BEYOND TEST SCORES: THE IMPACT OF BLACK TEACHER ROLE MODELS ON RIGOROUS MATH-TAKING

KRISTIN KLOPFENSTEIN

The low rates at which black high school students enroll in advanced math classes is a concern given the positive impact of rigorous math on eventual educational attainment and earnings. Curriculum choice is determined by prior academic achievement and expectations for future schooling, both of which can be influenced by effective role models. This paper finds that increasing the percentage of math teachers who are black has a non-trivial positive impact on the likelihood that a black Geometry student will take additional rigorous math. Black female teachers have a positive impact on the likelihood of math continuation for black male students while black male teachers have a positive impact on black female students.

I. INTRODUCTION

Black high school students participate in advanced math classes at low rates. In 1999, 24 percent of white high school juniors and seniors enrolled in Pre-calculus or Calculus, but only half as many black juniors and seniors enrolled in these same classes.[1] The low rates of advanced math-taking among black students should concern policymakers given that a rigorous high school math curriculum has been shown to have long-run implications for future labor market earnings and college success. The highest level of math completed is potentially a stronger predictor of bachelor's degree completion than socioeconomic status and has a greater impact on the graduation rates of black students than on white students (Adelman 1999). An advanced high school math curriculum not only affects wages by increasing the likelihood of post-secondary degree completion, it also has a unique direct impact on wages ten years after high school; the more demanding the math courses taken, the greater the earnings gain (Rose and Betts 2001).

The academic underachievement of black students relative to white students is often attributed to differences in family background characteristics such as income, family structure,

and parents' education (Phillips, et al 1998). In addition, black peers may discourage behavior conducive to academic success based on fears of "acting white" (Farkas, Lleras and Maczuga 2002, Cook and Ludwig 1998, Fordham and Ogbu 1986); predominantly black schools tend to have lesser school resources, including lower quality teachers (Phillips, et al 1998, Ferguson 1998b); and ability grouping practices (tracking) disproportionately place black students on remedial or vocational academic tracks (Oakes 1985, Losen and Orfield 2002, Gordon 2000). Black parents may also be less likely than white parents to intervene when their children are not placed in advanced academic tracks or in gifted and talented programs (Darity, et al 2001, Chmelynski 1998).

A less studied potential source of black underachievement is the shortage of culturally similar teacher role models. Poor black students, amongst whom teachers are often the only college-educated people they know, are in particular need of role models who (a) are interested in their educational progress; (b) understand the school system as an institution; and (c) actively encourage academic excellence and the pursuit of a challenging curriculum. Culturally similar teachers may take more interest in mentoring black students and have more credibility with those students. Given the importance of a rigorous mathematics curriculum and that math is frequently a gatekeeper subject for black students, same-race math teachers play a potentially vital role in preparing black students for their academic and working futures.

This paper examines the impact of black math teachers on the likelihood that a current black math student will choose to enroll in a rigorous math class in the following year. Students are only *allowed* to proceed to the next-level math class if they pass the pre-requisite class. Students will only be *willing* to proceed if they had a reasonably pleasant experience in the prerequisite class and/or they have strong expectations for attending college. The math

continuation decision provides a better indicator of the effectiveness of a student-teacher relationship than do test scores, which have been utilized in previous studies, since continuation is determined in part by academic achievement and in part by expectations for future schooling, both of which can be influenced by effective academic role models. Using the Texas Schools Microdata Panel, this paper finds that increasing the percentage of math teachers who are black has a non-trivial positive impact on the likelihood that a black Geometry student will take additional rigorous math.

II. THEORETICAL INFLUENCES OF MATH CONTINUATION

Black math teachers may increase the likelihood that a black math student pursues rigorous math by a) increasing learning such that a student has the option to continue and b) making learning a positive experience such that a student has the desire to continue.

A. Black teachers and student learning

Black students may learn more in math classes taught by same-race teachers for several reasons. "One common hypothesis is that all children learn more when their home and school environments are well matched," and same-race teachers are better able to provide black students with "cultural congruence" between home and school (Ferguson 1998b: 345). A common language can be a critical component of cultural congruence (Howard 2001). Delpit (1988) discusses cultural differences in oratory style that explain why white teachers might have difficulty maintaining a disciplined learning environment among black students. Orr (1987) suggests that some mathematical ideas can be confusing for Black English speakers due to grammatical differences between Black and Standard English.

There have been relatively few attempts to estimate the magnitude of the impact of same-race teachers on student learning. Existing empirical studies evaluate the impact of same-race

teachers on student achievement, usually via standardized test scores (Evans 1992, Dee 2001, Ehrenberg, Goldhaber & Brewer 1995, Ehrenberg & Brewer 1994, Farkas, et al 1990). Some studies find evidence that same-race teachers directly improve student learning as reflected by test scores (Evans 1992, Dee 2001) while others yield mixed results or find no effect (Ehrenberg, Goldhaber & Brewer 1995, Ehrenberg & Brewer 1995, Farkas, et al 1990). Orr's (1987) hypothesis that black students struggle in math and science due to differences between black and Standard English has received little attention in the literature and remains untested empirically.

B. Teacher expectations

Black teachers may have higher expectations for and interact more positively with black students than other teachers thereby increasing the motivation and self-esteem black students need to take on the challenge of rigorous coursework.[2] It is well documented that black teachers tend to have higher expectations of black students than do white teachers (Ferguson 1998b, Beady and Hansell 1981), and teacher expectations can have a strong influence on student effort. For example, "African-American [seventh- and eighth-grade] students show lower absenteeism and are reported to have better work habits when they have an African-American teacher" (Farkas, et al 1990: 134). Low teacher expectations can be particularly detrimental for "[l]ow socioeconomic status and low-achieving students of color [who] are usually more dependent on their teachers than middle-class SES students and are more often affected by the expectations that their teachers hold for them than are Euro-American students" (King 1993: 122). Studies conducted since the 1970s find that black students also receive less positive feedback and more criticism than white students and that race-based differences in the amount and type of contact a student receives continued into the mid-1990s (King 1993, Casteel 1998). Black teachers interviewed by Gordon (2000) expressed concern that even when white teachers were warm

towards black students, they "made excuses for them, felt sorry for them, [and] underestimated their abilities" (70).

