can overcome social disadvantage are related to student success, teachers' beliefs about the extent to which student background is a barrier have not been tested systematically as an important influence that individual teachers may have on their students.

At the same time, in these case studies and research on effective schools there is also the possibility that other aspects of schools are actually what produce better outcomes for students. As mentioned, charter schools are often highlighted in accounts of "transformational" schools; these may be schools that have undertaken a variety of reforms, or that hire teachers who are unusual in ways besides their beliefs. Or, schools' academic emphasis may result in instructional qualities that are independent of teachers' individual attitudes. Additionally, the lack of systematic analysis of such school contexts means that other school characteristics commonly understood to relate to student outcomes, such as school size (Lee and Burkam 2003), resources and funding (e.g. Payne and Biddle 1999; Wenglinsky 1997), and student body composition (e.g. Condron and Roscigno 2003; Crosnoe 2009; Owens 2010) are not typically mentioned as potential sources of positive outcomes. These possibilities highlight that teachers' beliefs about

students' social disadvantage need to be analyzed specifically, to understand their particular role, and that school context must be accounted for in a detailed fashion.

Teacher Effects Literature Focuses on Human Capital

In part to better understand schools' role in student achievement, researchers have paid increasing attention to the crucial influence of the classroom teacher (Darling-Hammond and Youngs 2002). Yet much of the literature examining teacher effects on students using large-scale data focuses exclusively on teachers' human capital. Academic background (Darling-Hammond and Youngs 2002), content knowledge in one's subject (Goldhaber and Brewer 2000), years of experience (Rice 2010), and certification or licensure (Goldhaber and Brewer 2000; Kane, Rockoff and Staiger 2008) are commonly analyzed sources of teacher effects.

Studies do not find significant influences of each of these human capital factors consistently (Peske and Haycock 2006; Lankford, Loeb, and Wyckoff 2002), perhaps because of collinearity among them (Darling-Hammond and Youngs 2002), provoking debate about which teacher traits are most important for student learning. However, there is broad consensus that teachers vary considerably with respect to their effectiveness (Rowan, Correnti, and Miller 2002). Rivkin, Hanushek, and Kain (2005) demonstrate variation within schools in quality of instruction that is substantial enough to bear on educational inequality, although they find that they can only explain a modest degree of the variation in teacher effectiveness using commonly measured characteristics such as years of experience and highest degree. The implication is that as-yet-unmeasured characteristics contribute greatly to teachers' impact on students.

Importantly, this research tradition has not addressed non-human capital characteristics of teachers. These large-scale analyses rarely consider psychological qualities such as teacher attitudes or interactional qualities such as how teachers engage with students alongside qualities such as teachers' preparation, experience, or certification. Palardy and Rumberger (2008), who

9

analyzed teachers' human capital, attitudes, and instructional practices simultaneously, is a notable exception. Examining a national sample of first graders, their results indicate that teachers' attitudes and practices are more strongly related to achievement gains than teachers' preparation is. It is unclear whether this pattern would hold at other grade levels, but this work suggests that it is possible that teachers' beliefs and interactional qualities provide a missing link in explaining teacher quality. Literature reflecting the long-standing sociological insight that interpersonal expectations can shape subsequent behaviors and interactions provides evidence that aspects of teacher-student interaction do matter for student outcomes—in general, and especially so for disadvantaged subgroups of students.

Evidence that Teachers' Expectations and Beliefs Matter

Merton (1948) first suggested the self-fulfilling prophecy effect, whereby a false judgment about an individual alters behavior such that the individual eventually fulfills the early expectation. Rosenthal and Jacobson's 1968 *Pygmalion in the Classroom* demonstrated self-fulfilling prophecies of teachers' expectations by showing that when teachers' erroneously judged students to be high performers, the students' achievement increased (see Good 1987; Jussim and Harber 2005). On the other hand, Jussim, Eccles, and Madon (1996) contend that a strong relationship between teachers' perceptions and their students' achievement is primarily due to the accuracy of teachers' perceptions based on students' past performance. Although "accurate" perceptions of past performance may explain why teachers' expectations are good predictors of students' later achievement, Good (1987) argues that a similar but subtler and more common process may occur with "sustaining" effects— when "teachers expect students to sustain previously developed behavior patterns, to the point that teachers… fail to see and capitalize on changes in student potential" (Good 1987: 32).

The literature on teachers' expectations highlights how teachers' attitudes toward students can be reflected in their interactions with students and behaviors in the classroom, in turn influencing students' learning. These studies have typically measured teachers' evaluations of the potential of specific individual students. A different approach has attempted to capture teachers' attitudes about the potential of teaching more broadly. Two concepts are relevant to the beliefs examined in this paper: teacher efficacy and teacher responsibility.

Teacher efficacy, defined as teachers' beliefs that they can successfully bring about student learning, has primarily been the province of psychology. This literature indicates that teacher efficacy is related to student outcomes, including student efficacy, motivation, and achievement (Tschannen-Moran and Woolfolk Hoy 2001). The early development of scales to measure teacher efficacy (e.g. Gibson and Dembo 1984; Guskey and Passaro 1994) indicated a multi-faceted concept, including dimensions of "personal teaching efficacy" and "general teaching efficacy." In this early work, "general teaching efficacy" was considered to reflect the extent to which a teacher perceives external obstacles to effective teaching and was operationalized using similar belief measures to those used in this paper, in addition to others. However, recent psychological research in this area has been primarily concerned with the self-oriented dimension of "personal teaching efficacy," reflecting beliefs about one's personal skills and abilities, and with measuring "efficacy" in ways that are more specific to particular teaching tasks and contexts (Tschannen-Moran and Woolfolk Hoy 2001). Thus, although "teacher efficacy" literature once incorporated beliefs "that any teacher's ability to bring about change is significantly limited by factors external to the teacher" (Gibson and Dembo 1984: 574), recent studies have largely ignored the general teaching efficacy concept.

Lee and Smith (1996) took the study of teachers' beliefs in a more sociological direction, developing a measure of teachers' collective responsibility for student learning, reflecting

11

teachers' "willingness, interest, and care for how and what all his or her students learned" (Lee and Smith 1996: 115). They aimed to develop a measure that would subsume aspects of teacher efficacy, and by establishing a measure of *collective* responsibility they theorized this teacher attitude as forming a coherent organizational property of schools. Their original work and its extensions have shown that schools with higher collective responsibility have higher levels of student learning (Lee and Loeb 2000; Lee and Smith 1996). The concept of teacher responsibility bears some similarity to teachers' beliefs about social disadvantage that are the focus of this paper because its underlying idea includes, in Lee and Smith's (1996) words, "teachers' internalizing responsibility for the learning of their students, *rather than attributing learning difficulties to weak students or deficient homelives*" (Lee and Smith 1996: 114; emphasis added). Importantly, though, collective responsibility for student learning has not actually been measured by examining whether teachers attribute difficulties to students' home environment or see family background as an obstacle.

Figure 1 presents a conceptual framework for how teachers' beliefs may affect student outcomes: beliefs are made manifest in teachers' behaviors (e.g. the material they teach, their teaching style, and their interactions with students), which in turn influence students' own attitudes and behaviors (e.g. their motivation, self-perceptions of ability, persistence, etc.), which then influence student learning and achievement. It is important to note that beliefs are not equivalent to action, and it is theoretically possible for teachers to suppress their beliefs such that they are not manifested in their behaviors toward students. Although I theorize that beliefs should matter for student outcomes because teachers' beliefs influence teachers' behaviors, I do not (and cannot) test this mechanism empirically in the present analysis. However, the findings in the literatures on teacher expectations, efficacy, and responsibility support such an

understanding of why teachers' beliefs would matter for student outcomes, and give good reason to believe that teachers with strong, committed, efficacious attitudes are beneficial for students.

[Figure 1 about here]

Expectations and Attitudes Toward Disadvantaged Student Groups

These literatures also provides a basis for expecting teachers' beliefs and expectations to matter differentially depending on students' background. Although earlier work sparked disagreement about how widespread self-fulfilling prophecies are in teacher-student interactions (see, e.g., Jussim, Eccles, and Madon 1996; Lee and Loeb 2000), there is consensus that teachers' expectations are lowest and matter most for students from disadvantaged groups. Rist's (1970) classic study showed that teachers' beliefs about kindergarteners' potential are highly correlated with students' social class, and that teachers make themselves more available to perceived high achievers and are more active in their learning. Thus, teachers' early expectations lead to a self-fulfilling prophecy of low achievement for the most economically disadvantaged students because teachers perceive them as "slow learners" with less potential than other students, and consequently provide them with fewer educational opportunities (Rist 1970).

In national samples, teachers in both early elementary school and middle school rate black students more negatively than they rate white students, seeing them as "poorer classroom citizens" (Downey & Pribesh 2004: 275). Teachers hold lower expectations for African American and Latino children than for white children, and hold the highest expectations for Asian American children (Tenenbaum and Ruck 2007). These differential expectations align with differential speech and feedback patterns, whereby white students receive more positive speech and feedback from teachers (Tenenbaum and Ruck 2007), race-linked academic

stereotypes are confirmed, and racial achievement disparities are exacerbated over the course of

an academic year (McKown and Weinstein 2008).

As noted above, Good's (1987) notion of "sustaining effects" conveys that unrevealed

potential may be ignored. As Ferguson (2003) argues,

> …stereotypes of Black intellectual inferiority are reinforced by past and present
> disparities in performance and probably cause teachers to underestimate Blacks' potential
> more than Whites'. If they expect that Black children have less potential, teachers
> probably search with less conviction than they should for ways of helping Black children
> to improve and miss opportunities to reduce the Black-White test score gap" (Ferguson
> 2003: 494).

This highlights how the concept of a student's "potential" can be challenging, because to the

extent that potential is not synonymous with past performance, it may be easy for teachers to

overlook (Ferguson 2003). The disproportionate burden of low teacher expectations placed on

children of color—black and Latino children in particular—has potentially large consequences

for student achievement if teachers' fulfill incorrect judgments or sustain achievement patterns

that do not reflect students' full potential.

Beyond teachers holding differential expectations for students of different backgrounds,

Jussim, Eccles, and Madon (1996) show that the effects students experience from these

expectations are largest for members of demographic groups who bear some societal

disadvantage or stigma. Even controlling for prior math performance and motivation in math, the

relationship between teachers' expectations and student math achievement is strongest for low

achieving, African American, and low SES students—and even stronger, in some cases, for

students who share more than one of these vulnerabilities to expectancy effects. As Jussim et al.

