

School Principal Race, Teacher Racial Diversity, and Student Achievement

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Abstract

Exploiting variation from principal and teacher transitions over long administrative data panels from Missouri and Tennessee, we estimate the effects of principal race on the racial composition of a school's teachers. Evidence from the two states is strikingly similar. Principals increase the proportion of same-race teachers in the school by 1.9–2.3 percentage points, on average. Both increased hiring and increased retention of same-race teachers explain this compositional change. Further, leveraging longitudinal student-level data from Tennessee, we find that having a same-race principal improves math achievement but that this effect largely operates through avenues other than the racial composition of the teaching staff.

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The authors are grateful to the Missouri Department of Elementary and Secondary Education, the Tennessee Department of Education (TDOE), and the Tennessee Education Research Alliance (TERA) at Vanderbilt University for facilitating data access, and to the anonymous reviewers for useful suggestions during the review process.

Disclosure statement: The authors have nothing to disclose.

Data replication statement: This paper uses restricted data acquired via data requests to the Missouri Department of Elementary and Secondary Education (<https://apps.dese.mo.gov/datarequestform/requestform.aspx>) and the Tennessee Department of Education (<https://www.tn.gov/education/data/data-downloads/request-data.html>). These data can be obtained by other authors by filing a request for research approval directly with these agencies. The authors are willing to assist.

The Online Appendix can be found at <http://jhr.uwpress.org/>

JEL codes: I2, J22, J23, J45, J71

I. Introduction

Research demonstrates that the racial/ethnic composition of a school's teaching faculty can matter for student outcomes and differences in outcomes across student groups. Specifically, growing evidence shows that students of color have more positive achievement and non-achievement outcomes when taught by teachers who share their racial/ethnic background (e.g., Clotfelter, Ladd, and Vigdor 2006; Dee 2004; Dee 2005; Egalite, Kisida, and Winters 2015; Gershenson, Holt, and Papageorge 2016; Grissom and Redding 2016; Lindsay and Hart 2017; Gershenson, Hart, Hyman, Lindsay, and Papageorge 2018). There may be benefits to teacher racial diversity for white students as well, including more prosocial attitudes and better preparation for employment in diverse work settings (see Wells, Fox, and Cordova-Cobo 2016). These findings have helped spur calls for increasing teacher diversity in pursuance of multiple policy goals, including combating persistent achievement disparities between white students and students of color (e.g., U.S. Department of Education 2016; Albert Shanker Institute 2015), particularly as proportions of students of color and teachers of color rapidly diverge in U.S. public schools; from 2000 to 2012, the fraction of students of color grew from 33% to 43%, while the fraction of teachers of color remained virtually flat at 17% (Grissom, Kern, and Rodriguez 2015). This attention to teacher racial diversity has highlighted that the factors that determine the supply and allocation across schools of teachers from racial/ethnic backgrounds are not well understood (Achinstein, Ogawa, Sexton, and Freitas 2010).

This article focuses on the role of school principals. As primary human capital managers for schools, principals are uniquely positioned to affect the racial composition of their teachers, which may in turn impact student outcomes. We directly test this chain of logic. First, we examine how principals of different racial backgrounds affect the racial composition of their

school's teaching staff. Then, we test whether students benefit from having a same-race principal. To the extent that principals are more likely to hire and retain same-race teachers, we expect to find that outcomes for same-race students also improve through increased exposure to same-race teachers.

Two bodies of research motivate our investigation into how principals may shape the racial composition of a school's teaching force. The first is a set of studies demonstrating the importance of school principals for teacher labor market outcomes. Principals bear primary responsibility for decisions about which teachers are hired into their schools, and even more so as districts have decentralized teacher hiring processes in recent decades (Engel, Cannata, and Curran 2018; Harris, Rutledge, Ingle, and Thompson 2010). Even in more centralized district hiring systems, the district's role is usually one of recruiting and screening applicants, with principals typically exerting substantial influence over final hiring decisions (Strauss, Bowes, Marks, and Plesko 2000). Principals are instrumental in teacher retention decisions as well. Teachers' perceptions of principal support and effectiveness are among the most important factors in teachers' decisions to remain in or leave their schools (Boyd et al. 2011; Grissom 2011; Ladd 2011). Moreover, principals can directly impact teacher turnover through their roles in teacher evaluation and dismissal decisions (Drake et al. 2015; Grissom and Bartanen 2019; Grissom and Loeb 2017; Jacob 2011).

The second is a literature from job settings outside education on how manager race and ethnicity impacts employee hiring, dismissal, and other labor market outcomes. Black and Hispanic workers tend to be concentrated in firms or workplaces with supervisors or owners of the same race/ethnicity (Carrington and Troske 1998; Giuliano, Levine, and Leonard 2009; Stoll, Raphael, and Holzer 2004). This sorting appears to be driven by differences in both hiring and

retention. For instance, using panel data from a large U.S. retail firm over a 30-month period and exploiting within-location differences in manager race/ethnicity, Giuliano, Levine, and Leonard (2009, 2011) find effects of manager race on employees' hiring and turnover outcomes.

Specifically, non-Black managers are less likely to hire Black workers, with the largest effects in locations in the South, and Hispanic managers are more likely to hire Hispanic workers in areas with a large Hispanic population. They also find that, in most cases, employees with a same-race manager are less likely to quit or be dismissed and are more likely to be promoted. In another study making use of personnel records over a nine-year period from a large U.S. grocery chain, Giuliano and Ransom (2013) investigate the effects of manager ethnicity on employee hiring and retention. They find that stores with Hispanic managers are more likely to hire Hispanic employees, but only in departments with a small number of positions. In contrast, they find little evidence that manager ethnicity affects employee separation or transfer patterns. Aslund, Hensvik, and Skans (2014) use a longitudinal employer-employee database of 70,000 Swedish firms to investigate the extent to which manager-worker similarity in origin (i.e., immigrant versus native) affects hiring patterns, turnover, and wages. Similar to the findings in Giuliano, Levine, and Leonard (2009), they find that managers are substantially more likely to hire workers of the same origin. They also find that same-origin workers earn higher wages and are less likely to leave their positions, but that the patterns are driven by employee sorting rather than a matching effect.

Little research on how manager race affects employee outcomes exists in public sector settings, let alone in public schools. Virtually no studies have investigated whether principal race informs how teachers with different demographic characteristics are hired, though some evidence suggests that teachers' demographic characteristics are a consideration for principals and that

what factors principals weight in hiring processes (e.g., teacher communication skills, caring for children) vary by their own characteristics in ways that ostensibly might lead to differences in hiring patterns (Engel 2013; Harris et al. 2010). Slightly more evidence exists regarding teacher turnover. In particular, Grissom and Keiser (2011) demonstrate using nationally representative data from the Schools and Staffing Survey that teachers who are race-congruent with their principal are less likely to turn over than non-congruent colleagues in the same school. The analysis is essentially cross-sectional, however, preventing the authors from ruling out some alternative potential explanations for this result.

What mechanisms might make it more likely that teachers are hired into schools with principals of the same racial background? One possibility is taste-based discrimination among principals. Principals may prefer to hire teachers with whom they share background characteristics, making it more likely that they select a same-race teacher from an applicant pool. Another is taste-based bias among teachers, who may prefer to work for a same-race principal, and thus be more likely to apply to a same-race principal's school or accept a job there if offered. Even in the absence of such taste-based biases, race-based patterns in hiring may arise if, for example, principals rely on their social networks to recruit new teachers for openings in their schools, and those networks are segregated by race (Giuliano, Levine, and Leonard 2009).

Similar mechanisms could make it more likely that teachers stay in schools with a principal of the same race. Principal bias towards same-race teachers may lead them to give preferential treatment to those teachers, including in formal personnel processes such as teacher evaluation, which may affect a teacher's propensity to remain in the school. Teacher bias towards same-race principals may mean that they are more satisfied working for such a principal than they would be working for a principal of a different background, increasing their retention

probability. Alternatively, shared backgrounds, communication styles, and values that likely correlate with racial similarity may facilitate teachers and principals with similar characteristics working together more productively, which may lead principals to hire more same-race teachers and increase a teacher's commitment to remain in the school.

If principal race affects the racial composition of the teacher workforce, then research demonstrating that this composition can affect students' outcomes (see Redding 2019) suggests a potential linkage between principal race and student outcomes as well. Principal race may also affect student outcomes through other mechanisms, if, for example, Black principals are more likely to build a school culture of high expectations for Black students, or white principals are less likely to implement discipline policies aimed at leveling discipline disparities between Black and white students.

Using longitudinal administrative personnel records from both Missouri and Tennessee and student-level data from Tennessee, we contribute to the nascent literature on how race influences interactions between principals and teachers in the teacher labor market. Our analysis of teacher hiring patterns is the first of its kind, and our analysis of teacher turnover using longitudinal data to leverage substantially improves on the estimates provided by prior work. For both hiring and turnover, we provide new insights on mechanisms driving our results. Moreover, this study is the first, to our knowledge, to estimate principal-student race match effects using student-level data, providing novel evidence on the potential importance of leader diversity for a rapidly diversifying student population.

We ask four main research questions. First, what is the impact of a change in the race of a school's principal on the racial composition of its teaching staff? Second, to decompose compositional changes, to what extent are principals more or less likely to hire teachers of the

same race, and third, to what extent are teachers more or less likely to stay in their schools when they work for a principal of the same race? Finally, what effects do changes in principal race have on student achievement, through either teacher composition effects or other mechanisms?

We find that principals increase the proportion of same-race teachers in the school by 2.3 percentage points in Missouri and 1.9 percentage points in Tennessee, on average. These effects compound over time—switching from a white to a Black principal, for instance, increases the proportion of Black teachers in the school after five years by 5.3 (5.2) percentage points in Missouri (Tennessee), which corresponds to 26% (24%) of the average proportion of Black teachers in the effective sample. The effect of principal race on teacher composition operates through both increased hiring and greater retention of same-race teachers. Black (white) principals are 5.3 and 6.8 percentage points more likely to hire Black (white) teachers in Missouri and Tennessee, respectively. In both states, the effects are concentrated among transferring teachers, with smaller effects for teachers who are new to the profession. Principals' segregated hiring networks partially explain the greater likelihood of hiring same-race transfer teachers. With policy attention towards increasing the exposure of Black students to Black teachers, a natural question is whether this same-race hiring dynamic leads to a more efficient allocation of Black teachers. One might worry, for instance, that Black principals are simply recruiting Black teachers from schools with white principals that nonetheless have an equal or greater need for Black teachers. However, we document descriptively that Black (white) teachers tend to sort towards schools with a larger (smaller) representation gap, and we find no difference in the demographic composition of the prior school of teachers hired by same-race versus different-race principals. While this pattern helps allay the concern that same-race hiring tendencies could undermine efforts to increase the exposure of Black students to Black teachers,

it also underscores that merely increasing the number of Black principals is not sufficient to erase large representation gaps between Black students and Black teachers in the K–12 workforce.

Our analyses demonstrate a consistent negative effect of teacher-principal race-match on yearly teacher turnover in both states. In our preferred specification, having a same-race principal lowers the probability that a teacher leaves their position between year t and year $t + 1$ by 2.5 percentage points (12% of the base rate). In both states, decreased turnover is driven by fewer teachers who transfer to a different school and lower probability that a teacher exits the state's education system. Consistent with these patterns, we present survey-based evidence that teachers report more positive perceptions of their school environments under same-race principals. We also present suggestive evidence that match effects are driven by Black teachers rather than white teachers, though the difference is only statistically significant in Tennessee and the race-specific matching effects model requires more stringent identification assumptions.

Finally, using student-level data from Tennessee, we leverage variation in principal race across cohorts of students in the same school, grade, and racial group to estimate the impact of having a same-race principal on math and reading test scores. Using a modeling approach that allows the effect to vary by the length of the principal's tenure, we find positive effects on math scores (0.018 SD) of same-race students after a principal's first year in the school, with suggestive evidence that this effect is driven by Black principal-student matches. However, although we also find positive effects of same-race teachers on students' outcomes, these effects largely do not explain the impacts of principal race, suggesting that principal race matters for students through other mechanisms.

II. Data

We analyze administrative personnel records from two states: Missouri and Tennessee. As of 2016, Missouri has 65,000 public school teachers working in 2,400 schools and 565 districts, while Tennessee has 72,000 public school teachers working in 1,800 schools and 147 districts. Similar to national trends, the share of white students in both states has declined in recent years; between 2004 and 2014, the percentage of public school students who were white declined from 77.3 to 72.7 in Missouri and 70.0 to 64.9 in Tennessee (U.S. Department of Education 2016). Missouri data were obtained via a data request to the Department of Elementary and Secondary Education, while the Tennessee data were accessed through the Tennessee Education Research Alliance at Vanderbilt University with approval from the Tennessee Department of Education.

Missouri personnel records were available from 1991 to 2016, while Tennessee records spanned 2002 to 2017. Because of missing covariates in the early years of both data sets, we limit the analytic samples to 1999 to 2016 in Missouri and 2007 to 2017 in Tennessee, though in both cases we make use of the earlier years of data in constructing measures of job-specific experience and tenure in schools.

Both datasets contain job classification and location information that allow identification of teachers and principals and what school they worked in each year. They also contain, for each year, each educator's years of work experience in the state's school system, highest degree obtained (e.g., Master's degree, educational specialist), and salary. Work experience in a given school or job classification (e.g., teacher or principal) is not recorded but can be calculated for any educator observed moving into a new location or job classification over the data stream.

The data also include information on educator sex (binary, listed as female or male) and race/ethnicity (white, Black, Hispanic, Asian, Native American, or other).¹ In both states, the

fraction of non-white, non-Black educators was too small to permit a robust analysis, so teachers falling into these categories or schools with principals in these categories were dropped.ⁱⁱ Our analytic samples include approximately 1,000,000 and 690,000 teacher-year observations from Missouri and Tennessee, respectively.

We matched educator personnel records to school information contained in the Common Core of Data (CCD), a repository of school-by-year information maintained by the National Center for Education Statistics. From CCD, we obtained information on school level (e.g., elementary, middle, high) and locale (urban, suburban/town, rural), as well as student enrollment size, proportion of Black students, proportion of Hispanic students, and the proportion of students eligible for free- or reduced-price lunch, a measure of poverty.