C. Individual mentoring

Same-race teachers may be more likely to initiate one-on-one mentoring relationships with black students than non-black teachers. Through these relationships, students might learn about the benefits of pursuing a rigorous math curriculum and receive the encouragement to do so. Teachers may also advocate on students' behalf when students are placed in low-level courses (Foster 1997). "For many African-American children, African-American teachers represent surrogate parent figures, disciplinarians, counselors, role models, and advocates" (King 1993: 121).

Black teachers have personal experience as well as institutional knowledge that can be particularly valuable for young black students making their way through white-dominated society. "African American teachers are able to communicate with African-American students 'about the personal value, the collective power and the political consequences of choosing academic achievement' as opposed to failure. Such a communication process between African-American teachers and students includes African-American teachers' ability to involve students in exchanges which help students to become empowered and involved in their own education" (King 1993: 118, with reference to Foster 1990). Black teachers can be particularly helpful for black students attending predominantly white schools: "For these young people of color… the teacher of color who already has successfully negotiated [an upper-middle-class version of white-dominated society] could be a great source of wisdom, a provider of cues for behavior, a source of inspiration, and a cultural decoder" (Kane and Orsini 2003, 10).

D. Other influences of curriculum choice

In addition to black math teachers, many other factors influence student curriculum choice. Table 1 presents the expected impact of individual student characteristics, the school's culture of learning, math teacher characteristics, and overall mentoring opportunities on the likelihood that a math student will enroll in the next level math course. Discussion of these variables follows.

Intellectual ability is expected to have a positive impact on the likelihood of math continuation since the marginal cost of engaging in a year of rigorous math is lower for those of higher ability. The effect of grade in school is likely to be non-linear. Holding the level of the initial math course constant, students in a high grade are less likely to be college bound than similar lower-grade students (given their placement in a less rigorous academic track) and therefore perceive a lower marginal benefit to taking rigorous math; hence, students in the highest grade are expected to be less likely than students at the lowest grade to take rigorous math. Low income students are expected to be less likely than other students to pursue a rigorous math curriculum due to pressure to work and/or to carry a large burden of family responsibilities while attending school. Low income students are also less likely to expect to attend college.

The culture of learning within the school is also a potentially important determinant of a student's math continuation decision. If low value is placed on present and future schooling, as might be true in a rural school or a school with high rates of absenteeism, individual students are predicted to be less likely to study rigorous math. Conversely, if expectations are high for all students, as might be true in a school where black students are well-represented in advanced math classes and a large proportion of math peers carry their course of study forward into the

following year, individual students are more likely to enroll in rigorous math courses. Whether a high percentage of black peers is likely to generate a higher or lower value on schooling for black students is theoretically uncertain holding other observable factors constant.[3]

The quality of a math teacher is undoubtedly of primary importance in determining whether students continue on to more advanced study, but teacher quality is difficult to quantify. Generally speaking, we might expect inexperienced teachers to have a negative impact on math continuation and teachers with advanced degrees to have a positive impact on continuation given their (presumably) deep conceptual understanding of the material. Considering the difficulty many students have learning math, encouraging mentors are likely to have a positive influence on student math continuation. In addition to the positive effects black math students might derive from black teachers, students of all races are likely to receive greater individual mentoring at small schools with small class sizes. If sex-matched teachers have higher expectations for female students, female math teachers may have a positive impact on the likelihood of math continuation for female students.

III. DATA: THE TEXAS SCHOOLS MICRODATA PANEL

The following analyses are conducted using the Texas Schools Microdata Panel (TSMP), a proprietary dataset compiled and maintained by the UTD Texas Schools Project. The sample consists of black high school Geometry students in grades nine through eleven who attended Texas public high schools in the 1997-98 academic year (9120 black males and 10,971 black females).[4] White Geometry students in the same year and grades serve as the control group (40,045 white males and 41,461 white females). The dependent variable is dichotomous and equal to one if a Geometry student proceeds to enroll in Algebra II in 1999.

I choose to study the transition from Geometry to Algebra II because teachers familiar with Black English have the potential to significantly impact black student success in Geometry: prepositions and notions of distance, both of which have unique prominence in Geometry, generate a great deal of confusion among Orr's (1987) Black English speakers. Previous research examines student performance over less advanced material where pattern recognition might compensate for language-based confusion. Furthermore, a substantial number of black students attempt Geometry by the eleventh grade.

Table 2 provides descriptive statistics for the variables included in the empirical model. Intellectual ability is measured by eighth grade Texas Assessment of Academic Skills (TAAS) math scores and by a variable equal to one if a student was enrolled in a special education program in any year since 1989. Grade in school is captured by a set of dummy variables with ninth grade as the reference group. A variable equal to one if the student qualified for free or reduced lunch in any year since 1989 indicates low income.

The culture of learning in a school is represented by: the mobility rate, defined as the percentage of students who missed six or more weeks at school; rural location (designated at the county level); the percentage of all Geometry students at the school who go on to Algebra II; and the percentage of students at the school who are black. In addition, black representation in Geometry is measured as the percentage of Geometry students who are black divided by the percentage of all students in the school who are black. If this variable is equal to one, black students are proportionately represented in Geometry; if it is less than one, they are under-represented; and if it is greater than one, they are over-represented. Inspiration for this variable comes from Darity, et al (2001).

Unfortunately, the TSMP does not allow for the precise matching of students with their math teachers. Therefore, the characteristics of all math teachers at the student's school serve as a proxy for the student's actual Geometry teacher. Mentoring opportunities are reflected by the percentage of math teachers who are black (for black students), the percentage of math teachers who are female (for female students), student enrollment, and the student/teacher ratio.[5] The percentage of math teachers who are inexperienced (in their first or second year of teaching) and who have earned an advanced degree represent teacher quality. Ideally, this study would control for teacher quality using measures more strongly correlated with innate teaching ability such as attitude and enthusiasm, verbal skills, and subject-matter mastery, but this information is not available in the TSMP (Ehrenberg and Brewer 1995).