(1996) speculate, for students who consistently encounter low expectations from teachers,

"Perhaps a supportive teacher who holds students to higher standards may be seen as such a

14

breath of fresh air that many students are inspired to achieve more highly" (Jussim et al. 1996: 355). Conversely, perhaps a teacher's low expectations of students of color activate concerns of being judged according to a negative academic stereotype, leading students to underperform due to stereotype threat (Steele and Aronson 1995).

Teachers' beliefs about students' social disadvantage are akin to stereotypes or broad expectations about what groups of students (rather than individuals, as is typical in the expectation effects literature) can accomplish. Based on the literatures that indicate that similar types of teacher beliefs matter for student achievement (Lee and Loeb 2000; Lee and Smith 1996; Tschannen-Moran and Woolfolk Hoy 2001), and that not only do teachers' expectations matter for student performance but they matter particularly strongly for students from socially disadvantaged groups, it seems likely that teachers' beliefs about students' social disadvantage have differential effects depending on students' demographic background.

Approaching Teachers' Beliefs in the Present Study

This paper builds on previous work with a conceptualization of teachers' beliefs that specifically reflect views about the extent to which students' family origins and home life are barriers to teaching. I recast these attitudes as teachers' beliefs about students' social disadvantage to reflect that despite bearing resemblance to the teacher efficacy and responsibility constructs, the focus is squarely on how teachers perceive students' social background. This focus is partially inspired by the mounting case study evidence suggesting that such beliefs among teachers play a crucial role in their capacity to provide "transformational" educational experiences. That these beliefs have been highlighted in schools serving a mostly poor and minority student body provides reason to suspect that teachers' beliefs of empowerment to overcome social disadvantage may be especially beneficial for certain groups of students—or

conversely, that certain groups may be most harmed by exposure to teachers who feel helpless to overcome social disadvantages that students face. Notably, although the relationship between social background and achievement is one of the most enduring scholarly interests, we know surprisingly little about how teachers understand this relationship. The beliefs studied here capture whether teachers see an inevitable link between social background and student achievement.

Despite a common interest in how teachers affect students, two main strands of research—literatures on teachers' human capital traits and teachers' expectations and beliefs—have occurred largely in parallel. In addition, both literatures rarely explore broader contextual features of schools. Or, in some cases, teachers' beliefs are aggregated to the school level rather than considered among individual teachers; though teachers' beliefs may collectively form a school culture, teachers' individual attitudes likely also form a culture for the classroom context. This paper bridges these literatures and uses a nationally representative sample of schools and students to scrutinize the relationship between beliefs about social disadvantage and student achievement. Thus, the paper incorporates insights from research on teachers' human capital, builds upon the teachers' beliefs and expectations literatures, and tests the implications of accounts of "transformational" schools in a more generalizable sample, while accounting for many potential confounding characteristics of students, teachers, and schools to isolate the role of teachers' beliefs about students' social disadvantage.

DATA

Data for this paper come from the first wave[1] of the High School Longitudinal Study of 2009 (HSLS:09), the newest National Center for Education Statistics dataset, which covers a nationally representative sample of 944 high schools and 21,000 ninth graders. During the fall of

2009, HSLS:09 fielded surveys of students, parents, school administrators, teachers, and school counselors. Most useful for this study, the math and science teachers who taught sampled ninth graders completed extensive surveys, and students from racial/ethnic minority groups were oversampled to ensure sufficient sample sizes for subgroup analysis.

Students were sampled from school ninth grade enrollment lists, without regard to the courses in which they were enrolled. After sampling, if the student was enrolled in math or science in fall 2009, the teacher of the student's respective course was asked to complete a survey as well. This sampling strategy means the teachers are not strictly representative of teachers at their school, of all subjects, or of teachers nationally; yet they do comprise a large sample of teachers who taught a representative sample of ninth graders and therefore can provide a much more accurate representation than yet exists of how teachers' beliefs about students' social disadvantage relate to their students' achievement at a national level.

My analyses focus only on math courses, restricting the sample to students who were enrolled in math and can be linked to a math teacher. HSLS:09 only administered a standardized test in math, not in science. Otherwise, inclusion in the sample only requires the presence of appropriate links between students, teachers, and schools. Using the restricted-access version of HSLS:09, students are linked to their schools and data for teachers is separated from student records, resulting in sample sizes of 4,010 math teachers that can be linked to 16,040 students taking math courses in 890 schools.[2,3] I handle missing data using multiple imputation.[4]

Key Variables

Teachers' Beliefs About Students' Social Disadvantage. HSLS:09 is novel and uniquely suited to this analysis compared to other datasets that have longitudinal data on students or teachers because its teacher survey includes belief measures that specifically reference students' social disadvantage. Teachers responded to questions about their level of agreement with three

items that have traditionally been subsumed within a measure of "teacher efficacy," as described in the literature review, but which I argue are distinctly valuable for their ability to gauge teachers' beliefs about disadvantages stemming from students' social background and whether they view student background as a barrier to effective teaching and student achievement. I construct my measure of teachers' beliefs based on the following items:

- The amount a student can learn is primarily related to family background.

- You are very limited in what you can achieve because a student's home environment is a large influence on their achievement.

- When it comes right down to it, you really cannot do much because most of a student's motivation and performance depends on their home environment.

Responses are reported with a Likert-type scale, and in each case strong agreement is akin to saying that family background and home environment are such strong influences on learning and performance that the teacher is relatively helpless to make a difference. In contrast, strong disagreement is indicative that a teacher feels empowered to overcome disadvantages. The full distributions of teachers' responses to the individual belief items are shown in Table 1. The distributions differ somewhat across the three items, but in each case, disagreement is the most common response, while strong disagreement—the most empowered response—is less common. For all three beliefs, strong agreement—representing the most helpless response category—is rare, but is nevertheless expressed by a nontrivial minority of teachers. Utilizing teachers' self-reported beliefs raises some concern about social desirability bias in teachers' responses. Although it is impossible to test for this with the survey data at hand, that some degree of agreement and strong agreement is present in the distributions provides some reassurance that teachers are not merely responding in ways that they believe to be socially acceptable.

[Table 1 about here]

18

To treat these teachers' beliefs as a single predictor of student outcomes, I combine the three items into a latent summary measure of teachers' beliefs about students' social disadvantage through a confirmatory factor analysis of the entire sample of HSLS:09 teachers (both math and science), with standard errors clustered by school. Standardized coefficients for each belief in the CFA model are above the 0.5-0.6 threshold indicating a strong relationship with the latent construct, and the coefficient of determination indicates that the teachers' beliefs factor explains 69.4 percent of the total variance in the observed belief items. Figure 2 displays the CFA model. My final teachers' beliefs measure is standardized ($M = 0$, $SD = 1$), with high values indicating more empowered beliefs and low values indicating more helplessness.

[Figure 2 about here]

Student Math Achievement. This paper focuses on students' math achievement as the key outcome. HSLS:09 administered an assessment of algebraic reasoning to all students and used this math assessment to compute estimates of students' math skills, resulting in a test score that provides a measurement of student math achievement, norm-referenced to the ninth grade student population. For consistency and ease of interpretation, I standardize this test score measure to have a mean of 0 and standard deviation of 1.[5]

Student Demographic Characteristics. The student demographic groups of interest in my interaction analyses are defined by socioeconomic status and race. Student socioeconomic status is a continuous composite variable created by HSLS:09 that combines information on parents' highest education, parents' occupational prestige, and family income. For ease of interpretation, I initially standardized the SES variable to have a minimum of zero and standard deviation of 1, and then linearly rescaled it to have mean 1.5, so that zero represents 1.5 standard deviations below the mean, i.e. zero can be interpreted as low SES. Racial groups are coded as white, African American, Latino/Hispanic, Asian/Pacific Islander, American Indian/Alaska Native, or

19

more than one race (non-Hispanic). I also create variables that interact each of these racial

groups with the SES composite variable.

Control Variables

Student Characteristics. In addition to SES and race, I control for student sex, native

language, age, and family structure. Descriptive characteristics of the analytic sample of math

students are shown in Table 2 alongside descriptive statistics for the full sample of ninth graders

in HSLS:09, demonstrating that the analytic sample of ninth graders taking math are

demographically similar to ninth graders nationally.

[Table 2 about here]

Teacher Characteristics. At the teacher level, I control for demographic characteristics—

teachers' sex and race—and human capital. Since much of the literature on teacher effects

focuses on teachers' human capital, controlling for these characteristics ensures that teachers'

beliefs do not merely stand in for other qualifications. I control for the teacher's highest degree

received, overall years of experience teaching high school, and whether the teacher is new (in her

or his first 1 or 2 years) to her or his current school. I also control for certification status, as well

as a separate indicator for having entered teaching through an alternative certification program,

and whether the teacher held a job that required college-level math prior to teaching. Finally, I

account for the selectivity of the teacher's college or other postsecondary institution.[6]

Descriptive statistics for all teacher variables are shown in Table 3.

[Table 3 about here]

School Characteristics. At the school level I control for several basic

institutional/organizational features. These include sector, location/urbanicity, region, and school

size. I also include an indicator for grade span (whether the school includes elementary or middle

grades) and measures of average daily attendance rate and enrollment as a percent of capacity, which proxy for schools' financial resources and demand among students.

I further account for a number of school characteristics that may independently relate to students' academic performance. These include measures of school academic composition (the percent of seniors going on to a four-year college, indicators of the school's pattern of making adequate yearly progress [AYP]), school racial and class composition (percent receiving free or reduced-price lunch, percent of each racial group), the instructional environment of the school (whether the school lacks any AP or IB offerings), and school reform characteristics (charter status, incentive pay for teachers, and increased instructional hours). Descriptive statistics for all school variables are displayed in Table 4. These extensive school-level data available in HSLS:09 encompasses a number of characteristics that have been studied in research on effective schools as well as features besides teachers' empowered beliefs that have been highlighted in accounts of "transformational" schools. Thus, I control for school context in a much more detailed way than previous work examining how teachers' human capital or teachers' beliefs relate to students' educational outcomes.