Table 1 displays descriptive statistics for the full sample of teacher-years. The teacher workforces in Missouri and Tennessee are similar demographically. Teachers in both states are overwhelmingly white (94% and 88%) and female (78% and 79%), and have an average of 11–12 years of experience in the public education system. Roughly one-sixth of all teachers are new to their school each year, while a little less than half have worked five or more years in their current school. Ninety-one percent of Missouri teachers are in schools led by a white principal, as are 83% of Tennessee teachers, with the remainder of teachers in both states almost exclusively led by Black principals.ⁱⁱⁱ

Figure 1 shows the “representation gap” (i.e., the difference in the proportion of Black students and Black teachers in a school) as a function of the proportion of Black students in the school. The dashed line demonstrates that, in both states, there is a substantial representation gap that widens as the proportion of Black students in the school increases, before closing somewhat in schools that have 100% Black students. For instance, among schools where 50% of students

are Black, the average teaching staff is 15% Black in Missouri and 20% Black in Tennessee. The average Black student in Missouri (Tennessee) is in a school where the representation gap is 32% (25%). The dotted line in Figure 1 shows the proportion of schools that have a Black principal for a given proportion of Black students. The representation gap is smaller for principals, particularly in Tennessee.

In addition, we access student-level data from Tennessee beginning in the 2006–07 school, which we connect to personnel data.^{iv} The student files contain detailed information on demographics, enrollment, attendance, suspensions,^v and performance on statewide exams. Specifically, we examine math and reading scores from mandatory end-of-year exams in grades 3–8 in addition to end-of-course exams for high school students.^{vi} For students in tested grades and subjects, student-teacher linkage files allow us to identify a student’s assigned teacher. These linkage files allow us to directly examine exposure to Black teachers and construct value-added measures of teacher quality, as we describe later.

III. Empirical Strategy

A. Teacher Composition and Hiring Analyses

The analyses of teacher composition and hiring follow the approach of Giuliano, Levine, and Leonard (2009). For composition, we estimate the probability that a given teacher in a school belongs to a particular race group. Given the small number of non-white, non-Black educators in both states, we limit our analysis to teachers and principals who are either white or Black. With only two racial groups, our dependent variable simply becomes a binary indicator for whether a teacher is Black. Specifically, we estimate the following model:

$$(1) \Pr(\text{BlackTch}_{ijkt} = 1) = \beta_1 \text{BlackPrin}_{jkt} + Z_{jkt} + S_{jt} + \alpha_j + \gamma_t + \varepsilon_{ijkt}$$

That is, we estimate the probability that teacher i in school j at time t is Black as a function of whether or not the principal is Black ($BlackPrin$). Importantly, β_1 also represents the effect of having a white principal on the probability that a teacher or new hire is white. We also adjust for other characteristics of the principal Z (gender, highest degree earned, years of experience as a principal, years as principal in current school) and the school S (proportion of Black students, proportion of Hispanic/Latino students, proportion of students eligible for free/reduced price lunch, enrollment size), plus school fixed effects (α_j). We also include an indicator for the school year γ to control for year-specific shocks to hiring or retention, such as recession-induced changes in the overall labor market. To estimate the effect of principal race on hiring, we simply estimate equation 1 for the sample of newly hired teachers—that is, teachers that are new to a school, regardless of whether they were previously a teacher elsewhere.

The inclusion of school fixed effects to isolate within-school variation in principal race is critical to disentangling the effect of principal race from other confounding factors. Even with numerous controls for school characteristics, there may be unobserved school-level factors that predict the demographics of both teachers and hiring principals. School fixed effects will account for these factors to the extent they are fixed over time. However, there may also be time-varying factors that drive changes in principal race and the racial composition of the teaching staff. For example, gradual changes in neighborhood composition over time that are not completely captured by changes in the demographic composition of a school's students could lead to bias in our estimates of the effect of principal race. To further guard against such possibilities, we also estimate models that include both school fixed effects and school-specific trends. Finally, there could be policy changes at the school district level (e.g., a districtwide initiative to increase hiring of black teachers and administrators) that lead schools to simultaneously hire Black

principals and Black teachers. Here, we can replace year fixed effects with district-by-year fixed effects to account for secular trends by district.^{vii}

We estimate linear probability models, which under straightforward assumptions are sufficient for estimating marginal effects from binary choice models (Angrist and Pischke 2008).^{viii} We cluster standard errors at the school level in composition and hiring models to account for the nested nature of the data.

B. *Teacher Turnover Analysis*

We operationalize teacher turnover as both a binary and a categorical outcome. For a given teacher working in school j in year t , the binary turnover outcome takes a value of 1 if that teacher is not working as a teacher in school j in year $t+1$, and 0 otherwise. The categorical outcome differentiates among four types of turnover: teachers who exit from the state's education system entirely (*exits*), teachers who remain in teaching but work at a different school in the same district (*within-district moves*), teachers who change to a teaching position in a different district (*across-district moves*), and teachers who stay in the education system but are no longer teachers (*position changes*). The binary model takes the form:

$$(2) \Pr(\textit{Turnover}_{ijkt} = 1) = \beta_1 \textit{RaceMatch}_{ijkt} + T_{it} + S_{jt} + Z_{kt} + \alpha_j + \gamma_t + \varepsilon_{ijkt}$$

We model the probability that teacher i in school j with principal k in school year t turns over as a function of fixed characteristics of the school (α_j) in addition to time-varying teacher (T), school (S) and principal (Z) characteristics, and an indicator for the school year (γ). Teacher characteristics include race, gender, years of experience, age, education level, number of years working in the school, and an indicator for whether the current principal hired the teacher. The parameter of interest is β_1 , the coefficient on a binary indicator for whether teacher i and principal k are the same race. A negative estimate of β_1 would indicate that teachers are less

likely to turn over when they have a principal of the same race. Importantly, β_1 estimates the average effect of race matching across different teacher racial groups. In fact, these effects may be different; having a same-race principal may matter more for turnover outcomes among Black teachers than white teachers (or vice versa). However, with only two adequately sized racial groups in Missouri and Tennessee, we cannot disentangle any “main effects” of principal race (e.g., if Black principals tend to have leadership styles that foster teacher retention among all racial/ethnic groups) from the race-specific matching effects (Giuliano et al. 2011).^{ix}

As with the composition and hiring models, identification of β_1 comes from within-school variation in principal race across school years. We also show specifications that include school-specific trends and district-by-year fixed effects. Finally, we also examine whether principal race differentially affects specific types of turnover events. Here, we adjust equation 2 to the multinomial case and estimate the probability of each category of turnover outcome (exits, within-district moves, across-district moves, and position changes) relative to the same base category, staying in the same teaching position.

C. Student Outcomes Analysis

To examine the effect of principal race on student outcomes, we first estimate a linear probability model for assignment to a Black teacher:

$$(3) \text{BlackTch}_{ijgst} = \beta_1 \text{BlackPrin}_{jst} + \gamma X_{it} + \psi S_{st} + \eta P_{jst} + \theta_1 (\text{School}_s \times \text{Grade}_g \times \text{BlackStu}_i) + \theta_2 (\text{Year}_t \times \text{BlackStu}_i) + \epsilon_{ijgst}$$

where i , j , g , s , and t indexes students, principals, grades, schools, and years, respectively. β_1 is the marginal effect of having a Black principal (instead of a white principal) on the probability that a student has a Black teacher in math or reading (we estimate separate models by subject). By including school-by-grade-by-race fixed effects, we identify the effect of principal race by comparing cohorts of students of the same race within the same school and grade across years.

The intuition of this design is that same-race students from prior or future cohorts (when the school had a different principal) serve as a counterfactual for the current cohort if they would have had a Black instead of white principal (or vice-versa).^x To account for possible changes in the composition of the cohort, grade, or school more broadly, we also include a rich set of controls for student characteristics (prior-year test scores and attendance rate, race/ethnicity, gender, free/reduced-price lunch eligibility, special education assignment, gifted classification, an indicator for starting the school year at a different school) as well as year-by-year averages of these student characteristics at the grade and school level. We also interact these controls with student race to account for the possibility that the underlying factors captured by these controls may differentially affect Black versus white students. We cluster standard errors at the school level.

While equation 3 captures the average effect of Black (white) principals on the probability of having a Black (white), if effects on teacher composition are dynamic, we would expect that the effect of principal race on students may increase as the principal has time to shape the composition of the teaching staff. To investigate this possibility, we modify equation 3 to allow the effect of principal race to vary by principal tenure (i.e., number of years served as principal) in the school:

$$(4) \text{BlackTch}_{ijgst} = \beta_1 \text{BlackPrin}_{jst} + \delta(\text{BlackPrin}_{jst} \times \text{TenurePrin}_{jst}) + \gamma X_{it} + \psi S_{st} + \eta P_{jst} + \theta_1(\text{School}_s \times \text{Grade}_g \times \text{BlackStu}_i) + \theta_2(\text{Year}_t \times \text{BlackStu}_i) + \epsilon_{ijgst}$$

Specifically, we parameterize tenure as a set of indicator variables (1st year in school, 2nd-3rd year, 4th-5th year, 6th+ year) and interact them with the principal race indicator.

To examine the effect of principal-student race match on student achievement, we estimate a similar set of specifications but include an indicator for having a same-race principal:

$$(5) \text{ Achievement}_{ijgst} = \beta_1 \text{ RaceMatch}_{ijst} + \beta_2 \text{ BlackPrin}_{jst} + \gamma X_{it} + \psi S_{st} + \eta P_{jst} + \theta_1 (\text{School}_s \times \text{Grade}_g \times \text{BlackStu}_i) + \theta_2 (\text{Year}_t \times \text{BlackStu}_i) + \epsilon_{ijgst}$$

Here, β_1 is the parameter of interest and represents the effect of principal-student race-match. Our dynamic model is as follows:

$$(6) Y_{ijgst} = \beta_1 \text{ RaceMatch}_{ijst} + \delta (\text{RaceMatch}_{ijst} \times \text{TenurePrin}_{jst}) + \beta_2 \text{ BlackPrin}_{jst} + \omega_1 (\text{BlackPrin}_{jst} \times \text{TenurePrin}_{jst}) + \omega_2 (\text{BlackStu}_i \times \text{TenurePrin}_{jst}) + \gamma X_{it} + \psi S_{st} + \eta P_{jst} + \theta_1 (\text{School}_s \times \text{Grade}_g \times \text{BlackStu}_i) + \theta_2 (\text{Year}_t \times \text{BlackStu}_i) + \epsilon_{ijgst}$$

Equation 6 is effectively a difference-in-difference-in-differences estimator, where δ represents the difference in the principal-student race-match effect between principals with varying levels of tenure in school (using the tenure categories described above). The other covariates are the same as described above for the exposure models.

IV. Teacher Composition Results

We begin by examining the average racial composition of teachers, broken down by the race of the school's principal. This description is shown in Table 2. Six percent of teachers in Missouri are Black, as are roughly 12% in Tennessee. In both states, Black principals lead schools with substantially more Black teachers than do white principals. For instance, in Missouri schools with Black principals, 41.2% of teachers are Black, compared to only 2.4% in schools with white principals. Tennessee has a similar disparity.

While Table 2 demonstrates stark descriptive differences in the racial composition of teachers by the race of the principal, much of this difference likely is driven by other factors that are correlated with principal race. Schools that have Black principals, for instance, are more likely to be located in districts with a larger pool of Black teachers. A way to pin down the effect of principal race is to exploit variation in principal race within the same school over time. We begin by showing descriptive event studies of the composition of teachers before and after

principal transitions.^{xi} Specifically, we examine the four years preceding and following each transition. Because schools can have multiple principal transitions within a brief period, some of these eight-year windows will overlap. In our unrestricted sample (left panels in Figure 2), we allow for overlapping windows, whereas our restricted sample (right panels) only includes principal transitions that were not preceded or followed by another transition within four years. The restricted sample, while providing a cleaner comparison, limits generalizability by dropping schools that experience higher rates of principal turnover.

The four plotted lines correspond to the combinations of the race of the departing and incoming principals. Prior to the principal transition, the proportion of Black teachers is fairly flat across all groups, though there are slight trends for schools that will experience a change in principal race. When schools transition to a principal of the same race as the departing principal (white to white and Black to Black lines), there is virtually no change in the racial composition of teachers. However, when the incoming principal is a different race, there is an increase in the proportion of teachers of that race that appears in the first year of the new principal and continues in the years following the transition. In our restricted samples (i.e., between two principals who stay in the school for at least four years), these patterns increase in magnitude. While these types of transitions are relatively less common, they illustrate the potentially large impacts that principals can have on the composition of the teaching staff, particularly when given the opportunity to affect teacher hiring and retention across several years.

Figure 2 provides descriptive evidence that principal race affects the racial composition of a school's teaching staff. Table 3 directly estimates this effect. Specifically, we estimate linear probability models that predict the likelihood that a given teacher is Black as a function of whether the principal is Black. For each state, we begin with a model that includes school fixed

effects, then successively add district-by-year fixed effects, school-specific trends, and indicators for principal race in prior and future years.

Across specifications, we find consistently that principal race affects the racial composition of the school's teaching staff. For instance, columns 3 and 7 demonstrate that having a Black (white) principal increases the proportion of Black (white) teachers in a school by 2.3 percentage points in Missouri and 1.9 percentage points in Tennessee, on average. Columns 4 and 8 add indicators for principal race in past and future years.^{xii} Incoming principals largely inherit the teachers hired under previous principals, and thus we would expect that the effects of prior principal race do not fade out immediately. In fact, we do find that principal race in prior years affects the current composition of the teaching staff. By contrast, if we are successfully capturing the causal effect of principal race rather than other confounding factors, we would expect that principal race in the future has no effect on current racial composition, which is supported by the precise null coefficient for having a Black principal in the next school year. Summing across coefficients, columns 4 and 8 imply that after five years in the same school, a Black (white) principal increases (decreases) the proportion of Black teachers in the school by 5.3 percentage points in Missouri and 5.2 percentage points in Tennessee. Among schools that have variation in principal race across the study period, these effects correspond to 26% and 24% of the average proportion of Black teachers.