The descriptive statistics in Table 2 are unsurprising. Regardless of sex, a smaller proportion of black than white Geometry students persist into Algebra II. A larger proportion of black Geometry students are in the eleventh grade while a larger proportion of white Geometry students are in the ninth grade. White Geometry students have higher standardized test scores and black students are three times more likely to be economically disadvantaged. There is little difference in rates of special education experience between white and black students in the sample, but males are more likely to have been in special education than females. On average, black students attend larger, non-rural schools with higher mobility rates than do white students. There is evidence of greater racial equity in academic tracking at schools with large proportions of black students: black students tend to be under-represented in Geometry classes in the average white student's school but are proportionally represented in Geometry classes in the average black student's school.

Given the substantial racial segregation across Texas public schools, it is to be expected that the average black student attends a school serving a large percentage of black students and employing a relatively large number of black teachers. Table 3 indicates the frequency with which black and white students come into contact with black math teachers of either sex. The first line in each cell represents the number of schools employing the specified number of black male and female math teachers. For example, there were no black math teachers at 955 (79 percent) of schools. Because schools vary widely in size (predominantly white rural schools tend to be small), the second line in each cell reports the number of black students who attended schools with the designated number of black math teachers and the third line represents the number of white students. While 24 percent of black students attended schools with no black math teachers, 72 percent of white students attended such schools.

IV. EMPIRICAL RESULTS

Tables 4 and 5 provide heteroskedasticity-consistent logit estimates that predict the Algebra II enrollment decision of male and female Geometry students. Two models are estimated. The first model does not differentiate between black male and female math teachers. If math continuation depends only on a black teacher's ability to clarify issues relating to differences in meaning between Black and Standard English, as hypothesized by Orr (1987), then the percentage of math teachers who are black should have a positive impact on student math continuation regardless of teacher sex. Alternatively, if the ways in which black teachers impact the math continuation decision depend on teacher expectations and willingness to offer individual mentoring, then teacher race *and* sex may interact in complicated ways. To test the latter hypothesis, the second model distinguishes between male and female black math teachers.

In model 1, black Geometry students experience a significant positive effect on math continuation from a higher percentage of black math teachers. Since the math continuation of white students is not similarly affected, the positive impact of same-race teachers on black students does not appear to reflect unobserved differences in teacher quality by race. A positive impact of black teachers on black students that does not apply to white students is consistent with Orr's language hypothesis.

Model 2 indicates that there are differences in role model effectiveness by sex: black male teachers are more successful with black female students and vice versa. Same-race, same-sex teachers have no discernible impact on the math continuation decision of black students, and black teachers of either sex have no impact on the white male control group. Moreover, the adverse impact of black teachers on the math continuation of white female students seen in model 1 derives entirely from black female teachers; black male math teachers have no impact on the likelihood of white female math continuation. The fact that same-race, same-sex teachers do not influence black student math continuation in model 2 weakens the support for the theory that language barriers are important for Black English-speaking Geometry students.

The positive cross-sex effects of black math teachers are surprising since it is commonly believed that same-sex teachers have the potential to serve as role models in much the same way as same-race teachers. Hints about the underlying reasons for these cross-sex effects can be found in Ehrenberg, Goldhaber, and Brewer (1995) which finds no impact of race- and sex-matched black teachers on math *achievement* gains between the eighth and tenth grades but does find cross-sex differences with respect to black teachers' *subjective evaluations* of black students. Teachers were asked whether they thought a particular student related well to others, worked hard, and/or was likely to go to college and whether they spoke to that student outside of

class. Black male teachers rated black female math students significantly more positively than did white male teachers, but black female teachers rated black female students no differently than did white male teachers. Furthermore, black female teachers rated black male math students more positively than did any other category of teachers, including black males (although the difference from white male teacher evaluations was not statistically significant for any group). Ehrenberg, Goldhaber, and Brewer's (1995) results inform the present study by suggesting that the higher expectations of opposite-sex black teachers have a significant impact on the decision of black students to take rigorous math.

A potential source of bias in the model arises from the fact that the categorical variable of interest, whether a student has a black math teacher, is measured with error when proxied by the percentage of math teachers who are black. Assuming measurement error is assigned independently of the other included variables, it can be cast in the framework of an omitted variable (Greene 1997). Omitted variables in the logit model bias coefficient estimates towards zero, so the true role model effect from a black student/teacher match may be even larger than the significant positive coefficient on the proxy variable suggests (Cramer 1991). Better data are needed to gain an unbiased estimate of the true impact of black teachers on black student outcomes. Furthermore, data including measures of teacher content knowledge, pedagogical skills, and interpersonal skills might allow researchers to identify the underlying sources of the cross-sex effects observed here.

According to the results presented in Tables 4 and 5, black math teachers impart benefits on black students without adversely affecting the math continuation of white males; black female math teachers diminish the likelihood of math continuation for white female students, but black male teachers do not. It is possible that the black teacher coefficients in the white samples are

biased towards zero due to measurement error, as discussed above, or due to omitted variables describing parents' education and ex ante expectations regarding college attendance. Previous studies find evidence that black teachers have a negative impact on white student test scores, but additional research is needed to investigate the effects of cross-race teachers on a variety of outcomes including curriculum choice and college attendance in addition to test scores (Dee 2001, Ehrenberg and Brewer 1995).

Although the results presented in Tables 4 and 5 indicate statistically significant role model effects, in a logit model the estimated marginal effect of one variable depends on the values of all the other independent variables. Therefore, the coefficients presented must be transformed to determine the magnitude of the role model effect for a "typical" black student.[6] Suppose the typical black Geometry student is an economically disadvantaged tenth-grader with no special education experience. This student attends a non-rural school that employs no black math teachers and has the average characteristics for black students of the same sex for continuous variables such as test scores and school size. If this black Geometry student is male, he has a baseline 68.5 percent probability of enrolling in Algebra II; if this student is female, she has a baseline 72.1 percent probability of enrolling in Algebra II.