[Table 4 about here]

METHODS

To analyze the relationship between teachers' beliefs about social disadvantage and student achievement I estimate three-level random-intercept models,[7] also known as hierarchical linear modeling. I use HLM in order to correct for student and teacher clustering within schools (which violates assumptions about the independence of observations), and to weight the data at all three levels to adjust for HSLS:09's complex survey sampling design.[8]

Indexing individual students with i, teachers with j, and schools with k, I display separate equations for each level of the analysis. The first set of models testing the average relationship between teachers' beliefs and achievement estimates the following student-level equation:

$$Math_{ijk} = \pi_{0jk} + \pi_{1jk}X_{ijk} + e_{ijk}$$

where X represents a vector of student-level controls and π_1 is a vector of coefficients. The outcome $Math_{ijk}$ represents students' predicted achievement. Then, at the teacher level I estimate:

$$\pi_{0jk} = \beta_{0k} + \beta_{1k}Beliefs_{jk} + \beta_{2k}T_{jk} + r_{0jk}$$

where β_1, the coefficient on teachers' beliefs, is the primary coefficient of interest, T represents a vector of teacher-level controls and β_2 is a vector of coefficients. Finally, at the school level I estimate:

$$\beta_{0k} = \gamma_{000} + \gamma_{001}S_k + u_{00k}$$

where S is a vector of school-level controls, and γ_{001} is a vector of coefficients. For this first set of analyses, I first establish the size and significance of the bivariate relationship between achievement and teachers' beliefs; I then test how this relationship changes when accounting for various potentially confounding characteristics at each level. To contextualize the findings relative to other teacher effects, I also draw comparisons between the teachers' beliefs coefficient and the coefficients for various teacher human capital characteristics. I next present robustness checks that draw on similar statistical models, adding extra controls as well as an interaction that exploits information on the timing of the outcome variable to gain greater causal identification.

In the second set of analyses, testing whether there are differential effects of teachers' beliefs for different demographic groups, the focus is on interactions between teachers' beliefs and student characteristics. The specific interactions estimated differ across models, but I illustrate these equations using SES as the interaction of interest. At the student-level I estimate:

$$Math_{ijk} = \pi_{0jk} + \pi_{1jk}SES_{ijk} + \pi_{2jk}X_{ijk} + e_{ijk}$$

where π_2 is now a vector of coefficients on student control variables, *SES* represents students'

socioeconomic status, and π_1 is the coefficient on student SES. (In alternative models, *SES* would

be replaced with a vector of race indicators, or race-SES interaction variables, and π_1 would

represent a vector of coefficients on those variables.) Then, at the teacher level I estimate:

$$\pi_{0jk} = \beta_{0k} + \beta_{1k}Beliefs_{jk} + \beta_{2k}T_{jk} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + \beta_{11k}Beliefs_{jk}$$

$$\pi_{2jk} = \beta_{20k}$$

where *T* represents a vector of teacher-level controls and β_2 is a vector of coefficients. The

coefficients on teachers' beliefs, β_1 and β_{11}, are the primary coefficients of interest. This

representation of the equations shows that whereas the teacher-level control variables in the

model only predict the overall intercept, teachers' beliefs predict both the overall intercept as

well as the student-level coefficient on SES, introducing a cross-level interaction. Finally, at the

school level I estimate:

$$\beta_{0k} = \gamma_{000} + \gamma_{001}S_k + u_{00k}$$

$$\beta_{1k} = \gamma_{010}$$

$$\beta_{2k} = \gamma_{020}$$

where *S* is a vector of school-level controls, and γ_{001} is a vector of coefficients.

For the interaction analyses, I first estimate a model with teachers' beliefs interacted with

just student SES. Second, I estimate a model with teachers' beliefs interacted with just student

race. Third, I show that these first two models mask additional heterogeneity by student race-by-

SES combinations with a model that interacts teachers' beliefs with student race-SES

interactions. I show these results graphically to discuss their interpretation.

RESULTS

Main Models Predicting Math Achievement

Table 5 displays results from multilevel models estimating the relationship between teachers' beliefs about social disadvantage and students' math achievement. The bivariate association between teachers' beliefs and math achievement is significant and positive: having a more empowered teacher predicts higher test scores, with the coefficient of 0.067 indicating that a one standard deviation increase in teachers' beliefs corresponds to almost a 7 percent of a standard deviation increase in math achievement. This relationship is reduced when controlling for student characteristics in Model 2, reflecting background differences in achievement scores, but not when controlling for teacher characteristics in Model 3, indicating that teachers' beliefs are largely independent of their human capital and other characteristics. A significant relationship between teachers' beliefs and students' math achievement remains even when differences in students' background and teacher traits are taken into account. However, controlling for characteristics of the school context reduces the association further, to 0.044, such that the coefficient on teachers' beliefs only borders on significance ($p = 0.064$) in Model 4 with controls at all levels. This suggests that the observed relationship may be an artifact of selection on school contextual factors, although it is possible that there is a small relationship between teachers' beliefs and students' math achievement that is imprecisely estimated.

[Table 5 about here]

It is useful to compare this coefficient in Model 4 with all controls to the estimated associations between teachers' human capital characteristics and students' math achievement. These results are largely consistent with other work on "effective teachers" that has examined test score outcomes (see, e.g., Darling-Hammond and Youngs 2002 and Rice 2010 for reviews),

24

identifying significant associations for new teachers and by certification status. The results in

Model 4 indicate that having a teacher who is new to the school predicts test scores one eighth of

a standard deviation lower. And both emergency certification and no certification predict worse

test score outcomes, with the effect for no certification being especially large at over half a

standard deviation drop in math achievement score predicted. Thus, even if the positive

relationship that teachers' beliefs have to math achievement is meaningful, it is less than a tenth

of the magnitude of lacking certification and a third of the magnitude of having a new teacher.

(Or, put another way, the positive relationship between teachers' beliefs and math test scores is

equivalent to less than a tenth of the magnitude of having a regularly certified teacher as

compared to a teacher without certification, or a third of the magnitude of having a teacher who

has passed the two-year mark at their current school). These results have important implications

for how we think about the influence that teachers have on students, which I discuss further in

the conclusion to the paper.

Robustness Checks to Probe Selection vs. Causality Interpretations

That the association between teachers' beliefs and achievement is smaller in magnitude

and only borders on significance with all controls presents inconclusive evidence as to whether

the relationship is merely imprecisely estimated or evidence of selection. The observational

nature of the data and the single wave of data available for both teachers and students pose

important limitations for the extent to which we can determine whether these results are due to

selection or weak but present causality. My analysis accounts for many potentially confounding

factors at the student, teacher, and school levels, but may omit important unobserved variables.

One especially important confounder is students' prior math achievement. To gain insight into

how to interpret these results despite this limitation, I probe my results further for evidence of

selection or a causal relationship in three additional robustness checks that exploit the data that *is* available in HSLS:09.

Analysis of Proxies for Math Preparation/Performance. I investigate the contribution of two potential sources of student selection by incorporating two variables that are imperfect measures of prior performance, to be sure, but to some extent proxy for students' engagement and achievement in math. First, Model 5 adds to the main model a control for the level of math course the student is in—indicators for whether it is a non-academic, low-academic, or high-academic course relative to average-level math courses for ninth graders.[9] This tests whether the relationships I observe are due to students who are more skilled in math enrolling in higher level math courses while teachers feel more empowered when they teach more advanced students, or conversely, that students who have lower math proficiency take lower level courses, while teachers feel helpless when they teach remedial courses. Model 5 in Table 6 shows that the teachers' beliefs coefficient for math achievement is reduced substantially and is no longer even marginally significant.

Second, Model 6 adds to the main model a control for the grade the student received in his or her 8th grade math course (self-reported by the student). Although this is not a strong proxy for prior achievement, it serves to test whether students with poor preparation in math end up with teachers who have more helpless attitudes, whereas students with stronger preparation have more empowered teachers. Model 6 in Table 6 shows how the teachers' beliefs coefficient changes when a linear measure of a grade of A through F is included. This control reduces the relationship between teachers' beliefs and students' math achievement even more than in previous models, to only 0.021. The results in Models 5 and 6 give reason to believe that there is selection in either which students end up with teachers with different types of beliefs, or in how teachers with differing beliefs end up in different kinds of classrooms. (These results are also

consistent with a reverse causality argument, which would suggest that teachers form their beliefs about what is possible based on the interest and ability they observe in their students; I return to this potential interpretation in the concluding discussion of the paper.)

[Table 6 about here]

Analysis of the Effect of Teachers' Beliefs by Timing. Due to differences in course offerings and grading practices across schools, as well as the extent to which grades are affected by inputs besides achievement such as effort and good behavior, the measures just described are weak proxies for achievement. Nevertheless, they appear to introduce some degree of signal regarding students' preparation and performance, rather than simply adding noise to the model. However, my last robustness check likely introduces less measurement error. HSLS:09 was fielded in the fall of the 2009 to 2010 academic year, so an additional concern is that outcomes are measured too early in the year for teacher effects to be measurable, rendering a null effect unsurprising. But the HSLS:09 study team administered the math assessment at varying points between September 2009 and February 2010. These dates are included with the data, so as a final step I run two models interacting teachers' beliefs with a linear measure of test timing and both linear and squared terms for timing (to account for non-linearities as high school students may switch teachers for the second semester of the year). That is, these models add interactions between teachers' beliefs and the timing of when the outcome variable was measured. If the relationship between teachers' beliefs and the outcome is entirely due to selection, we would not expect the relationship to change over time. On the other hand, if the relationship is causal, we would expect that more time with the teacher leads to a stronger effect on student outcomes.

Models 7a and 7b in Table 6 shows results from these models, which keep the control for the student's grade in his or her 8th grade math class; despite being a weak proxy, it accounts for some degree of selection and provides a more conservative model. Thus, the results in Models 7a

and 7b are net of preparation (to the extent it is captured in the 8th grade measure). These results indicate relatively large interaction effects for math achievement (marginally significant in Model 7a with $p = 0.055$, and more strongly significant in Model 7b), whereby the relationship between teachers' beliefs and student achievement grows stronger as the semester progresses—that is, as the student is exposed to the teacher longer. Together, the coefficients in Model 7a predict a negative relationship between teachers' beliefs and math achievement at the beginning of the school year—perhaps indicative of initial selection in student assignment to teachers—an association of about zero after one month, but then an effect of 2.6 percent of a standard deviation after two months, 5.5 percent of a standard deviation after 3 months, 8.4 percent of a standard deviation after 4 months, and even greater effects thereafter. The coefficients in Model 7b predict similar estimates at months zero and one, but then an effect of 5.4 percent of a standard deviation after two months, a peak effect of 7.2 percent of a standard deviation after three months, and 5.2 percent of a standard deviation after four months. (As a result of the negative coefficient on the squared term, the predicted association is close to zero after five months, suggesting a shift right around the time we would expect a new semester to be starting for high school students.) Thus, while the earlier robustness checks primarily indicate that selection drives the relationship between teachers' beliefs and achievement, this final set of analyses provides evidence that the observed association may in fact be causal.

