LET’S TALK ABOUT RACE: RACIAL TEACHER MATCHING AND STUDENT ACHIEVEMENT GROWTH

A Thesis

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by

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Abstract

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Should public school districts purposefully recruit African American teachers to help close the racial achievement gap? To answer this question, piecewise achievement growth models are fit to all seven data points in the Early Childhood Education Longitudinal Study in a test of the racial matching hypothesis, which posits that African American students experience greater rates of achievement growth when they have African American elementary school teachers. Furthermore, this study situates the racial teacher matching hypothesis as a test of two larger theoretical frameworks pertaining to the black-white test score gap, namely the oppositional culture and sociolinguistic theories. The results of this study yield null effects of racial teacher matching on students’ achievement growth rates, which supports neither the sociolinguistic nor the oppositional cultural hypothesis. Positioning the findings of this study within the current era of accountability in American education leads to two possible interpretations of the null effects of racial teacher matching on the achievement growth rates of black students: 1) the increasing professionalization of the teaching profession, and 2) the increasing standardization of the task of teaching.
For Justice.
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1.1. Introduction

Minority teacher recruitment efforts are often motivated by the assumption that increasing the number of black teachers may help to address lower levels of achievement, lower levels of college matriculation (Hess & Leal 1997) and higher dropout rates among black students relative to their white peers (Ehrenberg, Goldhaber & Brewer 1995). The National Education Association reiterates this perspective in their teacher recruitment policy: “with 40 percent minority students and 5 percent minority teachers…a critical shortage of education workers and role models may be at hand that could contribute to a worsening urban plight” (NEA). Accordingly, minority teacher recruitment centers, projects and initiatives have been developed on university campuses across America, such as the Minority Teacher Recruitment Project at Louisville University, the Minority Teacher Recruitment Center at Western Kentucky and the Latino Teacher Project in the Center for Multilingual and Multicultural Research at the University Southern California.

Such efforts are motivated and supported by academic research as it is a well established finding in the sociology of education that race plays a role in student-teacher relationships (Alexander, Entwisle & Thompson 1987; Ehrenberg et al. 1995). Specifically, there is mounting evidence that relative to black teachers, white teachers give less favorable subjective evaluations to black students (Dee 2005; Downey &
Pribesh 2004; Ehrenberg et al. 1995). However, the academic literature on the effects of black teachers on the achievement levels and gains of black students is far from conclusive and is primarily focused at the high school level when students’ growth rates are slower and less susceptible to contextual effects, such as the race of their teacher (Entwisle & Alexander 1994). The conclusions of this achievement oriented racial matching literature are mixed with some studies showing that having a same race teacher benefits a student’s academic progress (Dee 2005; Ehrenberg et al. 1995;) and other studies showing no academic performance effect of race matching (Ehrenberg et al. 1995; Howsen & Trawick 2007). Furthermore, there has been no theoretical consensus on why racially matching black students and teachers may increase the achievement gains of minority students, for even studies that affirm the linkage between teacher-matching and achievement do not “provide meaningful evidence on the exact mechanisms by which own-race teachers might actually influence student achievement” (Dee 2005: 22).

The body of research on racial teacher matching needs to be updated using current data and should further explore the effects of teacher matching at the primary school level in a way that is clearly generalizable to the national population. Accordingly, this study fits achievement growth models to all seven data points in the Early Childhood Longitudinal Study (ECLS-K 1998) data to examine the effects of racial matching on students’ achievement growth rates in both reading and math during elementary and middle school. This study aims to make several contributions to the academic literature on the black-white test score gap and racial teacher matching.

First, this study capitalizes on the longitudinal nature of ECLS-K, which allows the researcher to more reliably measure the achievement growth of students over time.
Cross-sectional approaches, which have been frequently used to study teacher matching, do not adequately control for student characteristics. Such cross-sectional approaches also fail to address the question of whether the effect of racial teacher matching is variable over time as previous longitudinal studies of teacher matching have been limited to two time points, which were often spread over several school years (i.e. NELS & ELS data sets).