In this analysis, an increase in the fraction of black math teachers indicates an increased likelihood of being matched with a black Geometry teacher. Only cross-sex effects are significantly different from zero, so Figure 1 represents the marginal effect of increasing the proportion of black female math teachers on the predicted probability that a black male student will enroll in Algebra II while Figure 2 represents the marginal effect of black male math teachers on the probability of math continuation for black female students. In the schools attended by black students, black female teachers comprise approximately 17 percent of all math

teachers while black male teachers comprise an average of ten percent of all math teachers (Table 2). In addition, 32 percent of black students attend schools with no black female math teachers and 40 percent attend schools with no black male math teachers (Table 3).

The curve in Figure 1 indicates that as the percentage of black female math teachers increases from zero to the mean (17 percent), the predicted probability of math continuation for the typical black male student increases by 5.5 percent from 68.5 to 72.3. Increasing the fraction of black female math teachers from zero to one standard deviation above the mean (37 percent) increases the likelihood of math continuation by 9.6 percent; increasing the fraction from zero to two standard deviations above the mean (57 percent) increases the likelihood of math continuation by 11.2 percent.

Similarly, Figure 2 indicates that as the percentage of black male math teachers increases from zero to the mean (ten percent), the predicted probability of math continuation for the typical black female student increases by 3.3 percent from 72.1 to 74.5. Increasing the fraction of black male math teachers from zero to one standard deviation above the mean (22 percent) increases the likelihood of math continuation by 6.2 percent; increasing the fraction from zero to two standard deviations above the mean (34 percent) increases the likelihood of math continuation by 8.5 percent.

The control variable representing the degree to which black students are proportionately represented in Geometry relative to their presence in the school also warrants some attention. When black students are well-represented in Geometry, there is a positive impact on the likelihood of rigorous math continuation for both black and white students. Although the impact is larger for black students, the equity principle encapsulated in the black representation variable

is a clear proxy for some trait in schools that positively influences the math experience for both white and black students.

Estimates of the effects of the other control variables are approximately the same across the two models and are generally of the expected sign, and the capricious coefficients on observable measures of teacher quality and class size are consistent with previous studies (Hanushek 1986, Hanushek 1996, Burtless 1996). School enrollment does not affect the math continuation of black students and the percent of math teachers who are female does not affect black or white students.[7] Grade level variables behave as expected in that the oldest group is always the least likely to continue with rigorous math. However, black tenth-graders are more likely to pursue higher math than similar ninth-graders while white tenth-graders are less likely than similar ninth-graders to continue. This result is consistent with the descriptive statistics in that essentially all white ninth-grade Geometry-takers continue on to Algebra II (93 percent of males, 95 percent of females) while relatively fewer black ninth-graders do the same (71 percent of males, 81 percent of females).

V. POLICY RECOMMENDATIONS AND CONCLUSIONS

The evidence presented in this paper indicates that a shortage of black teacher role models serves as one barrier to the academic progress of black mathematics students. This result is simultaneously encouraging, because schools have the power to recruit more black teachers, and dismaying, because the teaching pool is growing increasingly white (Kane & Orsini 2003, Spellman 1988). Policymakers might respond with a three-pronged approach that emphasizes recruitment, retention, and training.

Successfully increasing the number of black teachers requires effort from a range of parties. The colleges and universities who train future teachers and the schools who

subsequently hire them need to engage in aggressive recruiting and retention efforts to draw talented black teachers into the classroom and keep them there. Young black adults have more lucrative career opportunities than ever before, and the lack of prestige associated with being an educator coupled with frequently ungratifying personal experiences in the education system prevent many from seriously considering teaching as a profession (King 1993). Universities might recruit black education majors from local community colleges, but in order to generate successful graduates, these universities must be willing to provide such transfer students with ongoing academic assistance, mentoring, and financial aid (Orsini 2003, Spellman 1988).

Actively recruiting existing university students to the teaching profession is also likely to be effective. Among the top three reasons liberal arts graduates give for not teaching is that nobody recruited them, and "[m]ore than a third of the black students who were surveyed said that they would be influenced by on-campus recruitment" (Orsini 2003, 35). In 1985, "only 38% of newly prepared candidates of color entered full-time teaching" compared with 50 percent of white candidates (King 1993, p. 131).

Teachers of color, teachers of math and science, and teachers in urban schools (which tend to have a high proportion of black students) leave the teaching profession at the highest rates (King 1993, p. 131). Teacher education programs can help remedy high turnover rates by better preparing teachers to cope with the difficulties associated with public education, from inadequate supplies to student drug abuse (Gordon 2000, King 1993). However, the bureaucracy of the school system is a detriment to a creative and motivated teaching force, and one approach to increasing retention is to create opportunities for meaningful personal relationships within the system. There are successful mentoring models in New York that bring retired teachers to work in the difficult classrooms with new teachers. At a minimum, administrators should support

mentoring programs by providing release time for willing veteran and new teachers to visit each other's classes (Orsini 2003).

Given that the majority of black students will continue to be taught by non-black teachers, "[w]hat is needed most is an understanding of the factors that might make minority teachers better at addressing the needs of minority children. Such an understanding would be a great benefit because it would provide a means for enhancing the skills of *all* teachers who work with minority children" (Cizek 1995, 90, emphasis in original). Although substantial research exists on the unique aspects of black teaching (Gordon 2000, Foster 1994, King 1993), more research is necessary to figure out how best to apply that knowledge towards training non-black teachers to be successful with black students.

Previous role model research has primarily studied the impact of same-race teachers on standardized test scores. This study attempts to expand the debate by considering the influence of teacher role models on a broader (and hopefully more meaningful) measure, rigorous math-taking. Empiricists like to study easily measured learning outcomes, for obvious reasons, but quantifiable outcomes are not necessarily the most economically or socially valuable. Ehrenberg and Brewer (1995) remind us that in addition to test scores, educators are also interested in outcomes such as college attendance, college completion, and labor market success as well as the development of moral character. "Teachers of color are important role models to white students, as they shape white students' images of what people of color can and do achieve. For white students and many students of color, teachers of color could be the only people of color they see in professional roles" (Kane and Orsini 2003, 10). More research needs to be conducted to examine the effects of minority teachers on a broad range of economically and socially valuable outcomes.