Overall, our results demonstrate that principal race affects the racial composition of the school's teaching staff. In the next part of our analysis, we investigate the mechanisms for this relationship by examining the effect of principal race on teaching hiring and teacher retention.

V. Teacher Hiring Results

A. Main Results

The bottom of Table 2 shows that the racial breakdown of newly hired teachers (i.e., teachers who are in their first year in a given school) by principal race closely mirrors the patterns for all teachers, though Black teachers comprise a larger share of new hires relative to the overall teacher workforce. Descriptively, Black principals are substantially more likely to hire Black teachers than are white principals. To isolate the causal effect of principal race on hiring, we follow the same approach used for the composition models but limit the sample to teachers who new to their school in the given year.

Figure 3 shows the descriptive event study results for new hires. Prior to a principal transition, the trends in the proportion of Black new hires are roughly flat. For transitions between principals of the same race, there is no change in the composition of newly hired teachers under the new principal. However, transitioning from a white to a Black principal increases the proportion of newly hired teachers that are Black, with a corresponding decrease for Black to white transitions. Moreover, these changes persist beyond the first year after the transition and are still apparent four years afterward.

Table 4 shows the estimated effects of principal race on the racial composition of new hires. Columns 1 and 4 include school and year fixed effects, along with time-varying school characteristics and principal characteristics, with successive columns adding district-by-year fixed effects and school-specific trends. Our preferred specification (columns 3 and 6) shows that having a Black (white) principal increases (decreases) the probability that a newly hired teacher is Black by 5.3 percentage points in Missouri and 6.8 percentage points in Tennessee, which corresponds to 22% and 26% increases (decreases) in the effective samples in these states.^{xiii}

B. Heterogeneity in Hiring Networks

To shed light on the possible mechanisms that explain the hiring effects shown in Figure 3 and Table 4, we next examine whether the effects are more or less concentrated among certain types of new hires. One possible explanation for principals hiring more same-race teachers is that principals recruit teachers through networks that tend to be segregated by race. We examine this possibility in Table 5. Specifically, we examine heterogeneity in hiring effects for four types of teachers. In each panel, we estimate a model with all covariates and fixed effects (corresponding to our preferred specification in Table 4) and include interactions between the *type* variable and all covariates.

First, we examine teachers that are “new-to-state,” meaning they are first-year teachers or have not worked previously at a K–12 public school in Missouri/Tennessee (Panel A). If segregated networks help to explain the hiring effects, the estimated effect of principal race should be smaller for new-to-state teachers, who likely have the weakest networks among new hires. In both states, the effect of principal race on the probability that a newly hired teacher is Black is indeed smaller in magnitude for new-to-state teachers. However, there is still a positive effect among new-to-state teachers, demonstrating that segregated networks do not fully explain the connection between principal race and teacher hiring. Further, this finding is consistent with (though not necessarily strong evidence of) Black principals bringing new Black teachers into the workforce, rather than merely changing the allocation of existing Black teachers.

In the remaining panels, we examine three types of transferring new hires (teachers that are not new-to-state): teachers who are moving from a different school district (*New to District*), teachers who have worked previously with at least one teacher at their new school (*In Teacher’s Network*), and teachers who have worked previously with the hiring principal, including prior to the principal entering school leadership (*In Principal’s Network*). Panel B shows that there is no

difference in the effect of principal race for teachers from outside of the district. In other words, principals are not merely pulling same-race teachers away from schools in the same district. Instead, the results imply that increasing the number of Black principals in a district can increase the number of Black teachers in the district. In Online Appendix Table 4, we confirm this connection by estimating models at the district-by-year level (in a district fixed effects framework) that regress the proportion of Black teachers on the proportion of Black principals. We find a positive association.^{xiv}

Panels C and D explicitly test for heterogeneity in hiring effects by observed networks. Panel C shows no difference in the effect of principal race for new hires who have worked previously with one or more of the teachers at their new school. In both states, however, the magnitude of principal race is substantially larger among new hires who have worked previously with the hiring principal. In Missouri, the effect of having a principal on the probability that new hire is Black is 3.9 percentage points for teachers not in the principal's network, compared to 12.7 percentage points for teachers who have worked with the principal previously. In Tennessee, the effects are 8.6 and 15.5 percentage points, respectively. However, principal network hiring is uncommon overall; only 6–7% of new hires in Missouri and Tennessee have previously worked with their hiring principal, which suggests that (observed) network hiring does not explain a substantial portion of the same-race hiring effect.

Overall, the results in Table 5 suggest that networks are one mechanism through which principal race affects the racial composition of newly hired teachers. One limitation of these analyses is that our network measures are only proxies based on job history; connections between teachers and principals likely form through more complex processes that are unobservable in our administrative data. For example, teacher-principal connections could be

driven by an intermediary, such as a teacher's former principal or assistant principal. Given that we cannot easily identify many teacher-principal connections, our results likely understate the magnitude of networking in explaining hiring effects.

C. Differences in Qualifications and Effectiveness of Same-Race and Different-Race New Hires

Aside from segregated hiring networks, same-race effects on teacher hiring may arise from taste-based discrimination by either principals or teachers. If teachers systematically attempt to work with same-race principals by applying to work in their schools at higher rates, we would expect the applicant pool to have a larger fraction of teachers of the same race as the principal. Even principals who select teachers to hire at random would produce a race-matching pattern in this case. Assuming similar measures of quality among same- and different-race applicants, a principal attempting to hire the best teacher from the applicant pool, ignoring race, would produce a race-matching correlation under this scenario as well. Alternatively, if principals are exercising taste-based discrimination, we might expect that they are willing to sacrifice dimensions of teacher quality to choose a same-race teacher for a vacant position.

Unfortunately, we cannot observe teacher applicant pools, which might help us distinguish these two scenarios (see D'Amico et al. 2017). We can, however, provide partial evidence. We test for differences in observable proxies for teacher quality for teachers hired by same-race and different-race principals. We focus this analysis on Tennessee, where more such proxies are available in our data. We identify four such measures: a teacher's year of experience, degree attained at time of hiring, classroom observation scores (collected as part of the statewide evaluation system since 2011–12), and value-added to student achievement. For both observation scores, we use average prior scores (if available), scores the year of hiring (i.e., in their first year

in their new school), and career-average scores. For value-added, we draw on two measures. The first are single-year estimates from the Tennessee Value-Added Assessment System (TVAAS), which are used as part of the statewide evaluation system.^{xv} We supplement this measure with a leave-year-out, drift-adjusted VA score proposed by Chetty, Friedman, and Rockoff (2014).^{xvi} Using each measure as a dependent variable, we first estimate the difference between teachers hired by Black and white principals within schools, controlling for time-varying school characteristics and year fixed effects. We then estimate the difference between same-race and different-race teachers, adjusting for average differences in qualifications and effectiveness between Black and white teachers.

Results are shown in Table 6. Panel A shows the main effect of principal race on the qualifications and effectiveness of newly hired teachers. On average, Black principals hire teachers with higher education levels (1.8 percentage points more likely to have a master's degree or greater) and lower observation ratings (0.087 SD lower when averaging across a teacher's career). In terms of prior teaching experience and value-added, there are no significant differences between teachers hired by Black and white principals.

Panel B tests for differences in the qualifications and effectiveness of same-race and different-race hires, with results plotted in Figure 4. Each plot within the figure shows the average qualifications/effectiveness for the combination of teacher and principal race. The lines represent the marginal effect of principal race (i.e., the difference between Black and white principals) on the given measure for Black and white teachers, respectively. As demonstrated by Figure 4 and the corresponding coefficients in Table 6, when principals hire same-race teachers, they tend to have higher qualifications and effectiveness. These results suggest that teacher sorting is an important driver of the race-match result for hiring. Although we cannot rule out

that principals exhibit bias in hiring that is compensated for by teacher sorting, we do not see evidence in these results that principal bias toward same-race hires leads them to hire lower-quality teachers, on average.

D. Is Black Principals' Hiring of Black Teachers Zero-Sum?

One question raised by the results in Table 5 is whether same-race hiring patterns simply reflect the reshuffling of teachers among demographically similar schools. Under this scenario, for instance, Black teachers could be sorting away from schools with white principals to demographically similar schools (in terms of student/teacher racial composition) with Black principals. The benefits to Black students of having a Black teacher, then, would merely be a zero-sum transfer between students at the “sending” and “receiving” schools, with no net increase in the exposure of Black students to Black teachers.^{xvii} On the other hand, if Black principals are pulling Black teachers into schools with greater “need” (i.e., larger mismatch between the proportion of Black students and Black teachers), these hiring patterns could be welfare-enhancing. We conduct two analyses to shed light on this question. First, we descriptively examine the racial composition of sending and receiving schools for transferring teachers, disaggregated by teacher race and the race of the prior and hiring principal. Second, we estimate models similar to those in Table 6 that examine whether same-race hires tend to transfer from schools with more or less need for Black teachers.

Table 7 shows descriptive statistics of sending and receiving schools for Black teacher transfers.^{xviii} On average, Black teachers in both states transfer between schools with similar percentages of Black students. The more relevant comparison, however, is between the racial mismatch (i.e., the percentage point difference between Black students and Black teachers) in the sending and receiving schools, which is shown in the final column. Here, we find that Black

teachers tend to move to schools where mismatch is *greater*, meaning that on balance they are moving to schools where there is more “need” for Black teachers. This holds for all types of transfers, including when a Black teacher moves from a white principal to a Black principal.

To supplement these descriptive statistics, we estimate models with school fixed effects that examine whether the prior school demographics of transferring teachers are different between same-race and different-race hires. Finding no within-school differences would indicate that while principals tend to hire more same-race teachers, they are not systematically pulling them from schools that are demographically different than the typical new hire in that school. Our results, shown in Online Appendix Table 6, are largely consistent with this story. In fact, we find that same-race hires tend to transfer from schools that have a slightly *smaller* Black student-teacher mismatch (indicating less “need” for Black teachers), with suggestive evidence that this is driven by Black teacher transfers.

Together, these analyses help to allay concerns that the effect of Black principals on Black teacher hiring is zero-sum or, worse, actually reducing the overall exposure of Black teachers to Black students. That said, our results also suggest that, given the observed patterns of Black teacher transfers, simply increasing the number of Black principals is not sufficient to erase large representation gaps between Black students and Black teachers.

VI. Teacher Turnover Results

A. Main Results

We now turn from teacher hiring to teacher turnover. Figure 5 shows the descriptive event studies of teacher turnover among Black and white teachers before and after principal transitions.^{xix} Similar to Figures 2 and 3, there are large differences between schools transitioning from Black-to-Black and white-to-white principals—schools with Black principals

have substantially greater teacher turnover rates in both states. In general, there is a strong correlation between principal turnover and teacher turnover. In the year that a principal leaves their position, a much larger proportion of the school's teachers leave their positions as well. This spike encompasses multiple possible mechanisms. Teachers may choose to leave in response to their principal leaving, but there could also be a school-level shock (i.e., a downturn in student performance on end-of-year exams) that drives both administrator and teacher turnover (Bartanen, Grissom, and Rogers 2019).

Whereas the event studies for composition and hiring showed clear patterns with respect to changes in principal race, the patterns in Figure 5 are more complicated. Among white teachers, there is no consistent difference in the turnover rate trends between white-to-Black and Black-to-white principal transitions. Among Black teachers, comparing these same transitions shows descriptive patterns that are consistent with the hypothesis that the race of the incoming principal also influences teachers' turnover decisions (which we investigate further below).^{xx} Black teachers in both states are comparatively less likely to turn over in the year of a white-to-Black principal transition than a Black-to-white transition. Intuitively, this pattern suggests that teachers' own mobility decisions may be related not only to whether they race-match with the outgoing principal, but also to whether they race-match with the incoming principal. In many cases, teachers know whether their current principal is leaving (e.g., the transition is a planned retirement) and who the replacement will be before making a turnover decision. Even in the case where the principal transition occurs after the end of the school year, the new principal often is installed early in the summer, such that teachers have time to pursue a transfer. If teacher responses to principal transitions are independent of the race of the outgoing and incoming principal, our estimates of principal race would be unaffected. If, however, teachers are more

likely to leave their positions in the year that a same-race principal leaves or when the replacement is a different-race principal, our race-match estimates would be closer to zero, since we are modeling the effect of principal race in the current year. To account for this possibility, we add an indicator for principal turnover, interacted with indicators for race-match, to our teacher turnover models.^{xxi}

Table 8 shows estimates for various specifications of equation 2, with this accounting for principal turnover. Columns 1 and 5 include school and year fixed effects, columns 2 and 6 replace year fixed effects with district-by-year fixed effects, and columns 3 and 7 add school-specific trends. The final column for each state adds controls for principal turnover.

Across all specifications, the race match coefficient is negative and statistically significant ($p < 0.001$ for all), providing strong evidence that having a same-race principal lowers the probability of teacher turnover. Interpreting the results of our preferred specification in columns 4 and 8, we find that teacher-principal race matching decreases the probability of teacher turnover by 2.5 percentage points in both Missouri and Tennessee. Relative to the average teacher turnover rates in each state, these effects correspond to 14 and 15 percent decreases, respectively. Online Appendix Table 9 shows that these results are robust to the inclusion of teacher fixed effects.