Models Predicting Heterogeneous Effects of Teachers' Beliefs by Student Race and SES

Teachers' beliefs of empowerment to overcome social disadvantage may matter most when teachers actually teach students who truly face—or who teachers at least perceive to face—social and demographic disadvantages. If that is the case, the average effects of teachers' beliefs estimated above may mask differential benefits for certain subgroups. My next set of models tests this possibility by adding interactions between teachers' beliefs and student SES (Model 8),

race (Model 9), and SES-race combinations (Model 10) to a model maintaining all control variables from Model 6 above (the most conservative model, controlling for all student, teacher, and school characteristics as well as students' 8th grade math grade). For Models 8, 9, and 10, Table 7 displays coefficients on all terms that include teachers' beliefs—either their main effect or their interaction with other variables. In Model 8, we see no significant main effect of teachers' beliefs (and its size is similar to the analogous Model 6, above). And although the teachers' beliefs by SES interaction is negative, indicating teachers' beliefs matter more for lower SES students than higher SES students, it is not significant and its magnitude is virtually zero. Results in Model 9, which includes interactions between teachers' beliefs and student race, are quite similar, with a similarly sized (and insignificant) main effect and no significant interactions for any racial group.

[Table 7 about here]

However, the results in Model 10, with interactions between students' race and SES added and the interaction of teachers' beliefs with these race-by-class combinations as well, show that additional race- and class-based heterogeneity is masked in these previous two models. In particular, Model 10 shows significant variation by SES in the effect of teachers' beliefs for African American students, with increasing magnitude for higher SES blacks. This finding is in opposition to what accounts of "transformational" schools would suggest: rather than poorer black students benefitting most from having empowered teachers, it is more advantaged African American students who are most influenced by teachers' beliefs. The insignificant two-way beliefs-by-black and beliefs-by-SES interactions indicate that blacks and whites of low SES do not differ in the effect of teachers' beliefs, and that whites do not experience significant SES variation in the effect of teachers' beliefs. However, the significant three-way beliefs-by-black-by-SES coefficient (0.149) combined with the beliefs-by-SES coefficient (-0.020) indicates that

29

for each standard deviation increase in SES for African American students, the effect of teachers' beliefs increases by 12.9 percent of a standard deviation—a sizable relationship. We see similar SES variation in the effect of teachers' beliefs for multiracial students, although the magnitude is closer to 7.6 percent of a standard deviation. There are no significant differences in the effects of teachers' beliefs for other racial groups, although the SES gradient for Latino students is marginally significant; the negative coefficient would indicate that teachers' beliefs are more influential for lower SES Latinos than higher SES Latino students, but it is possible this relationship is no different than for whites.

Model 10 highlights the especially important role of teachers' beliefs for African American (and, to a lesser extent, multiracial students). Because in each case only the three-way interaction coefficient is significant, it is not obvious at what point on the SES distribution black or multiracial students differ from white students in how teachers' beliefs impact them. The results are more clearly interpreted when examined graphically. Figure 3 presents graphs of predicted achievement scores based on Model 10. Individual lines represent values of the SES distribution, and plot the predicted math scores for students across the range of teachers' beliefs along the horizontal axis, from two standard deviations below to two standard deviations above the mean. The predicted lines in Panel A for whites serve as a point of comparison; the lines are essentially flat, simply marking predicted achievement differentials by SES, indicating the lack of any significant relationship between teachers' beliefs and math achievement for white students. But Panel B for blacks is more striking, and represents the strongest significant result in how teachers' beliefs matter differentially for different demographic groups. The lines for the highest SES African American students, one or two standard deviations above mean SES, are steep, whereas the lines for black students below mean SES are closer to being flat. Lower SES blacks are predicted to have roughly the same math achievement regardless of their teachers'

30

beliefs. Achievement rises sharply, however, for higher SES blacks who have an empowered

teacher, and is predicted to be quite low among those with a teacher expressing helpless

attitudes. Mean math achievement among black students is -0.514 (standardized among the entire

sample). Thus, predicted math achievement for the highest SES black students with the most

helpless teachers is roughly a quarter of a standard deviation lower, while higher SES blacks

with the most empowered teachers are predicted to have achievement at least a half a standard

deviation higher than the black mean. The predicted math scores for high SES black students

with the most empowered teachers are similar to—or for the highest SES blacks, well above—

the achievement predicted for whites of a similar SES background and with similar teachers.

Results for multiracial students, in Panel C, reflect a similar, though less dramatic, pattern.

[Figure 3 about here]

These models already incorporate the most conservative robustness check for selection

used in the average models above, by controlling for students' 8th grade math grade. What if we

also subject them to the further causality check of adding an interaction with timing?

Incorporating a timing interaction into the beliefs-by-SES and beliefs-by-race models does not

illuminate any race or SES differences in the effect of teachers' beliefs. The estimates are either

too imprecise to reveal any significant effects of teachers' beliefs, or simply mirror the results of

the main timing interaction (Models 7a and 7b). Given the race-by-SES variation in the effect of

teachers' beliefs evident above, ideally a timing interaction could be incorporated into Model 10.

But this four-way interaction model is, unsurprisingly, highly imprecise and difficult to interpret.

Simply considering significant SES variation for African American students, the coefficients

suggest an increasing effect over time, but the magnitude is smaller than previously estimated.

(Results of these additional interaction models are not shown, but are available by request from

the author.) Taken together, these results provide some evidence that the association between

31

teachers' beliefs and achievement is especially strong for black and multiracial students, no evidence that there is other racial or SES variation in the effect of teachers' beliefs, and limited ability to conclude that the heterogeneity found can be interpreted as causal. The suggestive evidence that teachers' beliefs may be more influential for black and multiracial students at higher levels of SES should be investigated further in future research.

DISCUSSION

The results just described provide mixed evidence on the role that teachers' beliefs about social disadvantage play in student achievement. Teachers' beliefs are significantly related to achievement even controlling for student and teacher background characteristics. But the inclusion of controls for school contextual factors reduces the findings on teachers' beliefs to only marginal significance, and a control for the student's prior grade reduces it even further. Both of these findings indicate that the relationship initially observed between teachers' beliefs and math achievement is due to the types of students and teachers that select into certain schools, as well as how students and teachers are assigned to classes. However, the significant interaction between teachers' beliefs and the timing of the test administration, even net of prior preparation, provides evidence that the relationship between teachers' beliefs and math achievement is causal. It is not simply that students score higher when they are tested later in the school year, but teachers' beliefs actually matter more the longer a student has been exposed to the teacher. If the association between teachers' beliefs and achievement were solely due to selection, we would expect it to remain constant over time.

Beyond selection, another potential threat to causal inference is that teachers' beliefs about the extent to which social disadvantage is an obstacle could actually be shaped by their students' achievement level. This type of reverse causality argument would posit that perhaps

32

teachers judge the performance level of the students in their classes and then form their beliefs about how effective teaching can be. Reverse causality could plausibly produce the relationships I find. Unfortunately, in the absence of longitudinal data, I cannot directly test whether students' outcomes change in response to teachers' beliefs, or whether teachers' beliefs instead change in response to students' performance. One reason I am disinclined to believe that the relationships I observe are due to reverse causality is that evidence on teachers' beliefs about the nature of teaching suggests that these types of beliefs are actually formed early in teachers' own education and are relatively stable rather than being easily changed (Pajares 1992). The most direct way to test this possibility, though, would be with data that measures teachers and students over time—a type of research design that has been rare in the education world (as a case in point, HSLS:09 did not survey teachers in wave 2). Future research examining teachers' psychological and interactional qualities would shed additional light on these issues if teachers' were surveyed over time, and this paper provides evidence that greater attention to beliefs and attitudes in educational data collection efforts is warranted.

Research and popular literature give strong theoretical reasons to expect a causal relationship between teachers' beliefs and student outcomes, and my timing interaction model provides evidence that teachers with more empowered beliefs produce better achievement among their students. This effect is independent of a variety of human capital characteristics, but if some other important characteristic is correlated with these beliefs—some other attitude or training, for example—an alternative mechanism could be driving these results. Nevertheless, the analysis serves to document a notable relationship in how teacher qualities relate to student outcomes, and that this association exists on a national scale. A key goal of this paper was to isolate the role that teachers' beliefs about students' social disadvantage have in student achievement in a national sample of schools, rather than in the selective settings that have been highlighted in case

studies of "transformational" schools. It is important to note that although these results can be generalized to high schools and ninth grade math classes nationally, it is unknown whether these findings on teachers' beliefs can be generalized to teachers and classes in other subjects or at other grade levels. Future work will need to test this empirically to derive even more generalizable results about teachers' beliefs about students' social disadvantage.

I also examined how teachers' beliefs are differentially related to achievement for different groups of students, and I find interesting yet weaker evidence on this point. First, no differential effects of teachers' beliefs are apparent by student race or SES, even when considering exposure time to the teacher by incorporating the test timing interaction. However, I do find heterogeneity when students' race and class are considered simultaneously—in a way that is not as straightforward as accounts of "transformational" schools would imply. The relationship between teachers' beliefs and student achievement is particularly strong among higher SES African American students (and to a lesser degree, higher SES multiracial students). This is the opposite of what is suggested by literature on teachers' expectations and by case studies on "transformational" schools, which imply that lower-SES blacks—and potentially other students of color too—should benefit most from having a teacher with empowered attitudes. Examining the graphed predicted scores, we do not see any substantive effect of teachers' beliefs on achievement for the lowest SES blacks. However, math achievement among higher SES black students is predicted to be substantially higher when they have an empowered teacher, and quite low when they have a teacher with helpless attitudes. Having an empowered teacher is predicted to raise high SES African American students' achievement to at least a half a standard deviation above the average among black students, and to a similar level of achievement as whites from the same SES background have with similarly empowered teachers. More advantaged African

34

American students who have a helpless teacher, on the other hand, are predicted to have math achievement that is roughly a quarter of a standard deviation below the black mean.