REFERENCES

Adelman, C. (1999). Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment. Washington, D.C.: U.S. Department of Education Office of Education Research and Improvement.

Ball, D.L. (1990). The mathematical understandings that prospective teachers bring to teacher education. *The Elementary School Journal*. 90(4): 449-66.

Beady, C.H. & Hansell, S. (1981). Teacher race and expectations for student achievement. *American Educational Research Journal* 18 (2), 191-206.

Burtless, G., ed. (1996). *Does money matter? The effect of school resources on student achievement and adult success*. Washington, D.C.: Brookings Institution Press.

Casteel, C.A. (1998). Teacher-student interactions and race in integrated classrooms. *Journal of Educational Research*. 92(Nov/Dec): 115-20.

Chmelynski, C.C. (1998). Segregated schools in the '90s. *The Education Digest*. 63(5): 49-51.

Cizek, G.J. (1995). On the limited presence of African American teachers: An assessment of research, synthesis, and policy implications. *Review of Educational Research*. 65(1): 78-92.

Cook, P.J. & Ludwig, J. (1998). The burden of 'acting white': Do black adolescents disparage academic achievement? In: C. Jencks & M. Phillips, *The black-white test score gap* (pp. 375-400). Washington, D.C.: Brookings Institution Press.

Cramer, J.S. (1991). *The logit model: An introduction for economists*. New York, NY: Routledge, Chapman and Hall, Inc.

Darity, W. Jr., D. Castellino, K. Tyson, C. Cobb, and B. McMillen. (2001). *Increasing Opportunity to Learn via Access to Rigorous Courses and Programs: One Strategy for Closing*

the Achievement Gap for At-Risk and Ethnic Minority Students. Report prepared for the North Carolina Department of Public Instruction.

Dee, T.S. (2001). Teachers, race and student achievement in a randomized experiment. NBER working paper 8432.

Delpit, L. (1988). The silenced dialogue: Power and pedagogy in educating other people's children. *Harvard Educational Review*. 58(3): 280-98.

Ehrenberg, R.G & Brewer, D.J. (1995). Did teachers' verbal ability and race matter in the 1960s? *Coleman* revisited. *Economics of Education Review*. 14(1): 1-21.

Ehrenberg, R.G & Brewer, D.J. (1994). Do school and teacher characteristics matter? Evidence from High School and Beyond. *Economics of Education Review*. 13(1): 1-17.

Ehrenberg, R.G, Goldhaber, D.D. & Brewer, D.J. (1995). Do teacher's race, gender, and ethnicity matter? Evidence from the National Educational Longitudinal Study of 1988. *Industrial and Labor Relations Review*. 48 (3): 547-561.

Evans, M.O. (1992). An estimate of race and gender role-model effects in teaching high school. *Journal of Economic Education.* 23 (3): 209-217.

Farkas, G., Lleras, C. & Maczuga, S. (2002). Does oppositional culture exist in minority and poverty peer groups? *American Sociological Review*. 67 (Feb): 148-155.

Farkas, G., Grobe, R.P., Sheehan, D., & Shuan, Y. (1990). Cultural resources and school success: Gender, ethnicity, and poverty groups within an urban school district. *American Sociological Review*. 55(February): 127-42.

Ferguson, R.F. (2002). *What doesn't meet the eye: Understanding and addressing racial disparities in high-achieving suburban schools*. North Central Regional Educational Laboratory. Retrieved 9/21/03: http://www.ncrel.org/gap/research.htm.

Ferguson, R.F. (1998a). Teachers' perceptions and expectations and the black-white test score gap. In: C. Jencks & M. Phillips, *The black-white test score gap* (pp. 273-317). Washington, D.C.: Brookings Institution Press.

Ferguson, R.F. (1998b). Can schools narrow the black-white test score gap? In: C. Jencks & M. Phillips, *The black-white test score gap* (pp. 318-74). Washington, D.C.: Brookings Institution Press.

Fordham, S. & Ogbu, J.U. (1986). black students' school success: Coping with the burden of acting white. *The Urban Review*. 18(3): 1-31.

Foster, M. (1997). *Black teachers on teaching*. New York, NY: New Press.

Foster, M. (1994). Effective black teachers: A literature review. In: E.R. Hollins, J.E. King, & W.C. Hayman, *Teaching diverse populations: Formulating a knowledge base* (pp. 225-273). Albany, NY: State University of New York Press.

Foster, M. (1990). The politics of race: Through the eyes of African-American teachers. *Journal of Education*. 172(3):123-141.

Gordon, J.A. (2000). *The color of teaching*. New York, NY: RoutledgeFalmer.

Greene, W.H. (1997). *Econometric analysis, 3rd ed*. Upper Saddle River, NJ: Prentice Hall.

Hanushek, E.A. (1996). Measuring investment in education. *Journal of Economic Perspectives*. 10(4): 9-30.

Hanushek, E.A. (1986). The economics of schooling: Productivity and efficiency in public schools. *Journal of Economic Literature*. 24(September): 1141-77.

Howard, T.C. (2001). Powerful pedagogy for African American students. *Urban Education*. 36(2): 179-202.

Kane, P.R. & Orsini, A.J. (2003). The need for teachers of color in independent schools. In: P.R. Kane and A.J.Orsini, *The Colors of Excellence: Hiring and Keeping Teachers of Color in Independent Schools* (pp. 7-28). New York, NY: Teachers College Press.

King, S.H. (1993). The limited presence of African-American teachers. *Review of Educational Research*. 63(2):115-149.

Losen, D. & Orfield, G. (2002). *Racial inequity in special education*. Cambridge, MA: Harvard Education Publishing Group.

Massey, G.C., Scott, M.V., & Dornbusch, S.M. (1975). Racism without racists: Institutional racism in urban schools. *The black Scholar*. 7(3): 10-19.

Oakes, J. (1985). *Keeping track: How schools structure inequality*. New Haven, CT: Yale University Press.