Next, we examine the effect of teacher-principal race matching on different types of teacher turnover. Specifically, we run separate models predicting whether teachers leave the state education system (exits), whether teachers move to a teaching position in a school in the same district (within-district moves) or a different district (across-district moves), and whether teachers change to a non-teaching position (position changes). Table 9 displays the multinomial results for our preferred specification. In both states, having a same-race principal lowers the

probability of exiting the K–12 public education system and transferring to another school—including both within-district and across-district transfers. In Missouri (Tennessee), teachers are 1.7 (1.4) percentage points less likely to exit when they work for a same-race principal. Having a same-race principal lowers the probability of transferring to another school in the same district by 1.0 percentage points in Missouri and 1.3 percentage points in Tennessee. The effects on transferring to a different district are 0.9 and 0.7 percentage points, respectively. Neither state shows evidence of an effect for position changes.^{xxii}

B. Are Race-Match Effects Different for Black and White Teachers?

As previously discussed, the presence of only two adequately sized racial/ethnic groups in both Missouri and Tennessee means that we cannot separately identify race-specific matching effects and any “main effect” of principal race. However, we can estimate separate matching effects by removing the *Black Principal* indicator from the model, which implicitly assumes that Black and white principals (within the same school over time) do not differ on unobservable characteristics that also influence teacher turnover. While this assumption is untestable, we can provide suggestive evidence by examining the stability of the estimated main effect of principal race from our baseline models to the exclusion of principals’ observable characteristics (gender, education, experience, and tenure). If the main effect of principal race is stable, it must be the case that Black and white principals are balanced on observables and/or observable principal characteristics are not strongly related to teacher turnover. In fact, we show in Online Appendix Table 10 that omitting these characteristics does not appreciably change the estimated main effect of principal race. Though there are some observable differences by principal race (see Online Appendix Table 11), they are relatively small in magnitude and these characteristics are

not strongly linked to teacher turnover. We interpret these results as suggestive evidence that our identifying assumption for the race-specific match effects model is plausible.

Table 10 shows the estimates from the race-specific matching effects model for both binary and multinomial turnover outcomes. In both Missouri and Tennessee, the estimated effect of having a same-race principal on teacher turnover (binary) is larger for Black teachers than white teachers, though this difference is not statistically significant in Missouri. In Tennessee, having a Black principal lowers the probability of turnover among Black teachers by 4.3 percentage points ($p < 0.01$), compared to a reduction of 0.7 percentage points for white teachers with white principals (n.s.). These patterns persist across exits and transfers. Again, we stress that these results are suggestive in that they reflect both heterogeneity in the matching effect by race and any unobserved differences between Black and white principals that contribute to teacher turnover.^{xxiii, xxiv}

C. Exploring Mechanisms for the Effect of Race Matching on Turnover

Next, we explore potential mechanisms for the effect of principal race on teacher turnover. Specifically, we test whether having a same-race principal affects salary, job satisfaction, and teacher perceptions of school leadership and climate. Each measure proxies one or more channels through which matching effects on turnover may operate. For example, while teacher pay is typically constrained by a salary schedule, principals can delegate extra work opportunities (e.g., coaching a sports team) to teachers to provide them with a small pay increase. By raising the opportunity costs of alternative employment, extra pay could be a means for principals to increase retention of same-race teachers (see Grissom and Keiser 2011). Increases in either salary or numerous other working conditions factors that principals can affect may positively impact same-race teachers' perceptions of their school and job satisfaction.

Higher job satisfaction has been closely linked to lower turnover in many studies (e.g., Clark 2001; Guarino, Santibañez, and Daley 2006).

Although we do not have access to fine-grained salary information that would allow us to distinguish base pay from other sources, we do have total salary for both states. The first two columns of Table 11 show the impacts of teacher-principal race matching on salary. In neither state do we find evidence of a substantial salary effect. While the point estimate is positive and significant in Tennessee, the magnitude is small (\$108 per year).

Tennessee administers a statewide annual survey (since 2011–12)^{xxv} to teachers that includes series of questions aimed at gauging teachers' job satisfaction, perceptions of school leadership, and school climate.^{xxvi} Using factor analysis, we combined these responses into standardized scales of *job satisfaction*, *school climate*, and *school leadership*. Across all three outcomes, we find that having a same-race principal modestly improves (0.07–0.10 SD) teachers' perceptions of their school and their satisfaction.

VII. Do Principals Improve Outcomes for Same-Race Students?

Lastly, we turn to results for student outcomes. Table 12 reports the estimated effect of principal race on the race of a student's teacher in math and reading. Columns 1 and 3 show that, on average, having a Black (white) principal increases the probability of assignment to a Black (white) teacher by 4.9 percentage points and 4.0 percentage points in math and reading, respectively. As would be expected from the composition analyses, columns 2 and 4 demonstrate that this exposure effect for math grows in magnitude as the principal gains experience in the same school. For reading, there is a jump after one year in the school but no evidence that the effect of principal race increases after the principal's second year in the school.^{xxvii}

The patterns in Table 12 encompass multiple potential mechanisms. First, as shown in prior analyses, principals increase the share of same-race teachers in the school, which will increase the likelihood that a student is assigned to a teacher of that race. Principals may also influence student-teacher assignment even conditional on the teacher composition effect, such as strategically matching students to same-race teachers (e.g., Black principals may be more likely to assign Black students to Black teachers) or increasing the share of same-race teachers who are in tested grades and subjects. We examine these latter two explanations in Online Appendix Tables 13 and 14 and find little evidence that the exposure effects are driven by differential student-teacher assignment or moving same-race teachers to tested grades/subjects.^{xxviii} In other words, the mechanism that drives the pattern in Table 12 is that Black (white) principals increase the proportion of Black (white) teachers in the school, which in turn increases the likelihood that any student (regardless of race) is assigned to a Black teacher.

Table 13 shows the achievement results. Here, the parameter of interest is the interaction between Black principal and Black student. Columns 1 and 4 show the simplest specifications for math and reading, which do not account for possibility that the principal-student race-match grows over time. For both subjects, the coefficient estimates are positive but not statistically significant at conventional levels. However, when allowing the match effect to change as the principal remains in the school (columns 2 and 5), we find evidence of a positive effect in math beyond the principal's first year in the school. Whereas the estimated race-match effect for math achievement is -0.009 SD ($p = 0.31$) in the principal's first year in the school, it increases to 0.011 SD ($p = 0.17$) in their second and third years and 0.026 SD ($p = 0.01$) in their fourth and fifth years. For reading, the estimates are uniformly smaller and not statistically significant at conventional levels, even when we combine the post-first year math effects in column 6.

To what extent are these principal-student race-match effects driven by Black versus white matches? As with our teacher turnover analysis, we can disaggregate these matching effects by removing the main effect of principal race from the model, which is effectively assuming that Black and white principals do not differ on unobservables that are also related to student test score gains. Online Appendix Table 15 shows that the estimated main effect of principal race from the baseline models is not sensitive to exclusion of principals' observable characteristics, which provides suggestive evidence that any bias from omitting the main effect of principal race from the race-specific matching effects model is small. As shown in Table 14, we find that the estimated match effects from the dynamic models (i.e., that allow the match effect to vary by principal tenure) are larger for Black matches. In particular, for math achievement in column 3, we can reject the null hypothesis that the *Match x Principal's 2nd + Year in School* coefficients are equal ($p = 0.05$). For reading, we find no consistent evidence of principal-student match effects for Black or white students.

Online Appendix Tables 16 and 17 repeat this exercise for student discipline outcomes. Specifically, we examine the effect of principal-student race match on the probability that a student is suspended one or more times during the school year.^{xxix} We also show results separating in-school and out-of-school suspensions. We find no evidence of effects of principal-student race match on suspensions, on average. In the race-specific matching models, we find no evidence of effects for white students, though perhaps some weak evidence of reductions for Black students, concentrated on in-school (but not out-of-school) suspensions.

Next, we examine how much of the principal-student race-match effect on achievement is explained by principals' impacts on teacher composition. Table 15 shows how controlling for various teacher characteristics changes our estimated match effects. For simplicity and to

improve precision, we focus on the specifications that estimate match effects for a principal's first year versus second or greater year in the school (i.e., the models shown in Table 13, columns 3 and 6). We treat these teacher characteristics as potential mediators; if principals' positive impacts on same-race students operate through teacher composition, controlling for measures of teacher composition should attenuate the match effects. On the other hand, if match effects remain even conditioning on teacher characteristics, it would suggest that the match effects are at least in part driven by other mechanisms.^{xxx}

Columns 1 and 5 show the baseline model for math and reading scores, respectively. Columns 2 and 6 add teacher race (i.e., an indicator for whether the student's assigned teacher in math/reading is Black) and the interaction between teacher race and student race. The student-teacher interaction is positive and statistically significant in math ($p < 0.01$) but not reading. Importantly, however, accounting for this relationship does not appreciably change the principal-student match effects relative to columns 1 and 5. In other words, while we find evidence of a student-teacher race-match effect (at least in math), and we previously demonstrated that Black (white) principals increase the likelihood that a student is assigned to a Black (white) teacher, this mechanism explains little of the positive effects of principals on same-race students. This finding may appear counterintuitive until considering the relatively small effects of principal race on student exposure from Table 12 (4–5 percentage points) and of teacher-student race match in Table 15 ($0.035 \text{ SD}^{\text{xxxi}}$); a back-of-the-envelope calculation based on these effects suggests that the average impact on achievement via this channel would be no more than 0.002 SD.

Columns 3 and 7 examine whether the principal-student match effects are explained by changes in teacher quality, which we operationalize using drift-adjusted value-added, years of experience, and an indicator for being new to the school. Here we find that accounting for

teacher quality appears to explain some of the principal-student race match effect. For instance, the coefficient for *Race Match x Principal's 2nd+ Year in School* is reduced from 0.027 SD to 0.022 SD in the model for math achievement. Columns 4 and 8 include both teacher-student race-match and teacher quality. Including teacher quality measures attenuates the estimated teacher-student race-match effect, but even including both sets of teacher characteristics does relatively little to explain the positive impact of having a same-race principal (after their first year in the school).

VIII. Discussion and Conclusions

This study provides evidence that racial diversity in the principal's office matters for racial diversity of a school's teaching force and, ultimately, the outcomes of students. Drawing on rich longitudinal administrative records from Missouri and Tennessee, we demonstrate—remarkably consistently across the two state contexts—that hiring a Black principal to lead a school substantially increases the number of Black teachers in that school in subsequent years, relative to what the composition would have been under a white principal. Building on prior findings that students of color benefit from assignment to same-race teachers, we then draw on student-level data from Tennessee to test whether this compositional change improves student achievement. The presence of a same-race principal increases the likelihood that a student is taught by a same-race teacher, which we show is driven by compositional effects rather than differential assignment practices within the school. As in prior work, students have higher achievement under same-race teachers, at least in math. Importantly, however, although we find positive effects of same-race principals on student math achievement after the principal's first year, those effects appear to operate through channels other than the indirect effect on the presence of same-race teachers.

Decomposing the effect of principal race on teacher composition, we find same-race effects for both hiring and retention. In both states, switching from a white principal to a Black principal increases the probability that a newly hired teacher is Black (and vice versa). This increase appears to come—though only to a small extent—from differences in how principals access their own networks in the hiring process. We do not find appreciable evidence that an increase in the likelihood of hiring a teacher from one’s own racial group (for either Black or white principals) lowers the quality of new hires, suggesting that taste-based bias is unlikely to be a primary driver of the hiring results. Changes in the race of the school’s leader also reduce turnover among teachers from the same racial background. We present suggestive evidence that race effects are larger for Black teachers than white teachers, particularly in Tennessee. Principal race effects are concentrated both on teacher moves and exits from the education. We also find that teachers give higher ratings to school leadership, school climate, and their own satisfaction in years in which they have a race-congruent principal, and some evidence (in Tennessee only) that there may be very small salary benefits to teachers as well.

These findings help bridge several bodies of existing research. First, we extend a growing literature on the importance of educator diversity for students of color by providing some of the first evidence linking principal race to student outcomes. In particular, our findings not only demonstrate that principal diversity matters for increasing the exposure of students to racially diverse teachers, but also that increasing the number of principals of color may benefit students of color through other mechanisms. Identifying these channels with more detailed data on principal behaviors and school processes would be a useful endeavor for future research.

Second, this study provides new evidence that principals affect teacher labor market outcomes. Principals exercise substantial influence over teaching hiring and are also instrumental

in teacher retention decisions, which gives them substantial power to shape the composition of their school's workforce. However, little work to date has examined how principal race matters in this context. Comparatively more work examines the importance of manager race/ethnicity for workers' labor market outcomes in other industries, such as manufacturing plants and retail stores. Our results generally confirm that the findings of these prior studies (e.g., Giuliano, Levine, and Leonard 2009, 2011) hold in K–12 public schools.

Our results may have implications for education policy. Our findings suggest that a strategy for increasing the numbers of teachers of color in a school is to hire principals of color, who will be more likely to hire and retain those teachers. In our data, increasing teacher diversity in schools with Black principals comes with no apparent loss with respect to measures of teacher quality. Although there may be a zero-sum concern that increased teacher diversity in one school comes at the cost of another, our results suggest that policies to increase the number of Black principals may do more than simply shuffle teachers around. Our hiring results show evidence of same-race hiring among teachers entering the profession, suggesting that diverse leadership could encourage more teachers of color to enter K–12 schools. Relatedly, we show that teachers are less likely to exit the K–12 system when they have a same-race principal. Examining the transfer patterns of Black teachers, we find that transfers in both states tend to move to schools with larger representation gaps, which should serve to increase the overall exposure of Black students to Black teachers. Beyond this exposure, hiring Black principals appears to benefit outcomes for Black students.

The study faces several limitations. Perhaps most important is the generalizability of the current study. While our personnel results are strikingly similar between Missouri and Tennessee, these states are demographically similar and less diverse than the United States as a

whole. Most notably, neither state has a significant number of Hispanic teachers, who comprise 8% of the national teacher workforce. Our results may not be representative of states with large numbers of non-white, non-Black teachers. The consistency of our results with other studies using national data suggest our results have some external validity (Grissom and Keiser 2011), but future work investigating these patterns in more racially and ethnically diverse states would be useful. Also, because our student results come from just one state, external validity may be even more of a concern.

Future work might also employ additional data sources to further investigate the mechanisms driving our results. Studies with teacher application data might better distinguish differences in teacher job-seeking from principals' hiring decisions as a means to explain own-race hiring patterns. Additional mechanisms driving differences in teacher turnover might include differences in how principals evaluate teachers from the same racial/ethnic background, job opportunities provided to those teachers (e.g., opportunities for teacher leadership), or intangible benefits, such as encouragement or job recognition. Future research might investigate effects of racial/ethnic congruence on other teacher outcomes, such as their instructional improvement over time.