It may be that in schools broadly, the doubly stigmatized status of being black and poor is obstinate enough that teachers' attitudes toward students make little difference. On the other hand, higher SES blacks may be especially influenced by apparent judgments about their potential. Since many affluent African Americans families trace their own backgrounds to more modest means, they may be highly aware of the precariousness of their social status. Lacy (2007) describes how upper-middle class black parents purposefully discuss with their children routes to reproducing their parents' status as well as the possibility of downward mobility if children follow the wrong path. Thus, for higher SES blacks an empowered teacher may be that "breath of fresh air" (Jussim et al. 1996: 355) that reinforces the possibility of reproducing advantage, whereas a helpless teacher may be the opposite message that reinforces the stigmatization of being black and the potential for downward mobility.

Theory about why teachers' beliefs should matter for student outcomes indicates that teachers' beliefs are made manifest in their behaviors, and that teacher behaviors influence students' own motivation and engagement. It may be that this is less the case for white, Latino, and Asian students than for black students. Perhaps these groups derive their attitudes toward schooling more from their family or home lives, rather than their experiences in school. Recent work on "oppositional culture" at least suggests that schooling experiences are an important influence on black youths' attitudes toward education, in that the minimal evidence of opposition to schooling among black adolescents appears to emerge principally as a reaction to the sense that schools devalue them and deprive them of key resources and equitable access (Harris 2011; Tyson 2011).

35

This part of the analysis is more limited in its ability to make causal claims, however, because incorporating timing as a fourth interaction unsurprisingly produces imprecise results. Although my race-by-SES interaction model accounts for many alternative causes of student achievement, including a rough proxy measure for students' prior math preparation, it remains a possibility that selection in which students have which teachers could actually be the source of heterogeneous effects of teachers' beliefs. For example, the lack of effects we see for students from low SES backgrounds could be because they are exposed to the lowest skilled teachers, who may be less able to translate their beliefs—whatever those beliefs may be—into concrete practices that affect student achievement. However, such low skills would have to be captured by some dimension of teacher preparation that is distinct from all of the aspects of teachers' human capital that I control for, and given that teachers' beliefs are independent of all measured human capital characteristics, such a story is hard to conceive.

Although there is reason to suspect at least some selection in which students are most exposed to teachers' with helpless or empowered beliefs, or in the types of schools these teachers work in, there is also theory and empirical evidence to suggest a stronger causal relationship between teachers' attitudes and student achievement for marginalized groups (Jussim et al. 1996). The results presented here provide some suggestive additional support for that, but also contest the focus on the most disadvantaged students by providing evidence of the disproportionate benefit more advantaged African Americans derive from educational resources—and conversely, the heightened vulnerability of more advantaged African Americans. There is a small but nontrivial group of teachers who hold very helpless beliefs, and these teachers may do particular damage to black students.

Taken together, the results in this paper indicate that teachers' beliefs about students' social disadvantage have an important relationship with student achievement, but that additional

36

research would help to more definitively establish these relationships (as well as confirm or reject their importance in "transformational" schooling). I find some evidence that a significant relationship between teachers' beliefs and achievement can be explained by factors selecting students into particular classrooms and schools, but also some evidence that the relationship between teachers' beliefs and math achievement is causal, as it grows stronger with greater exposure. These competing explanations suggest that the most likely conclusion is that both selection and causality are at work.

Given that variability in teacher effectiveness is not adequately explained by teachers' human capital characteristics alone (Rivkin et al. 2005), and that this paper finds that teachers' beliefs are independent of teachers' human capital in their relationship to student achievement, an additional contribution is in showing that these two strains of research on teachers can be combined to reach a more complete understanding of teachers' role in student outcomes. In studying student outcomes, teachers' beliefs add new rather than redundant information about teachers' capabilities. Although I find that the role of teachers' beliefs is independent of teachers' human capital, I also find that their role is of a smaller magnitude than several human capital characteristics are predicted to have, which is an important contribution to our understanding of teacher effects on students. Considering Model 4, which was used to compare how various teacher qualities relate to achievement, a one standard deviation increase in teachers' beliefs about students' social disadvantage predicts roughly a 4.5 percent of a standard deviation increase in math outcomes. By comparison, having a teacher who has been at the school for more than two years (i.e. is not new) predicts math outcomes that are a tenth to a quarter of a standard deviation higher. And having a teacher with no certification predicts over half of a standard deviation lower math achievement. These results may indicate that teachers' human capital is an appropriate focus for education policy that aims to provide students with the

37

most effective teachers. However, the estimated effect of teachers' beliefs about students' social disadvantage appears much larger in the model that considers the timing of the test. And the beliefs tested in this analysis represent only a small subset of the psychological traits that teachers bring to their interactions with students.

Given the independence of teachers' beliefs from their human capital, these results highlight the role of teachers' beliefs about students' social disadvantage, and raise the possibility that a more complete measurement of teachers' other attitudes could provide a missing link in understanding differences in teacher effectiveness—currently a key focus in research to understand how educational factors contribute to student outcomes. Moreover, the surprising finding that teachers' beliefs are most strongly associated with achievement for high SES African American students underlines the importance of studying the intersection of race and SES, and a greater need to understand the educational experiences of students of color across the social class spectrum.

NOTES

---

[1] Although a second wave of data is available, HSLS:09 did not follow teachers.

[2] Construction of the teacher dataset is described in Appendix A.

[3] Sample sizes are rounded to the nearest ten to comply with NCES license requirements.

[4] Models are estimated on multiple complete datasets (10 in this paper, the maximum allowed in HLM) and results are combined to account for variance in imputed values across the datasets. Because units at lower levels cannot have different values at higher levels (e.g. students in the same school cannot have different values on school variables), I performed imputation in three successive steps, whereby missing school data were imputed first; missing teacher data were imputed second, incorporating school variables into the imputation model; and missing student data were imputed third, incorporating school and teacher variables into the imputation model.

[5] A more complete description of the math assessment methodology and full documentation on HSLS:09 can be accessed at http://nces.ed.gov/surveys/hsls09/hsls09_data.asp.

[6] College selectivity is measured by merging data from the NCES-Barron's Admissions Competitiveness Index Data Files to data in HSLS:09 on the higher education institutions that teachers' attended. Merging involved a multi-step approach based on the closest matching year, the selectivity ranking of the most competitive institution ever attended, and publicly-available IPEDS data on open admissions colleges. Additional description of this process is available from the author.

[7] A model with school fixed effects would be another approach to this question. I do not employ a fixed effects approach for a few reasons. Conceptually, an important part of the motivation for studying teachers' beliefs about students' social disadvantage comes from the different types of schools where empowered teacher beliefs have been highlighted. About one fourth of the variation in both teachers' beliefs and student achievement is between schools in HSLS:09. This

partitioning of the variance could be the source of difficulty in estimating a fixed effects model. Additionally, with school fixed effects, measurement error will contribute a greater proportion of variation to my estimates than in a random effects model. Because both my key independent variable and my outcome variables may contain some measurement error, I opt not to magnify any bias that may cause.

[8] Because teachers were not directly sampled in HSLS:09 but can be separated from student data and considered as a distinct level of analysis, I derived weights for teacher-level data by calculating the teacher's probability of selection as a function of the joint probabilities of her or his students' selection probabilities. Construction of the teacher weights is described in Appendix B.

[9] This categorization of math courses is based on a categorization of high school math courses in similar NCES data created by Burkam and Lee for a 2003 U.S. Department of Education report.

Appendix A: Construction of Teacher Data

HSLS:09 surveyed the math and science teachers of sampled ninth graders. Due to this sampling strategy, HSLS:09 does not provide teacher-identified datasets that exclusively include teacher data. Instead, teachers' survey responses are provided as variables on the student data records. These teacher responses include variables representing teachers' self-reports about their own characteristics, background, and attitudes, as well as variables representing teachers' responses to questions about the class attended by each sampled student that the teacher taught.

In order to analyze data at the teacher level and facilitate nesting students within teachers/classrooms for multilevel analyses, it was necessary to construct data files that are identified by teachers, rather than by students. To do this, students were nested within schools and their values on all math teacher variables that are specific to the teacher herself were retained. (Variables that represent her assessment of the class were not, as they might vary across students if the teacher taught more than one sampled student). These teacher-specific variables include 137 measures such as teacher sex and race, years of experience teaching and certification type, evaluation of whether certain issues were problems for the school, and college major, to name just a few. These variables all represent self-reports by the teacher, and some values are even coded verbatim as string values (such as college major). Values on these teacher variables were then compared across the "student" dataset, and if *all* 137 values matched across records, including the school identifier, the records were confidently considered to represent the same unique teacher. These teachers were then assigned a unique teacher identifier that can be linked back to the student record and the data were collapsed to contain only one record of data per math teacher.

Appendix B: Deriving Teacher-Level Weights in HSLS:09

Just as HSLS:09 did not provide teacher questionnaire responses as teacher-level data

(see Appendix A), no teacher-level weights are included with the NCES-release data. In order to

gain substantial overlap between students sampled and teachers interviewed, teachers were

selected based on being the math or science teacher of a ninth grader that was selected in the

random sample of students. In this respect, HSLS:09 teachers represent a quasi-random sample

of the math and science teachers experienced by ninth graders in the 2009 to 2010 school year.

This provides a justification for deriving survey weights for the teachers, which is important for

making inferences not just to the population of students experienced by these teachers, but to the

population of teachers that students nationally experience. The quasi-random manner in which

teachers were selected ensures that the probability of observing a teacher is a function of the

probability of sampling and observing the *b* students who have that teacher.