Orr, E.W. (1987). *Twice as less: Black English and the performance of black students in mathematics and science*. New York: Norton.

Orsini, A.J. (2003). A context for understanding faculty diversity. In: *The Colors of Excellence: Hiring and Keeping Teachers of Color in Independent Schools*. P.R. Kane and A.J.Orsini, eds. pp: 29-55.

Phillips, M., Brooks-Gunn, J., Duncan, G., Klebanov, P., & Crane, J. (1998). Family background, parenting practices, and the black-white test score gap. In: C. Jencks & M. Phillips, *The black-white test score gap* (pp. 103-145). Washington, D.C.: Brookings Institution Press.

Rose, H. & Betts, J.R. (2001). *Math matters: The links between high school curriculum, college graduation, and earnings*. San Francisco, CA: Public Policy Institute of California.

Spellman, S.O. (1988). Recruitment of minority teachers: Issues, problems, facts, possible solutions. *Journal of Teacher Education*. 39(July-August): 58-63.

ENDNOTES

*This is a revision of a paper presented at the Western Economic Association International 77th annual conference, Seattle, Washington, June 2002. The author thanks John F. Kain, Daniel M. O'Brien, Jeffrey Zax, seminar participants at the UTD Texas Schools Project, Rhonda Sharpe, Brian Bucks, Robert Garnett, Stephen Quinn, Jennie Wenger, Naci Mocan, and two anonymous referees for their assistance. This research was made possible in part by a grant from the Spencer Foundation. The views expressed and any errors are solely the responsibility of the author.

Klopfenstein: Assistant Professor of Economics, Texas Christian University, Fort Worth, TX and Faculty Research Fellow, UTD Texas Schools Project. Phone 817-257-6231, Fax 817-257-5058, E-mail k.klopfenstein@tcu.edu.

[1] Source: Texas Schools Microdata Panel, 1999.

[2] Ferguson 1998a provides a survey of the literature on teacher expectations

[3] Recent studies of the effect of black peers on black student achievement are highly controversial and find mixed results. See Farkas, Lleras and Maczuga 2002, Ferguson 2002, Cook and Ludwig 1998, and Fordham and Ogbu 1986.

[4] Hereafter, all academic years are referenced by the year of their spring term (1997-98 is "1998"). Charter and alternative schools are excluded from the sample.

[5] Black teachers of subjects other than math might also impact math continuation, but it is not possible to separately identify such an effect using these data. Regressions controlling for the percentage of all teachers who are black rather than the percentage of math teachers who are black yield virtually identical results because the two variables are so highly correlated (r=0.94). Theory indicates that the percent of math teachers who are black should be used in this model

because the percent of math teachers who are black is intended to proxy for whether a student has a black Geometry teacher, and math teachers are more likely than other teachers to emphasize the importance of a rigorous math curriculum.

[6] The predicted probability of enrolling Algebra II for observation *i* is $\exp(\hat{\beta}' X_i)/(1+\exp(\hat{\beta}' X_i))$.

[7] In model 2, the percent of math teachers who are female captures the impact of all non-black female teachers (white, Hispanic, Asian, and "other"). Therefore, this variable does not characterize the impact of a white student/teacher match in the white sample.

Table 1
Theoretical influences behind the math continuation decision for black Geometry students

Individual student characteristics		*Math teacher characteristics*	
Intellectual ability	+	Inexperienced	-
Grade in school	+/-	Advanced degree	+
Economically disadvantaged	-		
		Culture of learning	
Mentoring opportunities		Percent black in school	?
Black math teachers	+	Absenteeism rate in school	-
Average class size	-	Black representation in advanced math	+
Large high school	-	Rural school	-
Female math teachers (for female students)	+	High peer expectations for continuation	+

Table 2
Descriptive statistics of Geometry-takers in 1998

	Black		White	
	Male	Female	Male	Female
Student takes Algebra II in 1999	65.3	68.6	73.7	76.8
Student in grade 9	17.9	20.7	29.6	30.3
Student in grade 10	56.0	57.0	54.1	55.2
Student in grade 11	26.1	22.4	16.3	14.5
Student eighth-grade TAAS math score	41.1	41.3	50.6	50.3
	(11.1)	(11.0)	(7.9)	(8.1)
Student economically disadvantaged	69.9	73.5	20.8	22.1
Student has been in special education	13.5	6.7	14.5	8.1
	(2.4)	(2.5)	(2.4)	(2.4)
School enrollment	1798.5	1790.8	1674.4	1669.8
	(892.8)	(902.4)	(932.7)	(927.9)
Student/teacher ratio	16.4	16.3	15.4	15.4
	(2.4)	(2.5)	(2.4)	(2.4)
Percent Geometry peers who take Algebra II in 1999	70.2	70.2	74.5	74.5
	(16.3)	(16.7)	(21.2)	(21.4)
Mobility rate (absent six or more weeks)	23.2	23.0	17.9	18.0
	(7.0)	(7.5)	(5.3)	(5.3)
School percent black	41.8	41.9	10.1	10.0
	(29.8)	(29.1)	(10.9)	(10.6)
Black representation in Geometry (<1 if under-representation; =1 if equal representation)	1.0	1.0	0.8	0.8
	(0.2)	(0.2)	(0.5)	(0.5)
Rural county	13.3	13.8	29.4	29.5
Percent female math teachers	58.6	59.0	63.5	63.7
	(15.9)	(16.1)	(17.4)	(17.5)
Percent math teachers new	13.7	13.5	11.4	11.5
	(11.5)	(11.5)	(11.1)	(11.1)
Percent math teachers advanced degree	35.7	36.5	32.1	32.3
	(16.2)	(16.8)	(16.4)	(16.4)
Percent math teachers black female	17.3	17.7	1.9	1.9
	(19.6)	(20.1)	(5.0)	(5.0)
Percent math teachers black male	9.9	9.7	1.5	1.5
	(12.4)	(12.4)	(3.6)	(3.7)
n	9120	10,971	40,045	41,461

[1]Source: Texas Schools Microdata Panel, 1998-99. For continuous variables, standard deviations are in parentheses. Values reported for dummy variables represent the percentage of the sample reporting a one.