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Table 1

Descriptive Statistics for Missouri and Tennessee Teachers

	Missouri					Tennessee				
	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N
Teacher Characteristics										
White	0.94				1007707	0.88				690835
Black	0.06				1007707	0.12				690835
Male	0.22				1007700	0.21				690835
Years of Experience	10.9	8.7	0	57	1007707	12.6	10.3	0	63	682236
0 Years in Current School	0.16				1007707	0.16				690835
1-4 Years in Current School	0.36				1007707	0.36				690835
5+ Years in Current School	0.47				1007707	0.48				690835
Highest Degree is MA	0.51				1006899	0.48				679027
Highest Degree is Ed.S. or Doctorate	0.01				1006899	0.07				679027
Principal Characteristics										
White	0.91				1007707	0.83				690835
Black	0.09				1007707	0.17				690835
Male	0.54				1007707	0.48				684757
Years of Experience	17.4	8.3	0	56	1007707	23.3	9.3	0	66	687378
0 Years in Current School	0.13				1007707	0.15				690835
1-4 Years in Current School	0.39				1007707	0.49				690835
5+ Years in Current School	0.48				1007707	0.37				690835
Highest Degree is Ed.S.	0.30				1007501	0.27				687570
Highest Degree is Doctorate	0.16				1007501	0.13				687570
School Characteristics										
Proportion Black	0.17	0.27	0.00	1.00	1004590	0.23	0.29	0.00	1.00	689375
Proportion Hispanic/Latino	0.03	0.06	0.00	0.98	1004590	0.07	0.09	0.00	0.74	689375
Proportion FRPL	0.42	0.23	0.00	1.00	995367	0.53	0.26	0.00	1.00	689375
Enrollment (100s)	6.47	4.75	0.00	28.82	1005842	8.40	4.81	0.01	115.83	690483
Elementary School	0.46				1007495	0.52				690835
Middle School	0.20				1007495	0.18				690835
High School	0.31				1007495	0.26				690835
Other School	0.03				1007495	0.04				690835
Urban School	0.19				1007495	0.30				689229
Suburban School	0.32				1007495	0.18				689229
Town School	0.18				1007495	0.16				689229
Rural School	0.31				1007495	0.36				689229

Notes: For all variables, observations are at the teacher-by-year level. Missouri sample includes all Black and white teachers from 1999 to 2016. Tennessee sample includes all Black and white teachers from 2007 to 2017. Due to the very small number of non-Black, non-white educators in both states, we drop these teachers and principals from the analysis.

Table 2

Average Racial Composition of Teachers by Principal Race

	Missouri			Tennessee		
	All Principals	Black Principals	White Principals	All Principals	Black Principals	White Principals
All Teachers						
% who are Black	6.0	41.2	2.4	11.7	43.4	5.3
% who are white	94.0	58.8	97.6	88.3	56.6	94.7
New Hires						
% who are Black	8.5	42.3	3.1	14.7	44.4	6.3
% who are white	91.5	57.7	96.9	85.3	55.6	93.7

Notes: This table is constructed using the full analytic sample of teachers and principals from Tennessee and Missouri. New hires are defined as teachers who are in their first year in the given school, which includes brand-new teachers (i.e., those who have no prior teaching experience in the state) and teachers transferring from different school.

Table 3

Estimates of the Effect of Principal Race on the Racial Composition of the Teaching Staff

	Missouri				Tennessee			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Black Principal	0.035*** (0.005)	0.031*** (0.004)	0.023*** (0.004)	0.017*** (0.004)	0.040*** (0.005)	0.034*** (0.004)	0.019*** (0.003)	0.017*** (0.003)
Black Principal (next year)				0.001 (0.004)				0.000 (0.003)
Black Principal (last year)				0.014*** (0.004)				0.010*** (0.003)
Black Principal (two years ago)				0.009** (0.004)				0.010*** (0.003)
Black Principal (three years ago)				0.006** (0.003)				0.009*** (0.003)
Black Principal (four years ago)				0.007* (0.004)				0.006* (0.003)
School Fixed Effects	Yes							
District-by-Year Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
School-Specific Trends	No	No	Yes	Yes	No	No	Yes	Yes
Observations	950995	950989	950989	850391	704474	704474	704474	604357
R ²	0.395	0.398	0.402	0.405	0.393	0.394	0.399	0.393

Notes: School-level clustered standard errors in parentheses. The unit of observation is teacher-by-year. In each column the dependent variable is an indicator for whether the teacher is Black. Models estimated via OLS. Models control for school demographics (enrollment size, proportion of Black students, proportion of Hispanic students, proportion of students qualifying for free/reduced-price lunch) and principal characteristics (categorical indicators for principal experience and tenure in school, indicator for Ed.S. degree, indicator for Ph.D. degree, flag for male gender). Columns 1 and 5 include year fixed effects in lieu of district-by-year fixed effects.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4

Estimates of the Effect of Principal Race on the Probability that a Newly Hired Teacher is Black

	Missouri				Tennessee			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Black Principal	0.070*** (0.009)	0.063*** (0.009)	0.053*** (0.009)	0.035*** (0.013)	0.077*** (0.008)	0.076*** (0.008)	0.068*** (0.009)	0.067*** (0.011)
Black Principal (next year)				0.001 (0.012)				0.007 (0.011)
Black Principal (last year)				0.043*** (0.014)				-0.011 (0.011)
Black Principal (two years ago)				-0.026** (0.013)				-0.000 (0.011)
Black Principal (three years ago)				0.014 (0.014)				0.000 (0.011)
Black Principal (four years ago)				-0.004 (0.013)				0.007 (0.012)
School Fixed Effects	Yes							
District-by-Year Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
School-Specific Trends	No	No	Yes	Yes	No	No	Yes	Yes
Observations	150829	150829	150829	125322	107382	107382	107382	90600
R^2	0.376	0.392	0.404	0.412	0.372	0.376	0.389	0.391

Notes: School-level clustered standard errors in parentheses. The unit of observation is teacher-by-year. In each column the dependent variable is an indicator for whether the teacher is Black. Models estimated via OLS. Models control for school demographics (enrollment size, proportion of Black students, proportion of Hispanic students, proportion of students qualifying for free/reduced-price lunch) and principal characteristics (categorical indicators for principal experience and tenure in school, indicator for Ed.S. degree, indicator for Ph.D. degree, flag for male gender). Columns 1 and 4 include year fixed effects in lieu of district-by-year fixed effects.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5

Examining Heterogeneity in the Effect of Principal Race on the Probability that a Newly Hired Teacher is Black

	Missouri		Tennessee	
	Coef.	Pr > F	Coef.	Pr > F
<i>Panel A</i>				
Not New to State x Black Principal	0.067*** (0.010)	< 0.01	0.088*** (0.010)	< 0.01
New to State x Black Principal	0.027** (0.010)		0.036*** (0.010)	
<i>Panel B</i>				
Not New to District x Black Principal	0.051*** (0.014)	0.52	0.088*** (0.013)	0.68
New to District x Black Principal	0.042*** (0.015)		0.093*** (0.015)	
<i>Panel C</i>				
Not in Teacher's Network x Black Principal	0.046*** (0.014)	0.98	0.087*** (0.013)	0.43
In Teacher's Network x Black Principal	0.046*** (0.016)		0.097*** (0.015)	
<i>Panel D</i>				
Not in Principal's Network x Black Principal	0.039*** (0.013)	< 0.01	0.086*** (0.012)	0.01
In Principal's Network x Black Principal	0.127*** (0.031)		0.155*** (0.029)	

Notes: School-level clustered standard errors in parentheses. The dependent variable is a binary indicator for whether the newly hired teacher is Black. Models estimated via OLS and each panel-by-state is a separate regression where we omit the main effect of principal race. As such, the estimated coefficients are the marginal effects of principal race for the given teacher group and the corresponding F-test is for equality of these marginal effects. Panel A includes all new hires, while the remaining panels include new hires with previous experience in the state education system. Teacher Network is an indicator for whether the new hire previously worked with any teachers in the new school. Principal Network is an indicator for whether the new hire worked previously with the hiring principal in a different school. All models include: school fixed effects; school-specific trends; district-by-year fixed effects; controls for time-varying school characteristics and principal characteristics; interactions between the grouping variable (new to state, new to district, in teacher's network, in principal's network) and all control variables. In the effective sample in Missouri (Tennessee), 43% (46%) of new hires are new-to-state; among transfers, 49% (32%) are from a different district, 39% (37%) have a teacher connection, and 6% (7%) have a principal connection.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6

Predicting Characteristics of New Hires in Tennessee

	Qualifications		Classroom Observations (SD)			Value Added (SD)	
	Total Experience (1)	MA or above (2)	Prior (3)	Current (4)	Career (5)	Career TVAAS (6)	Drift-Adjusted (7)
Panel A							
Black Principal	-0.148 (0.159)	0.018** (0.009)	-0.068 (0.048)	-0.097 (0.063)	-0.087*** (0.020)	-0.018 (0.029)	-0.031 (0.025)
Panel B							
Race Match with Principal	0.423*** (0.091)	0.022*** (0.006)	0.126*** (0.025)	0.131*** (0.022)	0.106*** (0.012)	0.074*** (0.015)	0.064*** (0.016)
Black Principal	-0.024 (0.167)	0.018** (0.009)	-0.000 (0.051)	-0.025 (0.065)	-0.030 (0.022)	0.016 (0.030)	-0.002 (0.025)
Black Teacher	1.099*** (0.094)	0.135*** (0.006)	-0.106*** (0.026)	0.002 (0.023)	-0.079*** (0.013)	-0.029* (0.016)	-0.019 (0.017)
Observations	110656	106776	22425	33291	84820	34658	48526

Notes: School-level clustered standard errors in parentheses. In each column, the unit of observation is teacher-by-year. The dependent variable is listed above the column number. Models estimated via OLS. Models include school and year fixed effects and school characteristics. MA or above is an indicator for having a master's degree or other advanced degree. Classroom observation scores come from Tennessee's teacher evaluation system first implemented in the 2011–12 school year. Prior scores are a teacher's average observation and value added scores from all prior years. Current scores are teachers' scores in the first year at their new school. Career scores are teachers' average scores in all available years of data. Career TVAAS are teacher-level averages of one-year TVAAS estimates available beginning in 2007–08; for teachers with estimates for multiple subjects, we create an average score that is inversely weighted by the standard error of the estimate for an individual subject (math, reading, science, or social studies). Drift-adjusted value-added measure are constructed using the approach outlined in Chetty, Friedman, and Rockoff (2014).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7

Demographics of Prior and Hiring Schools for Black Teacher Transfers

	% Black Students			% Black Students – % Black Teachers		
	Hiring	Prior	Difference	Hiring	Prior	Difference
Panel A: Missouri						
All Moves	78.7	78.6	0.0	34.4	31.6	2.8
White Principal to White Principal	44.1	42.3	1.8	28.5	25.0	3.5
White Principal to Black Principal	84.9	64.4	20.4	36.9	34.3	2.6
Black Principal to White Principal	64.7	86.2	-21.5	36.5	33.6	2.9
Black Principal to Black Principal	89.3	89.9	-0.6	34.4	31.7	2.7
Panel B: Tennessee						
All Moves	71.7	73.9	-2.2	24.2	22.7	1.5
White Principal to White Principal	40.0	42.3	-2.3	19.7	19.1	0.6
White Principal to Black Principal	75.1	59.2	15.9	25.7	23.7	2.0
Black Principal to White Principal	60.1	80.1	-20.0	26.0	24.5	1.5
Black Principal to Black Principal	85.1	87.5	-2.4	24.4	22.8	1.6

Notes: The left column categorizes the type of transfer (e.g., white Principal to Black Principal means that a teacher transferred from a school where their principal was white to a school where their principal was Black). The school characteristics for hiring and prior school are tabulated in the teacher's final year in the prior school to avoid double counting.

Table 8

Estimates of the Effect of Principal-Teacher Race Match on the Probability of Teacher Turnover

	Missouri				Tennessee			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Race Match with Principal	-0.018*** (0.003)	-0.021*** (0.003)	-0.021*** (0.003)	-0.025*** (0.004)	-0.023*** (0.002)	-0.022*** (0.002)	-0.024*** (0.002)	-0.025*** (0.003)
School Fixed Effects	Yes							
District-by-Year Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes
School-Specific Trends	No	No	Yes	Yes	No	No	Yes	Yes
Controls for Principal Turnover	No	No	No	Yes	No	No	No	Yes
Observations	893562	893556	893556	893556	556208	556208	556208	556208
R^2	0.054	0.079	0.084	0.084	0.057	0.067	0.074	0.074

Notes: School-level clustered standard errors in parentheses. The unit of observation is teacher-by-year. In each column the dependent variable is an indicator for whether the teacher left their position between year t and $t+1$. Models estimated via OLS. Models control for teacher characteristics (race, gender, education, experience, tenure in school, and whether the principal hired the teacher), school demographics (enrollment size, proportion of Black students, proportion of Hispanic students, proportion of students qualifying for free/reduced-price lunch) and principal characteristics (race, gender, principal experience, tenure in school, education level).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9

Examining Differences in the Effect of Teacher-Principal Race Match on Types of Teacher Turnover

	Missouri				Tennessee			
	Exit System	Within District Move	Across District Move	Position Change	Exit System	Within District Move	Across District Move	Position Change
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Race Match with Principal	-0.017*** (0.003)	-0.010*** (0.002)	-0.009*** (0.002)	-0.000 (0.001)	-0.014*** (0.002)	-0.013*** (0.002)	-0.007*** (0.001)	-0.001 (0.001)
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District-by-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School-Specific Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Principal Turnover	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	815862	773741	766579	750429	507708	497035	480484	474753
R^2	0.083	0.074	0.078	0.029	0.074	0.069	0.046	0.028

Notes: School-level clustered standard errors in parentheses. The unit of observation is teacher-by-year. In each column the dependent variable is an indicator for the turnover type listed in the header. All models are relative to the base category of stayers, such that teachers who turned over in a different category than listed in the header are not included in the model. Models estimated via OLS. Models control for teacher characteristics (race, gender, education, experience, tenure in school, and whether the principal hired the teacher), school demographics (enrollment size, proportion of Black students, proportion of Hispanic students, proportion of students qualifying for free/reduced-price lunch) and principal characteristics (race, gender, principal experience, tenure in school, education level).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10