Specifically, the probability of observing the teacher, *j*, is equal to the probability of

observing at least one of the students, *i*, who has that teacher. The probability of observing at

least one of a teacher's students is logically equivalent to 1 minus the probability of observing

none of that teacher's students. Thus, the probability of observing the teacher can be represented

as:

$$Prob(observed)_j = Prob(\bigcup_{i=1}^{b} observed)_i = 1 - Prob(\bigcap_{i=1}^{b}(not\ observed)_i)$$

Similarly, the probability of not observing an individual student, *i*, is equivalent to 1 minus

Prob(observed)ᵢ. Furthermore, we know that conditional on the school having been selected,

HSLS:09 sampled individual students at that school independently. In general, when two events

are independent, the joint probability of their occurrence is equal to the product of their two

probabilities—that is, P(A and B) = P(A)*P(B). This rule allows the intersection in the equation above to be represented as a product, as follows:

$$Prob(observed)_j = 1 - \prod_{i=1}^{b}(Prob(not\ observed)_i) = 1 - \prod_{i=1}^{b}(1 - Prob(observed)_i)$$

This equation represents the teacher's probability of selection in a way that can be calculated based on available data regarding student probabilities of selection.

The creation of weights for the math teachers in HSLS:09 began with the mathematics course enrollee weight (W1MATHTCH) that HSLS:09 provides for individual students. These student-level weights include adjustments for nonresponse on the part of schools, students, and course-specific teachers, and are only non-missing and non-zero if a sampled student was enrolled in a math course and was not considered questionnaire-incapable by HSLS:09 (see Chapters 3 and 6, HSLS:09 Base-Year Data File Documentation).

In deriving teacher-level weights from these student-level weights, it is assumed that

$$W_{student*course,i} \cong \frac{1}{Prob(observed)_i}$$

That is, $W_{student*course,i}$, which is W1MATHTCH, is approximately equal to the inverse of the probability that the student, i, is sampled and observed. Under this assumption, the probability of observing the teacher, j, can be re-written as:

$$Prob(observed)_j = 1 - \prod_{i=1}^{b}(1 - \frac{1}{W_{student*course,i}})$$

Using this formula, teacher probabilities were calculated by (1) calculating the individual student probabilities as the reciprocal of the individual student*course weight, (2) taking the complement of the student probability, (3) multiplying all of these complements together within-teacher, and

(4) taking the complement of that total. Finally, the teacher weight, W_j, is calculated as the

inverse of the probability of observing the teacher. That is,

$$W_j = (Prob(observed)_j)^{-1} = \frac{1}{1 - \prod_{i=1}^{b}(1 - Prob(observed)_i)}$$

REFERENCES

Angrist, Joshua D., Susan M. Dynarski, Thomas J. Kane, Parag A. Pathak, & Christopher R. Walters. 2012. "Who Benefits from KIPP?" *Journal of Policy Analysis and Management* 31(4): 837-860.

Angrist, Joshua D., Parag A. Pathak, & Christopher R. Walters. 2011. "Explaining Charter School Effectiveness." National Bureau of Economic Research (NBER) Working Paper Series, Working Paper 17332. Available at http://www.nber.org/papers/w17332.

Chenoweth, Karin. 2007. *"It's Being Done": Academic Success in Unexpected Schools*. Cambridge, Massachusetts: Harvard Education Press.

Darling-Hammond, Linda & Peter Youngs. 2002. "Defining 'Highly Qualified Teachers': What Does 'Scientifically-Based Research' Actually Tell Us?" *Educational Researcher* 31(9): 13-25.

Dobbie, Will & Roland G. Fryer, Jr. 2011. "Are High-Quality Schools Enough to Increase Achievement Among the Poor? Evidence from the Harlem Children's Zone." *American Economic Journal: Applied Economics* 3(3): 158-187.

Downey, Douglas B. & Shana Pribesh. 2004. "When Race Matters: Teachers' Evaluations of Students' Classroom Behavior." *Sociology of Education* 77(4): 267-282.

Downey, Douglas B., Paul T. von Hippel, & Beckett A. Broh. 2004. "Are Schools the Great Equalizer? Cognitive Inequality during the Summer Months and the School Year." *American Sociological Review* 69(5): 613-635.

Ferguson, Ronald F. 2003. "Teachers' Perceptions and Expectations and the Black-White Test Score Gap." *Urban Education* 38(4): 460-507.

Gamoran, Adam. 2001. "American Schooling and Educational Inequality: A Forecast for the 21st Century." *Sociology of Education* 74(Extra Issue: Current of Thought: Sociology of Education at the Dawn of the 21st Century): 135-153.

Gibson, Sherri & Myron H. Dembo. 1984. "Teacher Efficacy: A Construct Validation." *Journal of Educational Psychology* 76(4): 569-582.

Goldhaber, Daniel D. & Dominic J. Brewer. 2000. "Does Teacher Certification Matter? High School Certification Status and Student Achievement." *Educational Evaluation and Policy Analysis* 22(2): 129-146.

Good, Thomas L. 1987. "Two Decades of Research on Teacher Expectations: Findings and Future Directions." *Journal of Teacher Education* 38: 32-47.

Guskey, Thomas R. & Perry D. Passaro. 1994. "Teacher Efficacy: A Study of Construct Dimensions." *American Educational Research Journal* 31(3): 627-643.

Harris, Angel L. 2011. *Kids Don't Want to Fail: Oppositional Culture and the Black-White Achievement Gap*. Cambridge, MA: Harvard University Press.

Hoy, Wayne K., Scott R. Sweetland, & Page A. Smith. 2002. "Toward an Organizational Model of Achievement in High Schools: The Significance of Collective Efficacy." *Educational Administration Quarterly* 38(1): 77-93.

Jussim, Lee & Kent D. Harber. 2005. "Teacher Expectations and Self-Fulfilling Prophecies: Knowns, Unknowns, Resolved and Unresolved Controversies." *Personality and Social Psychology Review* 9(2): 131-155.

Jussim, Lee, Jacquelynne Eccles, & Stephanie Madon. 1996. "Social Perception, Social Stereotypes, and Teacher Expectations: Accuracy and the Quest for the Powerful Self-Fulfilling Prophecy." *Advances in Experimental Social Psychology* 281-388.

Kane, Thomas J., Jonah E. Rockoff, & Douglas O. Staiger. 2008. "What does certification tell us about teacher effectiveness? Evidence from New York City." *Economics of Education Review* 27: 615-631.

Kopp, Wendy. 2011. *A Chance to Make History: What Works and What Doesn't in Providing an Excellent Education for All* (with Steven Farr). New York: PublicAffairs.

Lacy, Karyn R. 2007. *Blue-Chip Black: Race, Class, and Status in the New Black Middle Class*. Berkeley, CA: University of California Press.

Lankford, Hamilton, Susanna Loeb, & James Wyckoff. 2002. "Teacher Sorting and the Plight of Urban Schools: A Descriptive Analysis." *Educational Evaluation and Policy Analysis* 24(1): 37-62.

Lee, Valerie E. 2000. "Using Hierarchical Linear Modeling to Study Social Contexts: The Case of School Effects." *Educational Psychologist* 35(2): 125-141.

Lee, Valerie E. & David T. Burkam. 2003. "Dropping Out of High School: The Role of School Organization and Structure." *American Educational Research Journal* 40(2): 353-393.

Lee, Valerie E. & Julia B. Smith. 1996. "Collective Responsibility for Learning and Its Effects on Gains in Achievement for Early Secondary Students." *American Journal of Education* 104(2): 103-147.

Lee, Valerie E. & Susanna Loeb. 2000. "School Size in Chicago Elementary Schools: Effects on Teachers' Attitudes and Students' Achievement." *American Educational Research Journal* 37(1): 3-31.

McKown, Clark & Rhona S. Weinstein. 2008. "Teacher expectations, classroom context, and the achievement gap." *Journal of School Psychology* 46: 235-261.

Merton, Robert K. 1948. "The Self-Fulfilling Prophecy. *Antioch Review* 8(2): 193-210.

Paige, Rod & Elaine Witty. 2010. *The Black-White Achievement Gap: Why Closing It Is the Greatest Civil Rights Issue of Our Time*. New York: AMACOM.

Pajares, M. Frank. 1992. "Teachers' Beliefs and Educational Research: Cleaning Up a Messy Construct." *Review of Educational Research* 62(3): 307-332.

Palardy, Gregory J. & Russell W. Rumberger. 2008. "Teacher Effectiveness in First Grade: The Importance of Background Qualifications, Attitudes, and Instructional Practices for Student Learning." *Educational Evaluation and Policy Analysis* 30(2): 111-140.

Payne, Kevin J. & Bruce J. Biddle. 1999. "Poor School Funding, Child Poverty, and Mathematics Achievement." *Educational Researcher* 28(6): 4-13.

Peske, Heather G. & Kati Haycock. 2006. "Teaching Inequality: How Poor and Minority Students Are Shortchanged on Teacher Quality." Report. Washington, DC: The Education Trust. June 2006.

Ravitch, Diane. 2010. *The Death and Life of the Great American School System: How Testing and Choice Are Undermining Education*. New York: Basic Books.

Reardon, Sean F. 2011. "The Widening Academic Achievement Gap Between the Rich and the Poor: New Evidence and Possible Explanations." Pp. 91-115 in *Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances*, edited by G.J. Duncan and R.J. Murnane. New York: Russell Sage Foundation.

Rice, Jennifer King. 2010. "The Impact of Teacher Experience: Examining the Evidence and Policy Implications." Brief 11. National Center for Analysis of Longitudinal Data in Education Research (CALDER). August 2010.

Rist, Ray C. 1970. "Student Social Class and Teacher Expectations: The Self-Fulfilling Prophecy in Ghetto Education." *Harvard Educational Review* 40(3): 411-451.

Rivkin, Steven G., Eric A. Hanushek, & John F. Kain. 2005. "Teachers, Schools, and Academic Achievement." *Econometrica* 73(2): 417-458.

Rowan, Brian, Richard Correnti, & Robert J. Miller. 2002. "What Large-Scale, Survey Research Tells Us About Teacher Effects on Student Achievement: Insights from the *Prospects* Study of Elementary Schools." Consortium for Policy Research in Education. CPRE Research Report Series, RR-051.

Steele, Claude M. & Joshua Aronson. 1995. "Stereotype Threat and the Intellectual Test Performance of African Americans." *Journal of Personality and Social Psychology* 69(5):797-811.

Teddlie, Charles. 2010. "The Legacy of the School Effectiveness Research Tradition." In *Second International Handbook of Educational Change*. A. Hargreaves et al. (eds.). Springer International Handbooks of Education 23.

Tschannen-Moran, Megan & Anita Woolfolk Hoy. 2001. "Teacher efficacy: capturing an elusive construct." *Teaching and Teacher Education* 17:783-805.