Table 3
Distribution of Black math teachers across schools

Number of Black female math teachers	Number Black male math teachers						
	0	1	2	3	4	5	6
	955	66	5	0	0	0	0
0	4917	1267	285	0	0	0	0
	61,175	7469	545	0	0	0	0
	63	25	9	2	0	0	0
1	1738	972	847	204	0	0	0
	6280	3106	1428	130	0	0	0
	15	5	5	3	1	1	0
2	663	430	213	507	39	11	0
	1530	522	265	245	3	2	0
	4	7	4	3	2	2	0
3	289	580	430	296	205	57	0
	198	660	15	253	71	65	0
	3	1	2	1	3	1	0
4	214	54	298	348	661	99	0
	353	83	159	0	85	0	0
	1	3	2	0	4	0	1
5	181	505	350	0	738	0	193
	3	54	168	0	143	0	1
	0	1	1	2	1	0	0
6	0	79	349	370	180	0	0
	0	13	3	137	0	0	0
	0	1	3	3	1	0	0
>6	0	214	481	740	234	0	0
	0	2	5	149	2	0	0

In each cell: Top number represents number of schools (of 1212); middle number represents Black students served (of 20,238); bottom number represents White students served (of 85,322).
Source: Texas Schools Microdata Panel, 1998

Table 4
Logit estimates of the math continuation decision for Geometry students: Male

	Black		White	
	Model 1	Model 2	Model 1	Model 2
Student in grade 10 (relative to grade 9)	0.451 ***	0.452 ***	-0.919 ***	-0.919 ***
	(0.068)	(0.068)	(0.044)	(0.044)
Student in grade 11 (relative to grade 9)	-0.226 ***	-0.229 ***	-2.395 ***	-2.395 ***
	(0.082)	(0.081)	(0.057)	(0.057)
Student eighth-grade TAAS math score	0.046 ***	0.046 ***	0.041 ***	0.041 ***
	(0.003)	(0.003)	(0.002)	(0.002)
Student economically disadvantaged	-0.284 ***	-0.283 ***	-0.370 ***	-0.370 ***
	(0.056)	(0.056)	(0.034)	(0.034)
Student has been in special education	-0.180 **	-0.178 **	-0.103 ***	-0.102 ***
	(0.072)	(0.072)	(0.039)	(0.039)
School enrollment/1000	-0.132	-0.132	-0.150 **	-0.153 **
	(0.117)	(0.117)	(0.070)	(0.070)
(School enrollment/1000)^2	0.008	0.008	0.028 *	0.028 *
	(0.023)	(0.023)	(0.016)	(0.016)
Student/teacher ratio	0.034 **	0.031 **	0.0003	0.001
	(0.014)	(0.014)	(0.009)	(0.009)
Percent peers who take Algebra II in 1999	0.040 ***	0.040 ***	0.050 ***	0.050 ***
	(0.002)	(0.002)	(0.001)	(0.001)
Mobility rate	0.007	0.007	0.008 ***	0.008 **
	(0.004)	(0.004)	(0.003)	(0.003)
School percent black	0.002	0.002	0.0002	0.0002
	(0.002)	(0.002)	(0.002)	(0.002)
Black representation in Geometry	0.340 **	0.344 **	0.068 **	0.070 **
	(0.137)	(0.138)	(0.032)	(0.032)
Rural county	-0.073	-0.097	-0.033	-0.040
	(0.095)	(0.097)	(0.042)	(0.042)
Percent math teachers female	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.001)	(0.001)
Percent math teachers new	-0.001	-0.0004	-0.0002	-0.0002
	(0.002)	(0.002)	(0.001)	(0.001)
Percent math teachers advanced degree	-0.004 **	-0.004 **	-0.0004	-0.0005
	(0.002)	(0.002)	(0.001)	(0.001)
Percent math teachers black	0.009 **	-	-0.003	-
	(0.004)		(0.004)	
Percent math teachers black)^2	-0.0001 *	-	0.00001	-
	(0.00004)		(0.0001)	
Percent math teachers black female	-	0.012 **	-	0.005
		(0.005)		(0.006)
(Percent math teachers black female)^2	-	-0.0001 **	-	-0.0003
		(0.00006)		(0.0002)
Percent math teachers black male	-	-0.0003	-	-0.011
		(0.006)		(0.007)
(Percent math teachers black male)^2	-	0.00001	-	0.0005 *
		(0.0001)		(0.0003)
n	9120	9120	40,045	40,045

Heteroskedasticity-consistent standard errors are in parentheses.
*** $p \leq 1$ percent; ** 1 percent < $p \leq 5$ percent ; * 5 percent < $p \leq 10$ percent

Table 5
Logit estimates of the math continuation decision for Geometry students: Female