Predicting Race-Specific Matching Effects

	All Turnover	Exit	Within	Across	Position Change
	(1)	(2)	(3)	(4)	(5)
Panel A: Missouri					
Race Match x Black Teacher	-0.033*** (0.009)	-0.022*** (0.008)	-0.013** (0.006)	-0.013*** (0.004)	0.001 (0.003)
Race Match x White Teacher	-0.018*** (0.006)	-0.012** (0.005)	-0.008 (0.005)	-0.005* (0.003)	-0.001 (0.002)
p-value (coefficients are equal)	0.30	0.38	0.54	0.12	0.75
Observations	893556	815862	773741	766579	750442
R^2	0.084	0.083	0.074	0.078	0.028
Panel B: Tennessee					
Race Match x Black Teacher	-0.043*** (0.008)	-0.025*** (0.005)	-0.024*** (0.007)	-0.012*** (0.003)	-0.003 (0.002)
Race Match x White Teacher	-0.007 (0.007)	-0.002 (0.005)	-0.003 (0.006)	-0.003 (0.002)	0.001 (0.002)
p-value (coefficients are equal)	0.01	0.01	0.10	0.06	0.30
Observations	556208	507708	497035	480484	474753
R^2	0.074	0.074	0.069	0.046	0.028

Notes: School-level clustered standard errors in parentheses. The unit of observation is teacher-by-year. In each column the dependent variable is an indicator for the turnover type listed in the header. For columns 2 to 5, models are relative to the base category of stayers, such that teachers who turned over in a different category than listed in the header are not included in the model. Models estimated via OLS. Models control for teacher characteristics (race, gender, education, experience, tenure in school, and whether the principal hired the teacher), school demographics (enrollment size, proportion of Black students, proportion of Hispanic students, proportion of students qualifying for free/reduced-price lunch) and principal characteristics (gender, principal experience, tenure in school, education level). To estimate race-specific match effects, we omit the main effect of principal race from the model under the assumption of balance on unobservables.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11

The Effect of Principal Race on Teacher Salary, Satisfaction, and Climate

	Missouri		Tennessee		
	Total Salary (1000s)	Total Salary (1000s)	Satisfaction (SD)	Leadership Perception (SD)	Climate Perception (SD)
	(1)	(2)	(3)	(4)	(5)
Race Match with Principal	-0.072 (0.067)	0.108** (0.042)	0.074*** (0.017)	0.095*** (0.021)	0.083*** (0.020)
School Fixed Effects	Yes	Yes	Yes	Yes	Yes
District-by-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	948682	585800	124883	80253	80676
R^2	0.825	0.818	0.172	0.187	0.177

School-level clustered standard errors in parentheses. The dependent variable is listed in the column header. Models estimated via OLS. Models control for teacher characteristics (race, gender, education, experience, tenure in school, and whether the principal hired the teacher), school demographics (enrollment size, proportion of Black students, proportion of Hispanic students, proportion of students qualifying for free/reduced-price lunch) and principal characteristics (race, gender, principal experience, tenure in school, education level). In both states, salary is available for all years. In Tennessee, teacher survey responses for satisfaction are available beginning in the 2011–12 school year. Leadership and climate perception are available beginning in 2014–15. Each of these measures are constructed using factor analysis to collapse multiple survey items into a single standardized score.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12

The Effect of Principal Race on Assignment to a Black Teacher

	DV = Math Teacher is Black		DV = Reading Teacher is Black	
	(1)	(2)	(3)	(4)
Black Principal	0.049*** (0.010)	0.029** (0.012)	0.040*** (0.010)	0.030*** (0.011)
Black Principal x 2nd-3rd Year in School		0.019* (0.010)		0.014 (0.009)
Black Principal x 4th-5th Year in School		0.034** (0.014)		0.017 (0.013)
Black Principal x 6th+ Year in School		0.041** (0.016)		0.015 (0.013)
Observations	2998231	2998231	4111404	4111404
R^2	0.609	0.609	0.570	0.570

School-level clustered standard errors in parentheses. Unit of observation is student-by-year. The dependent variable is a binary indicator for whether the student's assigned teacher in the given subject is Black. Models estimated via OLS. For students with multiple teacher assignments in a given year, the student has multiple observations that are weighted by the percentage claim of each teacher. Models include: school-by-grade-by-race fixed effects, prior-year test scores and attendance, student characteristics, school characteristics, grade characteristics, principal tenure in school, and year fixed effects. Additionally, we control for interactions between student race and all school- and grade-level controls. "Year in school" variables refer to the number of years the principal has worked in the school as the principal, with the omitted category being "1st year in school."

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13

Do Principals Improve the Achievement of Same-Race Students?

	Math Achievement			Reading Achievement		
	(1)	(2)	(3)	(4)	(5)	(6)
Black Principal	-0.001 (0.010)	-0.004 (0.012)	-0.005 (0.011)	-0.003 (0.005)	-0.002 (0.006)	-0.002 (0.006)
Race Match with Principal	0.010 (0.006)	-0.009 (0.009)	-0.009 (0.008)	0.002 (0.004)	-0.002 (0.005)	-0.002 (0.005)
Race Match with Principal x 2nd-3rd Year in School		0.020** (0.009)			0.009 (0.006)	
Race Match with Principal x 4th-5th Year in School		0.034*** (0.012)			0.003 (0.006)	
Race Match with Principal x 6th+ Year in School		0.033** (0.015)			0.001 (0.007)	
Race Match with Principal x 2nd+ Year in School			0.027*** (0.009)			0.006 (0.005)
Observations	2998231	2998231	2998231	4111404	4111404	4111404
R^2	0.618	0.618	0.618	0.646	0.646	0.646

Notes: School-level clustered standard errors in parentheses. In the first three columns, the dependent variable is a student's math test score, standardized within subject, grade, and year. The last three columns show the same score for reading. Models estimated via OLS. Models include: school-by-grade-by-race fixed effects, prior-year test scores and attendance, student characteristics, school characteristics, grade characteristics, principal tenure in school, and year fixed effects. Additionally, we control for interactions between student race and all school- and grade-level controls. "Year in school" variables refer to the number of years the principal has worked in the school as the principal, with the omitted category being "1st year in school."

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14

Race-Specific Estimates of Principal-Student Race-Match Effects on Achievement

	Math Achievement			Reading Achievement		
	(1)	(2)	(3)	(4)	(5)	(6)
<u>Black Matches (Black Principal x Black Student)</u>						
Match	0.009 (0.013)	-0.013 (0.016)	-0.014 (0.016)	-0.001 (0.006)	-0.004 (0.008)	-0.004 (0.008)
Match x Principal 2nd-3rd Year in School		0.034** (0.016)			0.021* (0.011)	
Match x Principal 4th-5th Year in School		0.048** (0.021)			0.007 (0.011)	
Match x Principal 6th+ Year in School		0.061** (0.028)			0.007 (0.013)	
Match x Principal 2nd+ Year in School			0.045*** (0.017)			0.015 (0.010)
<u>White Matches (White Principal x White Student)</u>						
Match	0.011 (0.011)	-0.005 (0.013)	-0.003 (0.013)	0.006 (0.006)	0.000 (0.008)	0.000 (0.008)
Match x Principal 2nd-3rd Year in School		0.006 (0.008)			-0.002 (0.005)	
Match x Principal 4th-5th Year in School		0.021** (0.010)			-0.001 (0.005)	
Match x Principal 6th+ Year in School		0.004 (0.011)			-0.005 (0.005)	
Match x Principal 2nd+ Year in School			0.009 (0.008)			-0.002 (0.004)
Observations	2998231	2998231	2998231	4111404	4111404	4111404
R^2	0.618	0.618	0.618	0.646	0.646	0.646

Notes: School-level clustered standard errors in parentheses. In the first three columns, the dependent variable is a student's math test score, standardized within subject, grade, and year. The last three columns show the same score for reading. Models estimated via OLS. Models include: school-by-grade-by-race fixed effects, prior-year test scores and attendance, student characteristics, school characteristics, grade characteristics, principal characteristics, and year fixed effects. Additionally, we control for interactions between student race and all school- and grade-level controls. "Year in school" variables refer to the number of years the principal has worked in the school as the principal, with the omitted category being "1st year in school." "Match" refers to either "Black Principal x Black Student" or "White Principal x White Student." To estimate race-specific matching effects, we omit the main effect of principal race from the model under the assumption of balance on unobservables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15

Does Teacher Composition Explain the Benefits of Having a Same-Race Principal?

	Math Achievement				Reading Achievement			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Race Match with Principal x Prin 2nd+ Year in Sch	0.027*** (0.010)	0.026*** (0.010)	0.022** (0.010)	0.022** (0.010)	0.008 (0.005)	0.008 (0.005)	0.006 (0.005)	0.006 (0.005)
Race Match with Principal	-0.008 (0.009)	-0.009 (0.009)	-0.011 (0.008)	-0.011 (0.008)	-0.003 (0.005)	-0.003 (0.005)	-0.002 (0.005)	-0.002 (0.005)
Black Principal	-0.007 (0.012)	-0.007 (0.012)	-0.006 (0.010)	-0.006 (0.010)	-0.003 (0.006)	-0.002 (0.006)	-0.002 (0.006)	-0.002 (0.006)
Black Teacher		-0.021** (0.010)		-0.015** (0.006)		-0.011** (0.004)		-0.012*** (0.004)
Black Teacher x Black Student		0.035*** (0.012)		0.021*** (0.007)		0.007 (0.006)		0.004 (0.005)
Teacher Value-Added			0.109*** (0.001)	0.109*** (0.001)			0.040*** (0.001)	0.040*** (0.001)
Teacher First Year in Sch			-0.039*** (0.004)	-0.039*** (0.004)			-0.022*** (0.002)	-0.021*** (0.002)
Teacher Exp = 1 years			0.039*** (0.006)	0.039*** (0.006)			0.014*** (0.004)	0.014*** (0.004)
Teacher Exp = 2 years			0.056*** (0.007)	0.056*** (0.007)			0.018*** (0.004)	0.019*** (0.004)
Teacher Exp = 3 years			0.050*** (0.007)	0.050*** (0.007)			0.018*** (0.004)	0.018*** (0.004)
Teacher Exp = 4 years			0.055*** (0.007)	0.055*** (0.007)			0.026*** (0.004)	0.026*** (0.004)
Teacher Exp = 5 years			0.058*** (0.007)	0.058*** (0.007)			0.013*** (0.004)	0.013*** (0.004)
Teacher Exp = 6-10 years			0.049*** (0.006)	0.048*** (0.006)			0.020*** (0.003)	0.021*** (0.003)
Teacher Exp = 11-15 years			0.051*** (0.006)	0.051*** (0.006)			0.018*** (0.004)	0.018*** (0.004)
Teacher Exp = 16+ years			0.043*** (0.006)	0.043*** (0.006)			0.019*** (0.004)	0.019*** (0.004)
Observations	2766784	2766784	2766784	2766784	3812211	3812211	3812211	3812211
R ²	0.617	0.617	0.628	0.628	0.644	0.644	0.645	0.645

Notes: School-level clustered standard errors in parentheses. In the first four columns, the dependent variable is a student's math test score, standardized within subject, grade, and year. The last four columns show the same score for reading. Models estimated via OLS. Models include: school-by-grade-by-race fixed effects, prior-year test scores and attendance, student characteristics, school characteristics, grade characteristics, principal characteristics, and year fixed effects. Additionally, we control for interactions between student race and all school- and grade-level controls. "Year in school" variables refer to the number of years the principal has worked in the school as the principal, with the

omitted category being “1st year in school.” “Match” refers to either “Black Principal x Black Student” or “White Principal x White Student.” Teacher value-added calculated using the leave-year-out, drift-adjusted approach outlined in Chetty, Friedman, & Rockoff (2014).

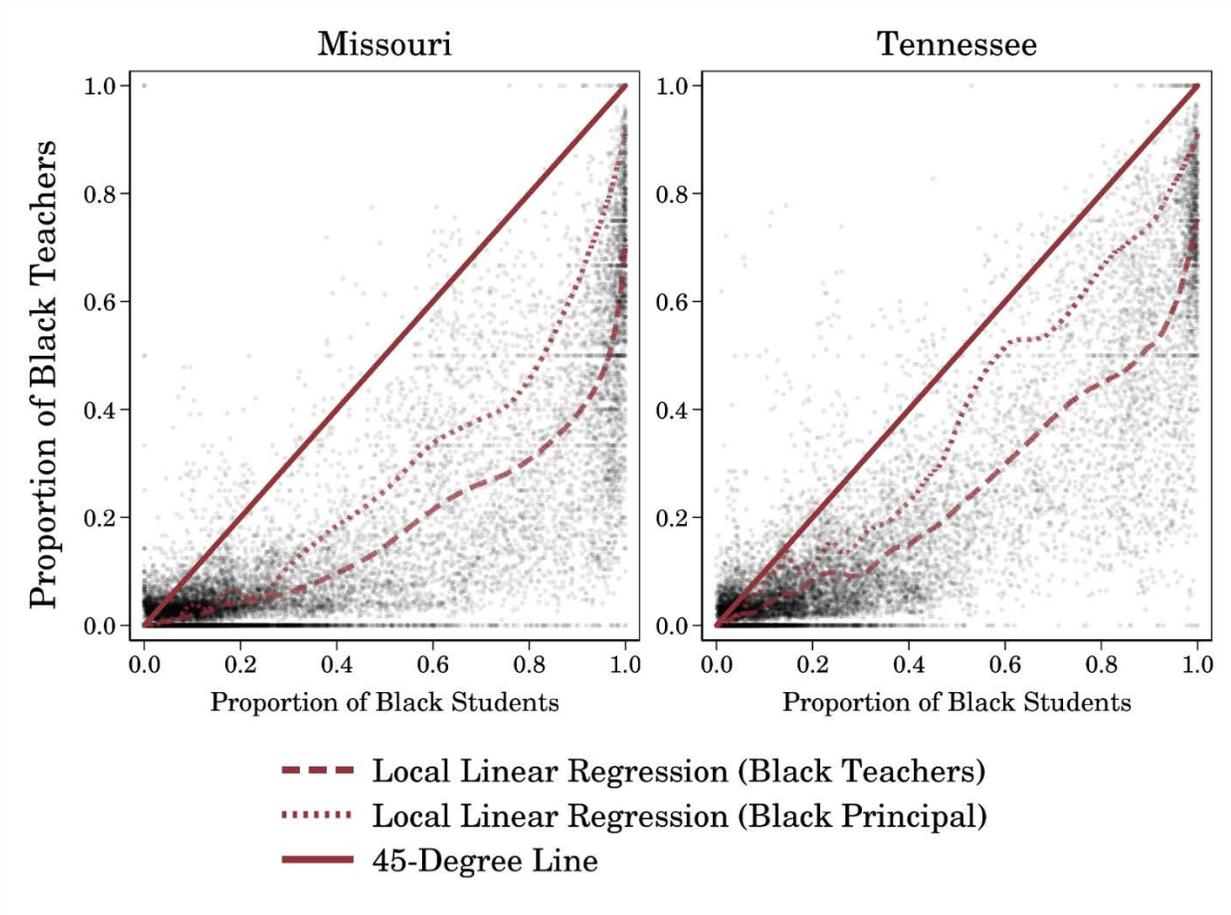


Figure 1

Representation Gaps Between Black Students and Black Teachers

Notes: Each dot represents a school-by-year observation. Solid line represents equal proportions of Black students and Black teachers. The dashed line is a local linear regression that predicts the proportion of Black teachers in a school as a function of the proportion of Black students. The dotted line is a local linear regression that predicts the probability of having a Black principal in a school as a function of the proportion of Black students.