Tenenbaum, Harriet R. & Martin D. Ruck. 2007. "Are Teachers' Expectations Different for Racial Minority Than for European American Students? A Meta-Analysis." *Journal of Educational Psychology* 99(2): 253-273.

Tyson, Karolyn. 2011. *Integration Interrupted: Tracking, Black Students, & Acting White After Brown*. New York: Oxford University Press.

Wenglinsky, Harold. 1997. "How Money Matters: The Effect of School District Spending on Academic Achievement." *Sociology of Education* 70(3): 221-237.

Wilson, Steven F. 2008. "Success at Scale in Charter Schooling." Working Paper 2008-02. American Enterprise Institute Future of Education Project.

Woolfolk, Anita E. & Wayne K. Hoy. 1990. "Prospective Teachers' Sense of Efficacy and

    Beliefs About Control." *Journal of Educational Psychology* 82(1): 81-91.

U.S. Department of Education, National Center for Education Statistics. 2003. "Mathematics,

    Foreign Language, and Science Coursetaking and the NELS:88 Transcript Data." By David

    T. Burkam and Valerie E. Lee. NCES 2003-01. Project Officer Jeffrey Owings. Washington,

    DC.

Figure 1. Conceptual Framework for Understanding How Teachers' Beliefs Affect Student Outcomes
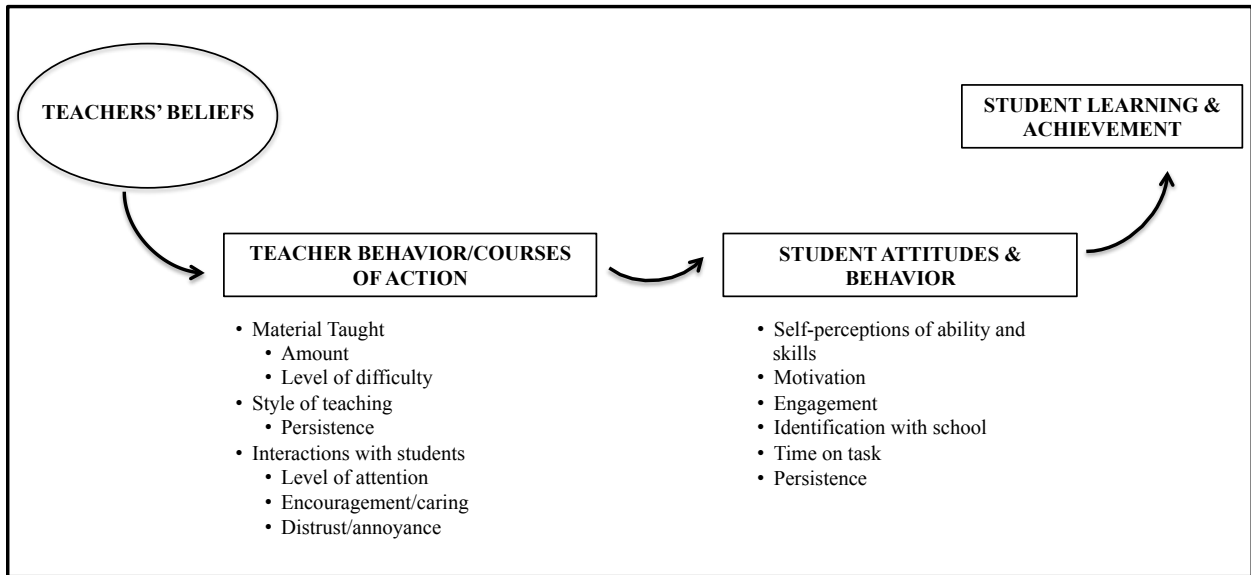
Figure 2. Confirmatory Factor Analysis Model of Teachers' Beliefs
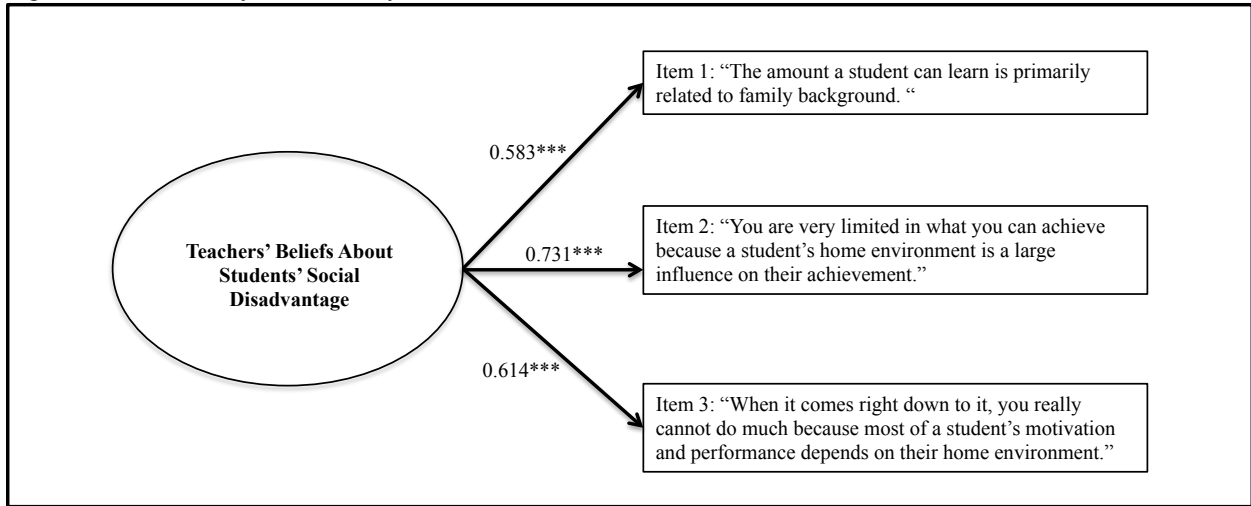
Note: Standard errors clustered by school. Coefficient of determination = 0.694.

Table 1. Full Distributions of Items Used to Measure Teachers' Beliefs About Students' Social Disadvantage

"The amount a student can learn is primarily related to family background"

Response	Frequency	Weighted Percent
Strongly agree	140	3.73
Agree	890	20.98
Disagree	2,250	57.12
Strongly disagree	730	18.18
Total	4,010	100

"You are very limited in what you can achieve because a student's home environment is a large influence on their achievement"

Response	Frequency	Weighted Percent
Strongly agree	260	7.31
Agree	1,440	38.43
Disagree	2,100	48.74
Strongly disagree	210	5.52
Total	4,010	100

"When it comes right down to it, you really can not do much because most of a student's motivation and performance depends on their home environment"

Response	Frequency	Weighted Percent
Strongly agree	70	1.46
Agree	580	16.01
Disagree	2,590	64.74
Strongly disagree	780	17.80
Total	4,010	100

Note: Teachers' responses are weighted to approximate national representativeness for ninth grade math teachers. Overall N and cell frequencies are rounded to the nearest ten to comply with NCES license requirements. Numbers that do not sum properly are due to rounding error.

Table 2. Descriptive Statistics of Students

	Analytic Sample of 9th Graders Taking Math		Full HSLS:09 Sample Representative of 9th Graders in U.S.	
	Weighted Mean	SD	Weighted Mean	SD
Demographic Characteristics				
Sex				
Female	0.498	–	0.497	–
Male	0.502	–	0.503	–
Race				
White	0.530	–	0.518	–
Black	0.128	–	0.135	–
Hispanic/Latino	0.217	–	0.222	–
Asian/Pacific Islander	0.039	–	0.040	–
Native American/Alaska Native	0.006	–	0.007	–
2+ races	0.080	–	0.077	–
Student's first language				
English only	0.828	–	0.824	–
Other language only	0.107	–	0.115	–
English and other language equally	0.065	–	0.061	–
Age	14.860	0.596	14.874	0.611
Family structure				
Two-parent	0.576	–	0.568	–
One-parent plus partner/guardian	0.167	–	0.168	–
One-parent	0.212	–	0.219	–
Other	0.046	–	0.045	–
Socioeconomic status (HSLS:09 scale)[†]	1.351	0.961	1.340	0.963
Outcome				
Math Achievement Score[†]	-0.087	0.991		
N	16,040		21,440	

Note: Sample sizes are rounded to the nearest ten to comply with NCES license requirements.
† These variables have been standardized to initially have mean 0 and standard deviation 1. SES has also been linearly rescaled to move its mean to equal 1.5, such that a value of SES=0 represents 1.5 standard deviations below the mean (i.e. low SES). The values displayed here only differ from these standardized values due to sample weighting.

Table 3. Descriptive Statistics of Teachers

	Weighted Mean	SD
Demographic Characteristics		
Sex		
Female	0.582	–
Male	0.418	–
Race		
White	0.784	–
Black	0.057	–
Hispanic/Latino	0.091	–
Asian/Pacific Islander	0.049	–
2+ races or American Indian	0.020	–
Human Capital Characteristics		
Highest Degree Received		
BA or AA	0.440	–
MA	0.519	–
Educational Specialist diploma	0.018	–
PhD/MD/law degree/other professional degree	0.022	–
College Selectivity Ranking (Barron's) [†]		
Most competitive	0.051	–
Highly competitive	0.088	–
Very competitive	0.241	–
Competitive	0.456	–
Less competitive	0.108	–
Noncompetitive	0.050	–
Special	0.006	–
Math-related job prior to teaching	0.258	–
Alternative certification	0.269	–
Certification Status		
None	0.074	–
Regular	0.778	–
Probationary	0.048	–
Emergency/temp/waiver	0.100	–
Years taught 9-12 (max. of math, science, or any subject)	10.316	8.610
Teacher is new (1st or 2nd year) to current school	0.239	
Teachers' beliefs about students' social disadvantage[‡]	-0.029	1.018
N	4,010	

Note: Sample sizes are rounded to the nearest ten to comply with NCES license requirements.

† The seven Barron's rankings are shown as categories for descriptive purposes, but for simplicity regression models control for selectivity as a continuous variable, as tests indicated no non-linearity that would require using indicators as predictors of students' outcomes.

‡The teachers' beliefs measure has been standardized to have mean 0 and standard deviation 1. The values displayed here only differ from these standardized values due to sample weighting.