	Black		White	
	Model 1	Model 2	Model 1	Model 2
Student in grade 10 (relative to grade 9)	0.120 *	0.117 *	-1.105 ***	-1.105 ***
	(0.066)	(0.066)	(0.050)	(0.050)
Student in grade 11 (relative to grade 9)	-0.763 ***	-0.764 ***	-2.690 ***	-2.689 ***
	(0.082)	(0.082)	(0.065)	(0.065)
Student eighth-grade TAAS math score	0.049 ***	0.049 ***	0.036 ***	0.036 ***
	(0.003)	(0.003)	(0.002)	(0.002)
Student economically disadvantaged	-0.242 ***	-0.241 ***	-0.296 ***	-0.294 ***
	(0.057)	(0.057)	(0.035)	(0.035)
Student has been in special education	-0.306 ***	-0.306 ***	-0.092 *	-0.093 *
	(0.088)	(0.088)	(0.051)	(0.051)
School enrollment/1000	-0.158	-0.172	-0.194 **	-0.194 **
	(0.110)	(0.111)	(0.077)	(0.077)
(School enrollment/1000)^2	0.015	0.016	0.045 ***	0.045 ***
	(0.022)	(0.022)	(0.018)	(0.017)
Student/teacher ratio	0.004	0.003	0.007	0.008
	(0.012)	(0.012)	(0.009)	(0.009)
Percent peers who take Algebra II in 1999	0.044 ***	0.044 ***	0.052 ***	0.052 ***
	(0.002)	(0.002)	(0.001)	(0.001)
Mobility rate	0.007 **	0.007 *	0.007 **	0.007 **
	(0.004)	(0.004)	(0.003)	(0.003)
School percent black	0.001	0.001	-0.0004	-0.0002
	(0.002)	(0.002)	(0.002)	(0.002)
Black representation in Geometry	0.297 **	0.307 **	0.116 ***	0.116 ***
	(0.149)	(0.150)	(0.034)	(0.033)
Rural county	-0.141	-0.147	-0.044	-0.043
	(0.090)	(0.092)	(0.044)	(0.044)
Percent math teachers female	-0.0002	0.001	-0.0003	-0.0002
	(0.002)	(0.002)	(0.001)	(0.001)
Percent math teachers new	-0.001	-0.001	0.004 ***	0.004 ***
	(0.002)	(0.002)	(0.001)	(0.001)
Percent math teachers advanced degree	0.001	0.001	0.002 **	0.002 *
	(0.002)	(0.002)	(0.001)	(0.001)
Percent math teachers black	0.007 *	-	-0.011 **	-
	(0.004)		(0.004)	
(Percent math teachers black)^2	-0.00004	-	0.0003 ***	-
	(0.00004)		(0.0001)	
Percent math teachers black female	-	0.003	-	-0.012 **
		(0.005)		(0.006)
(Percent math teachers black female)^2	-	-0.00003	-	0.0004 **
		(0.0001)		(0.0002)
Percent math teachers black male	-	0.013 **	-	-0.006
		(0.006)		(0.007)
Percent math teachers black male)^2	-	-0.0001	-	0.0005 *
		(0.0001)		(0.0003)
n	10,971	10,971	41,461	41,461

Heteroskedasticity-consistent standard errors are in parentheses.
*** $p \leq 1$ percent; ** 1 percent < $p \leq 5$ percent ; * 5 percent < $p \leq 10$ percent

Figure 1
Effect of Black Female Teachers on
Algebra II Continuation of Black Males

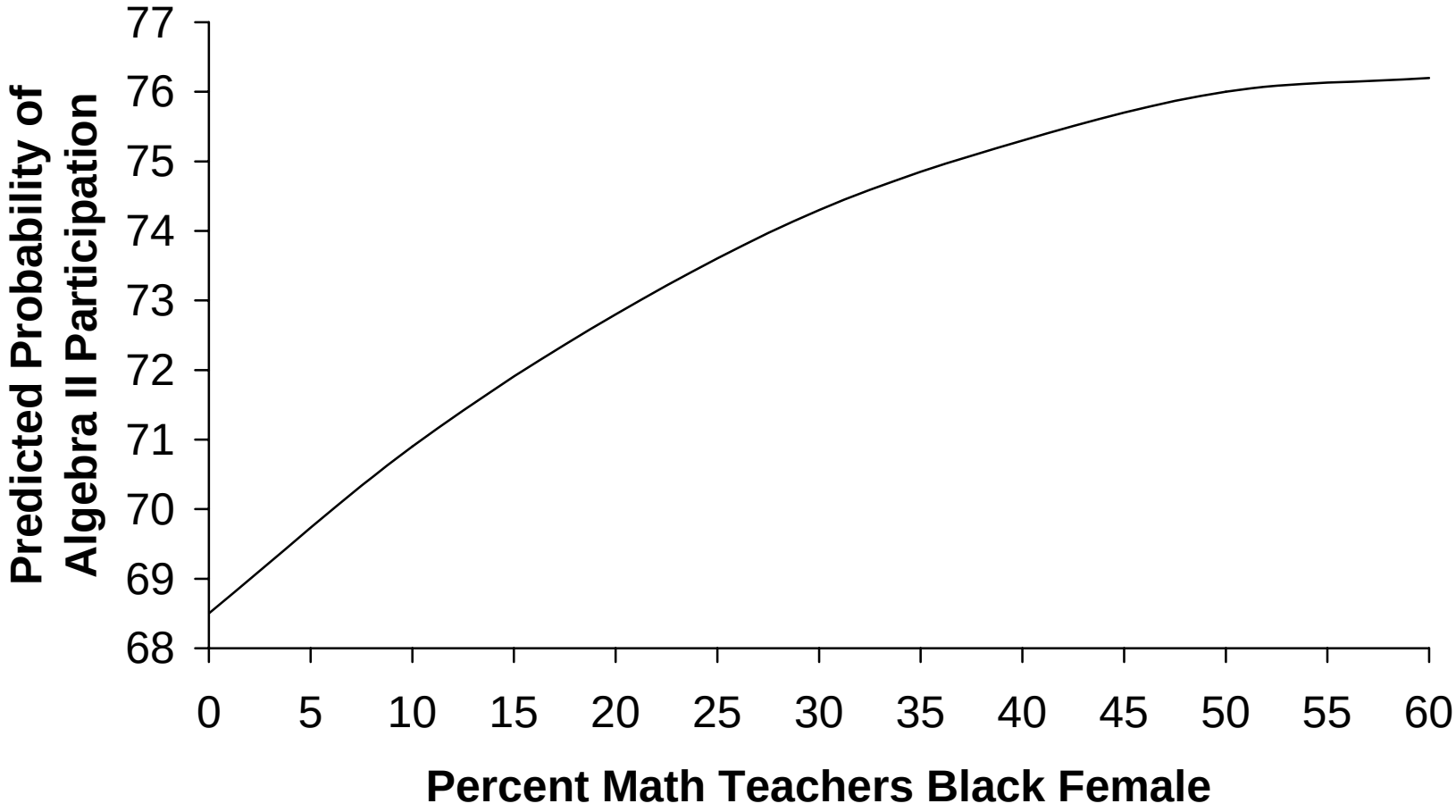

Figure 2
Effect of Black Male Teachers on
Algebra II Continuation of Black Females