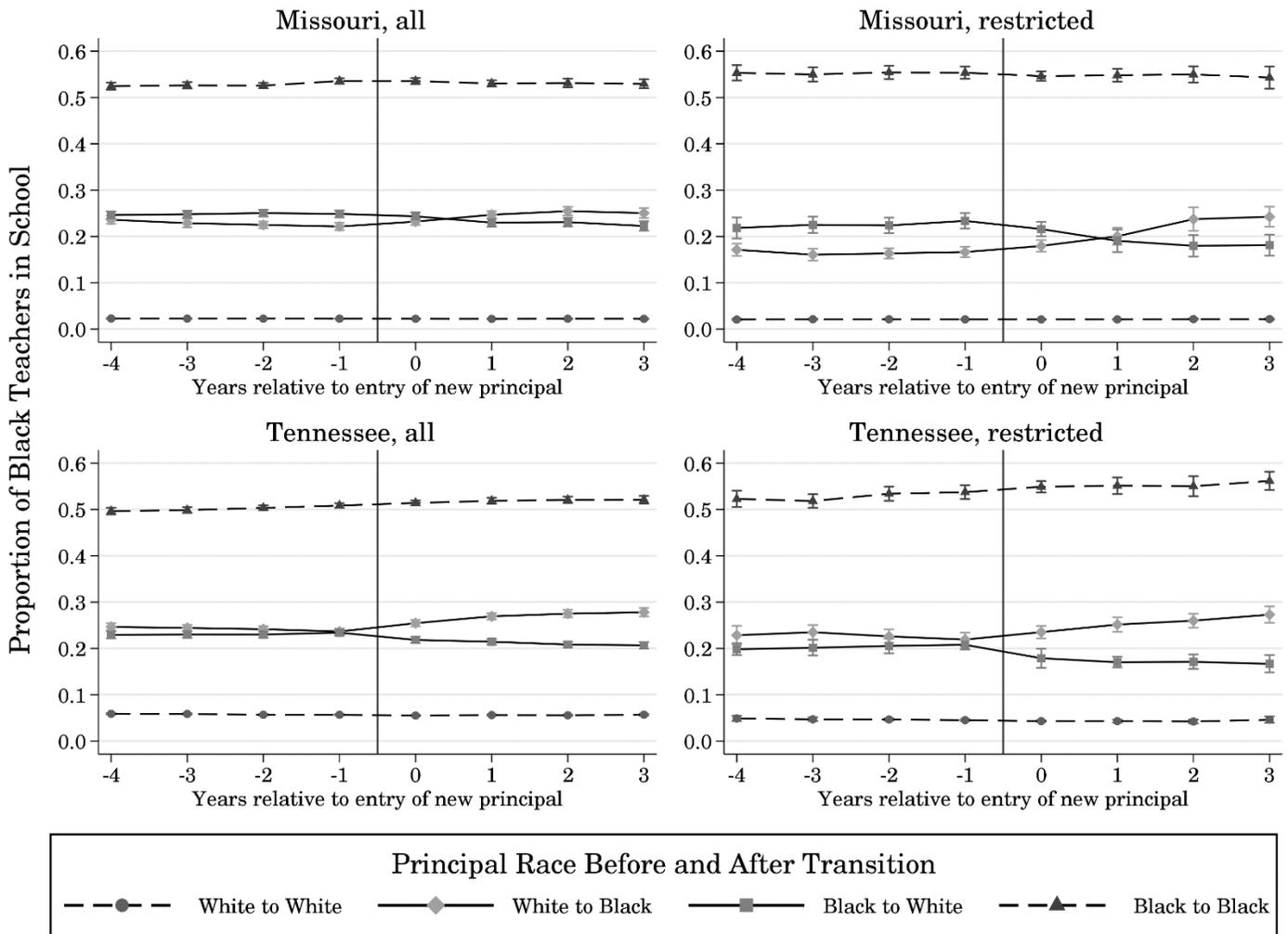


Figure 2

Teacher Racial Composition Before and After Principal Transitions

Notes: These figures plot event studies (8-year window) of the proportion of a school’s newly hired teachers that are black by year. Models include school and year fixed effects. Left panels (all) include all principal transitions, such that school-by-year observations are duplicated by the total number of principal transitions across the data stream. Right panels (restricted) limit the sample to cases where the old and new principal each stayed at least four years in the school. Errors bars show 95% confidence intervals.

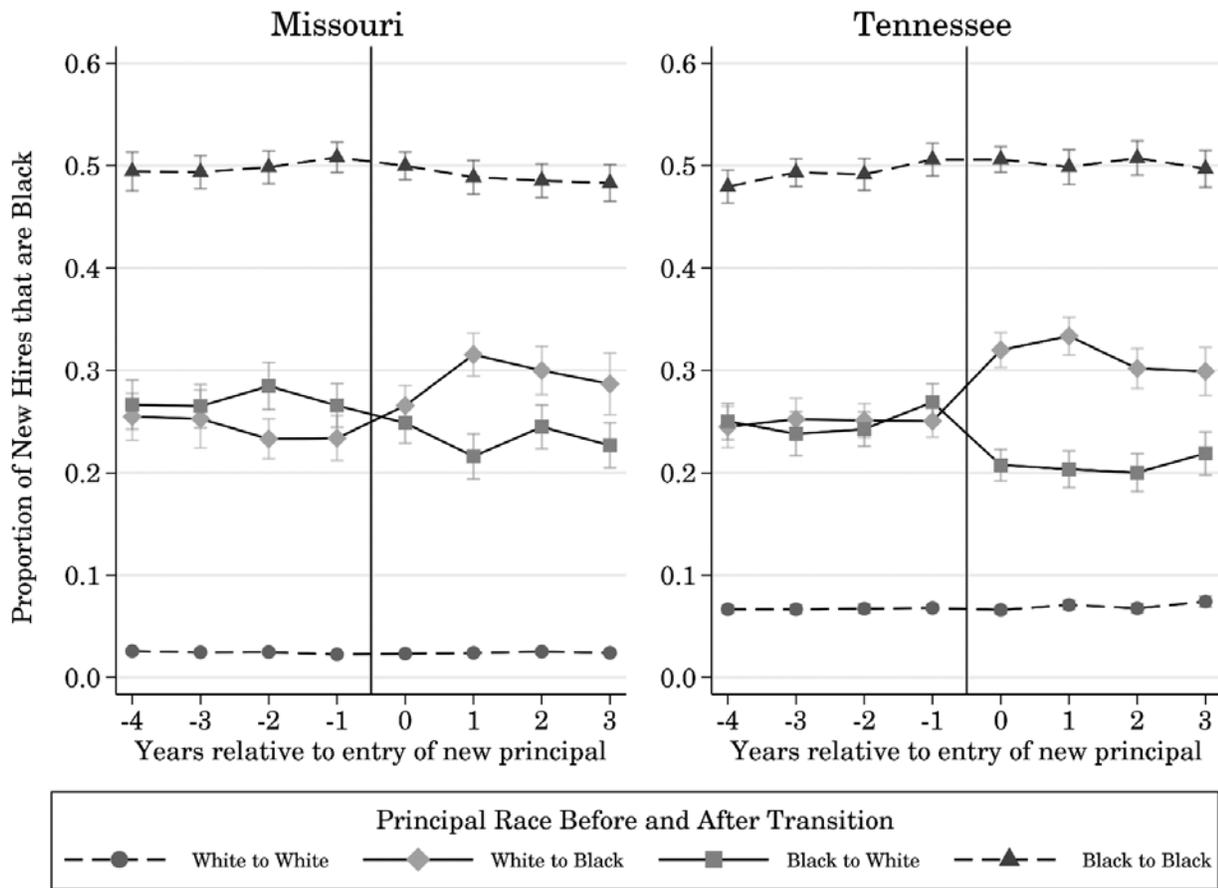


Figure 3

Proportion of Black Hires Before and After Principal Transitions

Notes: These figures plot event studies (8-year window) of the proportion of a school’s newly hired teachers that are black by year. Sample includes all principal transitions between Black and white from Missouri and Tennessee, respectively. Models include school and year fixed effects. Schools with multiple principal transitions have a corresponding number of 8-year windows in the regression model. School-by-year observations are weighted by the number of new hires. Errors bars show 95% confidence intervals.

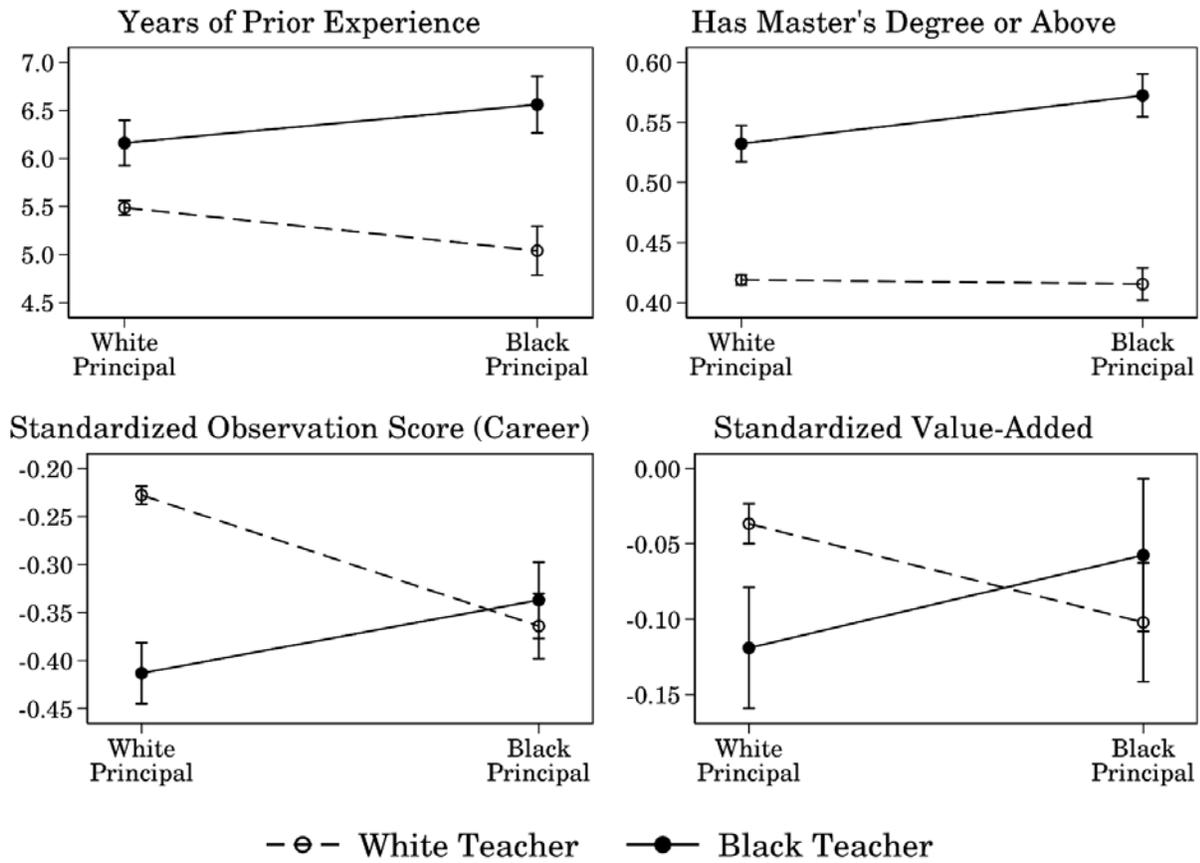


Figure 4

Qualifications and Effectiveness of New Hires by Teacher and Principal Race

Notes: These figures plot the predicted margins of the combination of teacher and principal race based on the results shown in Table 6 Panel B. Standardized value-added refers to the drift-adjusted VA measure (column 7). Specifically, the model predicts the given qualification/effectiveness measure of a newly hired teacher as a function of teacher race, principal race, and the interaction of teacher and principal race, with controls for time-varying school characteristics, school fixed effects, and year fixed effects. Error bars show 95% confidence intervals.