Table 4. Descriptive Statistics of Schools

	Weighted Mean	SD
Basic Institutional/ Organizational Features		
Sector		
Public	0.761	–
Catholic	0.050	–
Private	0.189	–
Location		
Suburban	0.227	
Urban	0.212	–
Town	0.166	–
Rural	0.396	–
Region		–
South	0.340	–
Northeast	0.174	–
Midwest	0.294	–
West	0.192	–
Number of students (school size)	670.759	668.812
Gradespan (lowest grade elementary or middle)	0.385	–
Average daily attendance	93.500	6.135
Enrollment (percent capacity to which school is filled)	87.300	13.829
Instructional Environment		
Does NOT offer AP or IB courses	0.292	–
School Academic Composition		
School failing to meet AYP[†]	0.300	–
Year of "In Need of Improvement" for AYP[†]		
0	0.800	–
1	0.076	–
2	0.068	–
3	0.035	–
4	0.014	–
5	0.008	–
% of 2008-09 seniors who went to 4-year college	49.821	28.370
School Race/Class Composition		
% Receiving free/reduced-price lunch	36.895	27.303
% White	70.192	30.700
% Black	13.267	22.352
% Latino	11.925	19.638
% Asian	2.933	6.536
% Native American	1.683	8.237
School Reform Characteristics		
Charter school	0.043	–
Average instructional hours per day	6.089	0.655
School/district offers incentives to attract teachers	0.185	–
N	890	

Note: Sample sizes are rounded to the nearest ten to comply with NCES license requirements.
† Because only public schools are subject to "adequate yearly progress" mandates, Catholic and private schools are coded as not failing to meet AYP and in year 0 of AYP improvement.

Table 5. Coefficients from Multilevel Models of Teachers' Beliefs about Students' Social Disadvantage Predicting Students' Math Achievement

	Model 1	Model 2	Model 3	Model 4
Teachers' Beliefs About Social Disadvantage	0.067[*]	0.052[*]	0.055[*]	0.044
	(0.028)	(0.024)	(0.023)	(0.024)
Student Background Controls		✓	✓	✓
Teacher Demographic & Human Capital Controls			✓	✓
School Context Controls				✓
Coefficients on Teachers' HC Characteristics (Model 4 only)				
Highest Degree Received (ref: MA)				
College degree				0.028
				(0.048)
Educational Specialist diploma				0.102
				(0.123)
Doctorate or Professional degree				0.181
				(0.128)
College Selectivity				0.023
				(0.016)
Previous math-related job				0.006
				(0.050)
Alternative certification				-0.040
				(0.051)
Certification Status (ref: Regular)				
No Certification				-0.560[***]
				(0.088)
Probationary Certification				-0.067
				(0.095)
Emergency Certification				-0.222[**]
				(0.079)
Years of teaching experience				0.002
				(0.002)
New to current school				-0.119[*]
				(0.052)
Observations				
Schools				890
Teachers				4,010
Students				16,040

Note: Models include controls indicated and are weighted at each level. Standard errors in parentheses. Full model results including coefficients for control variables are available by request from the author.
[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Table 6. Coefficients from Robustness Checks Adding Controls for Proxies of Math Level/Preparation and Interactions Between Teachers' Beliefs and Timing of Test Administration to Multilevel Models of Teachers' Beliefs about Students' Social Disadvantage Predicting Students' Math Achievement

	Model 5	Model 6	Model 7a	Model 7b
Teachers' Beliefs About Social Disadvantage	0.027	0.021	-0.032	-0.096[*]
	(0.022)	(0.022)	(0.032)	(0.038)
Student Background Controls	✓	✓	✓	✓
Teacher Demographic & Human Capital Controls	✓	✓	✓	✓
School Context Controls	✓	✓	✓	✓
Indicators for 9th Grade Math Course Level	✓			
Grade in 8th Grade Math Course		✓	✓	✓
Timing Interactions				
Teachers' Beliefs*Test month			0.029	0.113[**]
			(0.015)	(0.041)
Teachers' Beliefs*Test month^2				-0.019[*]
				(0.009)
Observations				
Schools	890	890	890	890
Teachers	4,010	4,010	4,010	4,010
Students	16,040	16,040	16,040	16,040

Note: Models include controls indicated and are weighted at each level. Standard errors in parentheses. Full model results including coefficients for control variables are available by request from the author.
[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Table 7. Coefficients from Multilevel Models Predicting Students' Math Assessment Score, with Teachers' Beliefs Interacted with Students' Race and Socioeconomic Status

	Model 8	Model 9	Model 10
	Teachers' Beliefs Interacted with Student SES	Teachers' Beliefs Interacted with Student Race	Teachers' Beliefs Interacted with Student Race* SES
Teacher Level			
Teachers' Beliefs About Social Disadvantage	0.022	0.027	0.056
	(0.039)	(0.030)	(0.068)
Student Level (Cross-Level Interactions)			
Teachers' Beliefs*SES	-0.001		-0.020
	(0.024)		(0.033)
Teachers' Beliefs*Black		0.068	-0.083
		(0.045)	(0.073)
Teachers' Beliefs*Black*SES			0.149**
			(0.045)
Teachers' Beliefs*Latino		-0.117	-0.037
		(0.075)	(0.081)
Teachers' Beliefs*Latino*SES			-0.088
			(0.049)
Teachers' Beliefs*Asian		0.043	-0.027
		(0.059)	(0.120)
Teachers' Beliefs*Asian*SES			0.040
			(0.061)
Teachers' Beliefs* Native American		-0.027	-0.101
		(0.126)	(0.159)
Teachers' Beliefs* Native Amer.*SES			0.051
			(0.123)
Teachers' Beliefs* Multiracial		0.005	-0.133
		(0.068)	(0.107)
Teachers' Beliefs*Multiracial*SES			0.096*
			(0.047)
Observations			
Schools	890	890	890
Teachers	4,010	4,010	4,010
Students	16,040	16,040	16,040

Note: Models include controls for all student-, teacher-, and school-level covariates (including students' 8th grade math grade) and are weighted at each level. Standard errors in parentheses. Full model results including coefficients for control variables are available by request from the author.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 3. Predicted Achievement for White, African American, and Multiracial Students at Different SES Levels with Teachers Across the Range of Teachers' Beliefs Values, Based on Model 10
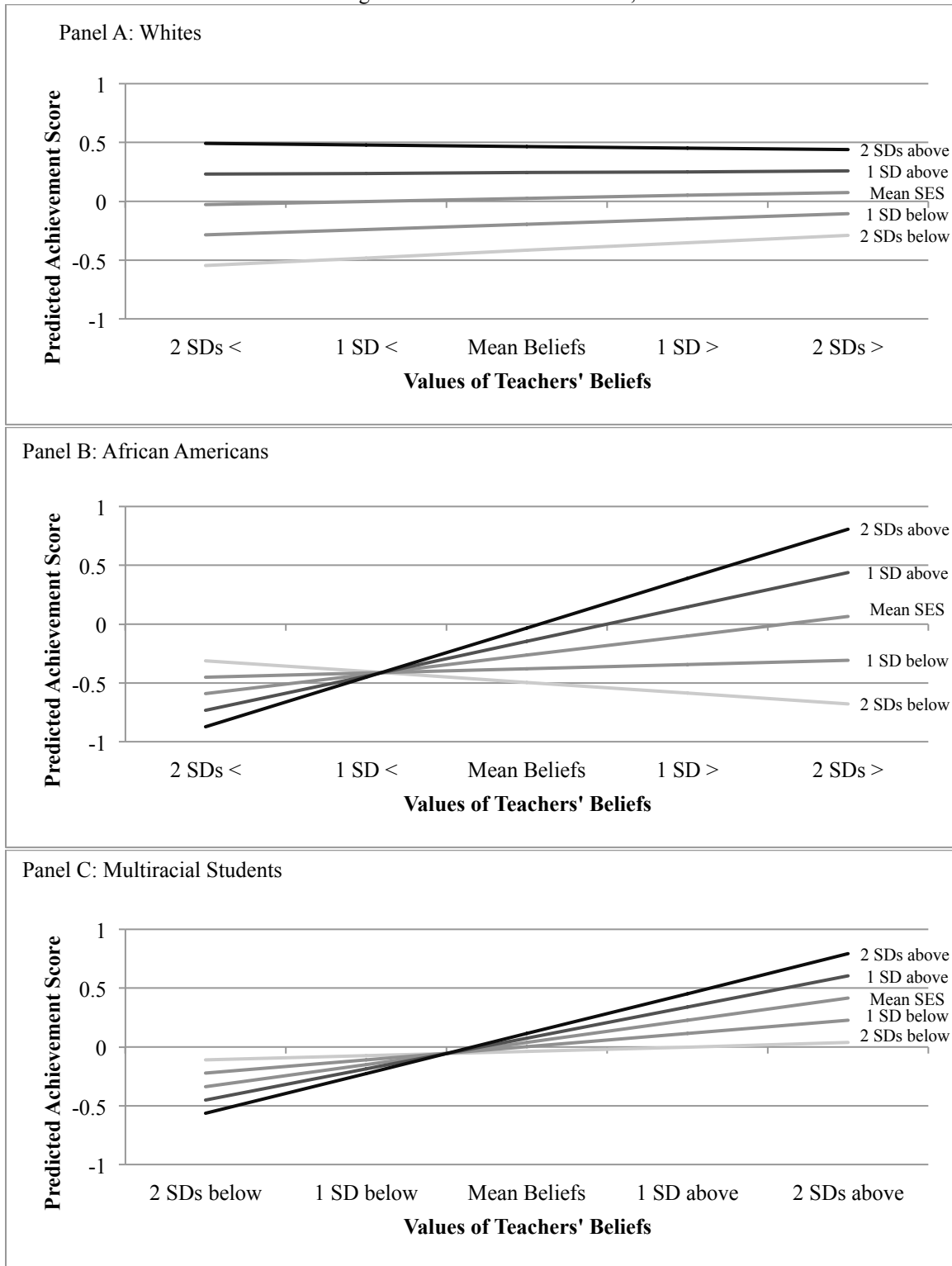
Note: Predicted scores, represented in standard deviations, based on Model 10 in Table 7 with all control variables set at their means. Mean achievement in the entire sample is 0. Mean achievement for whites (weighted) is 0.078. Mean achievement for blacks (weighted) is -0.514. Mean achievement for multiracial students (weighted) is -0.105.