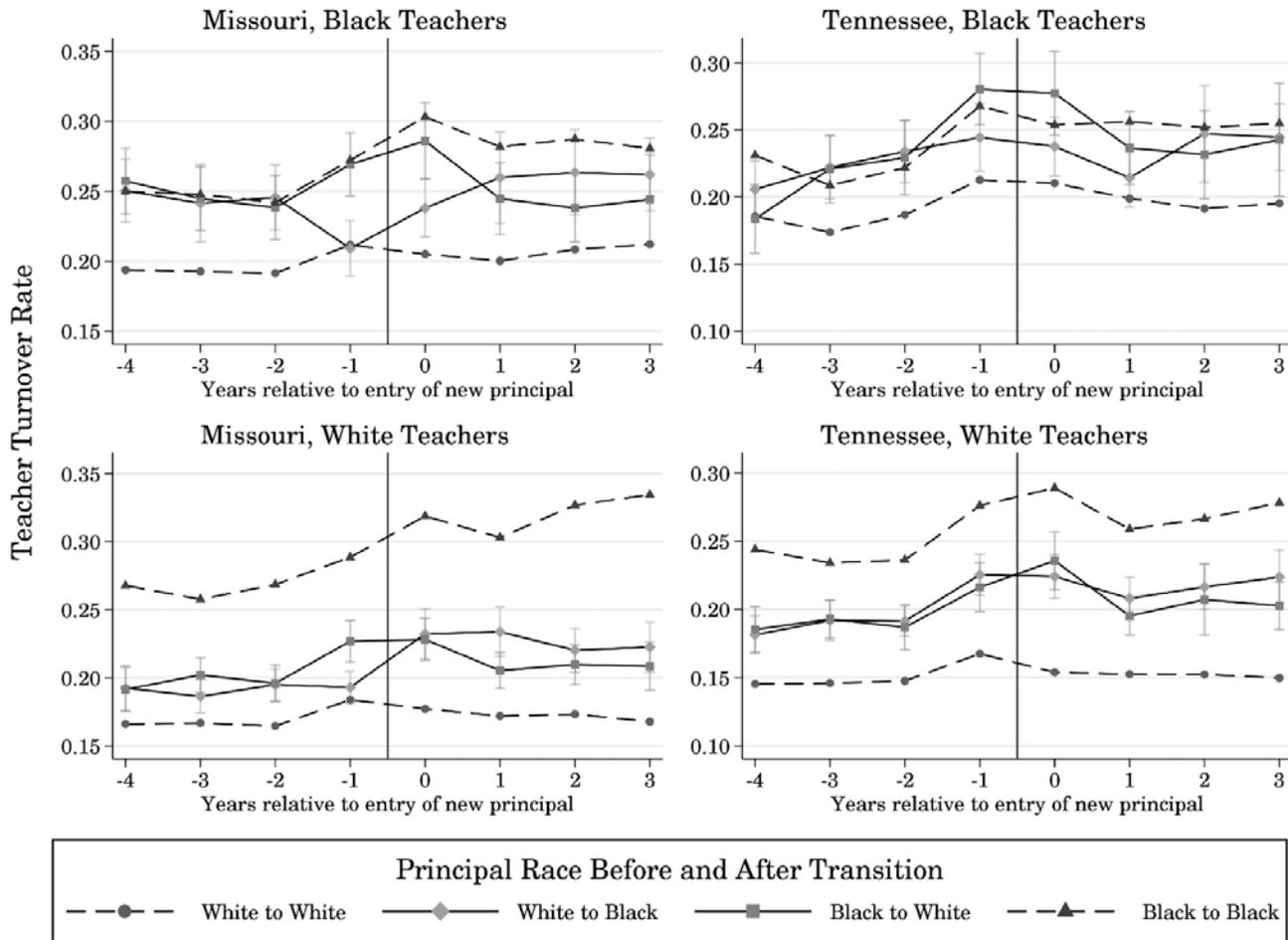


Figure 5

Teacher Turnover Before and After Principal Transitions

Notes: These figures plot event studies (8-year window) of the proportion of a school’s Black and white teachers that leave their position. Sample includes all principal transitions between Black and white from Missouri and Tennessee, respectively. Models include school and year fixed effects. Schools with multiple principal transitions have a corresponding number of 8-year windows in the regression model. School-by-year observations are weighted by the number of Black or white teachers. Errors bars show 95% confidence intervals and are omitted for white to white and Black to Black lines for the sake of readability.

ⁱ In a small number of cases, sex or race/ethnicity was missing or inconsistent for the same educator over time. In these cases, other years of a teacher's record were used to fill in or correct the questionable cases. Omitting these teachers from the analysis does not affect the results.

ⁱⁱ In Missouri and Tennessee, 99% and 98% of teachers are White or Black, respectively.

ⁱⁱⁱ In both states, educators moving into principal positions typically come from another position within the same district and occasionally from the same school. In Missouri (Tennessee), 61% (90%) of principals worked in the same district immediately prior to being hired as a principal, and 23% (29%) worked in the same school. The lower percentage of within-district promotions to the principalship in Missouri makes sense given that Missouri has many more districts that are smaller in size, on average.

^{iv} We did not have access to student-level data from Missouri.

^v Reliable data on suspensions starts a year later in 2007–08.

^{vi} These high school exams include English I, English II, English III, Algebra I, and Geometry.

^{vii} There could still be sudden school-level changes that cause both the hiring of a Black principal and the hiring of Black teachers. To bias our estimates, such changes would need to differentially affect certain schools within the same district and not be captured by school demographic controls and school-specific trends. While we cannot directly rule out such threats, we perform a number of checks to examine these potential issues. First, Online Appendix Figure 2 shows trends in the proportion of Black students before and after principal transitions. We find no evidence of any substantial pre-turnover trends in student composition in either state. We also implement a series of robustness checks similar to those used in Giuliano et al. (2009) to examine whether changes in teacher composition predict changes in principal race, which are shown in Online Appendix Table 3. We find no evidence that changes in the percent of Black new hires or overall teacher composition predict the probability that a new principal is Black. We do, however, find a small, statistically significant relationship between hiring a Black principal and the “representation gap” between the proportion of Black students and Black new hires in Tennessee. Specifically, increases in the representation gap positively predict that a new principal is Black. However, the magnitude is small—a one

percentage point change in the difference between the percentage of Black students and Black new hires (which corresponds to roughly 10% of a standard deviation in the effective sample) predicts a 0.38 percentage point increase in the probability that the new principal is Black.

^{viii} The fixed effects probit model can be estimated by including indicator variables for each school in the model, though such estimates are only consistent if a sufficient number of teachers within each school are observed. We observe a median of 59 and 46 new hires in each school in Missouri and Tennessee, respectively.

^{ix} Previous studies (e.g., Giuliano et al. 2011) have proposed exploiting the presence of three or more groups to identify race-specific matching effects. The intuition behind such models is that comparing turnover outcomes of Black and White teachers under Hispanic principals, for example, provides a “no-bias” comparison (i.e., neither group is race-matched) that can be used to establish baseline differences in turnover rates. This approach requires both adequate precision to estimate individual comparisons and that the outcomes of race j and k under race l principals in fact represent a “no-bias” condition. This assumption may not hold if, for instance, having a Hispanic principal lowers turnover among White teachers but increases turnover among Black teachers (or any other scenario in which there is a differential response). Given the extremely small number of non-Black, non-White educators in both states and concerns about the required assumptions, we do not pursue this approach.

^x An advantage of using school-by-grade-by-race fixed effects instead of school or school-by-race fixed effects is that we can control for students’ prior-year outcomes without violating strict exogeneity. With school fixed effects, prior-year outcomes are endogenous as most students remain in the same school between year $t - 1$ and year t . Interacting school-by-grade fixed effects with race accounts for the possibility that unobserved school- or school-by-grade factors differentially affect Black students. However, replacing school-by-grade-by-race with school-by-grade fixed effects produces very similar results.

^{xi} Specifically, these figures contain indicators for the combination of time and group (e.g., four years before a White-principal-to-White-principal transition), year fixed effects, and school fixed effects.

^{xii} While the specification in Table 3 only includes one leading indicator, adding additional leads does not change the results. Results for the full set of leads and lags are shown in Online Appendix Table 1.

^{xiii} Online Appendix Table 2 shows the results with indicators for leads and lags. Consistent with a causal interpretation, we find no evidence that future principal race affects the race of current new hires. In Missouri, we do find evidence of a lagged effect of principal race (only in the immediate prior year), where in Tennessee the effect of principal race only appears in the current year.

^{xiv} Specifically, we estimate three specifications in each state that add successive controls: (1) district and year fixed effects, (2) time-varying average demographic characteristics (e.g., proportion of Black students in the district), and (3) district-specific trends. The results are consistent across each of these specifications, although including district-specific trends in Tennessee greatly increases the standard errors because Tennessee has fewer districts and a shorter panel.

^{xv} To increase precision, we average all available years within teacher.

^{xvi} The estimation steps are as follows. First, we residualize student test scores (separately by subject) on a vector of prior-year test scores, student characteristics (race/ethnicity, gender, FRPL eligibility, gifted status, special education status, lagged absences, grade repetition, and whether the student changed schools at least once during the year), school- and grade-level averages of these student characteristics, grade-by-year fixed effects, and teacher fixed effects. After computing the student residuals, we add back the teacher fixed effects and estimate the best linear predictor of a teacher's average student residuals in the current year based on their residuals from prior and future years. The coefficients from this best linear predictor are then used to predict a teacher's value-added in the current year. We then standardize these estimates within subject and year. For teachers with value-added estimates in multiple subjects, we average these estimates within each year, weighting by the number of students taught in each subject.

^{xvii} Note that this is from the perspective of society or the state policymaker. As discussed above, the results in Table 5 Panel B suggest that from the perspective of an individual district, Black principals can increase the proportion of Black teachers in the district through transfers from schools in other districts.

^{xviii} Online Appendix Table 5 shows the equivalent numbers for White teacher transfers.

^{xix} Online Appendix Table 7 shows yearly teacher turnover rates disaggregated by principal race.

^{xx} One confounding factor in these plots is that the composition of a school's teaching staff changes after switching to a different-race principal due to the hiring effects demonstrated earlier. In a school in which a Black principal hires more Black teachers, the turnover rate among Black teachers may go up initially because new teachers tend to have higher turnover propensities. As a check, we also created a version (Online Appendix Figure 1) that includes only teachers who were in the school prior to the principal transition and find similar patterns. The main difference between the figures is that restricting to returning teachers results in a downward trend in turnover over time, as the likelihood of turnover decreases with each additional year of tenure in a school.

^{xxi} Online Appendix Table 8 shows estimates across various specifications with different controls for principal turnover.

^{xxii} If teachers' preferences for working with same-race principals are driving the higher rates of transfer among teachers with different-race principals, we might expect that those teachers would systematically sort into schools with same-race principals. Indeed, in both states, sorting patterns for Black teachers are consistent with this expectation. Among Black teachers transferring from a school with a White principal in Missouri, 53% moved to a school with a Black principal. However, only 44% of other teachers in the district of the receiving school work for a Black principal, so 53% is much higher than what would be expected if teachers were transferring at random. In Tennessee, 56% of teachers transferring from a school with a White principal move to a school with a Black principal (41% of other teachers in the district work for a Black principal). In contrast, in neither state is there evidence of similar sorting for White teachers. White teachers leaving schools with Black principals are overwhelmingly likely to move to schools with White principals (55% in Missouri, 67% in Tennessee), but the proportions are virtually identical to the total fraction of teachers in the district working for a White principal.

^{xxiii} For instance, larger same-race match effects for Black teachers could in part reflect that Black principals are more effective (with respect to reducing teacher turnover), on average, than White principals.

^{xxiv} We also considered whether the impact of principal-teacher race-match varied by teacher value-added. For instance, high-performing teachers who have more opportunities to seek alternative school placements might be more responsive to changes in principal race. However, we found no evidence of heterogeneity by teacher value-added in the race-match effect. These results are show in Online Appendix Table 12.

^{xxv} Teacher response rates across years ranged from 27% to 56%.

^{xxvi} Responses were on a four-point Likert scale from “Strongly Disagree” to “Agree”. Examples of items include, “The stress and disappointments involved in being at this school aren’t really worth it” and “I feel appreciated for the job I am doing”.

^{xxvii} In column 4, the interaction terms are jointly statistically significant but not significantly different from one another.

^{xxviii} Online Appendix Table 13 examines whether having a same-race principal increases the likelihood that a teacher is assigned to a tested grade/subject in the given year. We estimate two specifications: one that includes teacher fixed effects and one that does not. The models also include the full set of covariates from the teacher turnover models in addition to school fixed effects, district-by-year fixed effects, and school-specific trends. The estimated race-match effects are small for Black and White teachers and there is no clear pattern of statistical significance. Appendix Table 14 examines whether Black students are more likely to be assigned to a Black teacher than White students in the same school, grade, and year when the school has a Black principal. To isolate differential assignment from the compositional effect of principal race, we employ school-by-grade-by-year fixed effects and estimate the interaction between *Black Principal* and *Black Student*. We find precise null effects for both math and reading, indicating that Black principals are not systematically assigning Black students to Black teachers at greater rates than White principals.

^{xxix} Here, we replace prior-year test scores with prior-year suspensions, which allows us to include students in all grades, rather than the subset of tested grades. However, our results are very similar if we use the subset of students with prior test scores and include these scores in the model.

^{xxx} To ensure comparisons across models are not driven by sample selection, we restrict this analysis to a common sample of students for whom we can calculate value-added for their assigned teacher. This drops roughly 8% of student-by-year observations relative to the main models.

^{xxxi} This coefficient is likely an upper bound for the teacher-student race-match effect in our data, given that we have not included other teacher-level controls (e.g., value-added, experience). When we include those covariates in columns 4 and 8, the match effect is attenuated but remains statistically significant in math at 0.021 SD. Our estimates are comparable to teacher-student match effects from other studies. Egalite et al. (2015) find that having a same-race teacher increases math (reading) scores by 0.018 (0.005) SD for Black students and 0.008 (0.005) SD for White students. Similarly, Clotfelter et al. (2007) find that having a same-race teacher increases math scores by 0.02–0.03 SD and reading scores by 0.01–0.02 SD. Other work finds larger student-teacher match effects on test scores. For instance, leveraging random assignment of students to classrooms in the TN STAR experiment, Dee (2005) finds that having a same-race teacher increased math and reading scores of K–3 by 2 to 4 percentile points. Given our use of statewide administrative data and test scores from grades 3 to 8 and high school, however, we think the Egalite et al. (2015) and Clotfelter et al. (2007) estimates are more relevant to our analysis.