Secondly, this study analyzes the potential effects of teacher matching at a critical period in learning development, namely kindergarten through 8th grade, which has yet to be addressed in the education literature using a nationally representative sample. Children’s growth rates in the first few years of schooling are significantly greater in elementary school than those same students’ rates of growth in high school, “perhaps 10 times as great” (Jencks 1985). This rapid achievement growth in elementary school has led researchers to conclude that elementary school students’ achievement growth rates are significantly more susceptible to contextual effects than are the achievement growth rates of high school students (Entwisle & Alexander 1994). Disadvantages may compound quickly in elementary school, leading to early and substantial expansion in racial achievement gaps, which become increasingly difficult to close as students’ achievement growth rates slow. Furthermore, differences in student achievement levels and growth during elementary school are highly correlated with disparities in academic outcomes later in the schooling experience (Alexander, Entwisle & Horsey 1997; Baydar, Brooks-Gunn & Furstenber 1993; Ensminger & Slusarcik 1992). Thus, addressing academic disparities in elementary school may be a more effective approach to
decreasing racial educational inequality and may help to eliminate such inequalities later in the schooling experience.

Lastly, this study will position the effects of racial teacher matching within a larger theoretical framework pertaining to the black-white test score gap. If the expansion of the black-white test score gap in elementary school is truly a function of the schooling environment (Downey et al. 2004; Entwisle & Alexander 1994) then an analysis of racial teacher matching may provide some theoretical leverage as to what school level mechanisms are driving the early expansion of the black-white achievement gap. The early expansion of the black-white test score gap in elementary school appears to occur before peers become a significant influence on academic achievement (Harris 2006; Steinberg 1997), which leaves teachers and students as the two potential human agents behind the expansion of the achievement gap, for schools themselves —an do nothing without the assistance of human agents” (Tyson 2003: 327).

Accordingly, this study examines two distinct theoretical causes of the underachievement of black students: 1) how teachers interact (and specifically speak) with black students; and 2) how black students interact with (and may rebel against) teachers, who serve as representatives of the schooling environment. It may be that black students are disadvantaged by the pedagogical styles of white teachers or it may be that black students rebel against the white schooling environment, which is most tangibly represented by white teachers. This paper will use a longitudinal analysis of racial teacher matching in an attempt to parse out the directionality of this relationship, that is if the lower achievement growth rates among black students are more attributable to black students' anti-academic actions and attitudes (i.e., the oppositional culture hypothesis) or
rather are a result of linguistic differences between the pedagogical styles and expectations of teachers and those that black students develop in their home environments (i.e., the sociolinguistic hypothesis).
1.2.1. Racial Teacher Matching

Most of the national research on teacher matching by race focuses on the high school level when students’ perceptions of their teachers and of school in general may already be rigidly constrained from prior experiences (Table 1) and when the black-white test score gap has already developed and solidified. Students' growth rates are significantly higher in elementary school than in high school (Figure 1; Figure 2) and when growth is rapid, [one] would expect any contextual effects to be more pronounced” (Entwisle & Alexander 1994: 447). This means that students are likely to be more sensitive to both home and school influences during elementary school than during high school (Downey et al. 2004: 616).

The racial teacher matching studies at the high school level often make use of the NELS data, which was collected in the late 1980’s and may no longer provide an accurate picture of student-teacher race relations (Dee 2005; Ehrenberg et al. 1995). Additionally, the studies that have been done at the elementary level are often based on smaller and nonrepresentative samples (Dee 2004; Klein, Le & Hamilton 2001; Pigott & Cowen 2000),
which may be unduly influenced by local issues, demographics or policies, and as a result are ungeneralizable. Furthermore, the overall conclusions of the racial matching literature are mixed in terms of achievement with some studies showing that having a same race teacher benefits a student’s academic progress (Dee 2004; 2005; Ehrenberg & Brewer 1994) and other studies showing little or no academic effects of race matching (Howsen & Trawick 2007; Ehrenberg et al. 1995).

In their analysis of NELS data Ehrenberg et al. (1995) measured achievement gains between the 8th and 10th grades in history, reading, math and science using the cognitive tests that are a part of the NELS data and found that teacher matching based on race, gender or ethnicity did not affect how much a student learned. The null finding of Ehrenberg et al. (1995) that racial teacher matching did not have an effect on students’ achievement gains from 10th to 12th grade is not surprising. Ehrenberg et al.’s study is conducted at the high school when students’ achievement growth rates are less susceptible to contextual effects. Furthermore, it is doubtful that the effect of being racially matched in one of many academic courses in 10th grade would persist and register on an assessment administered in 12th grade (Downey & Pribesh 2004: 279).
This does not necessarily imply that teacher matching had no effect in the NELS:88 data, but simply that the data not be of high enough quality to measure such an effect.

Concerning the effect of matching on achievement, Dee (2004, 2005) found a strong relationship between racial teacher matching and academic achievement for both black and white students. Dee used Tennessee’s Project STAR class size experiment, which randomly placed students and teachers in classrooms, to assess the effects of teacher matching on achievement. The experiment was not intended to analyze teacher race matching, but it provides an excellent opportunity to do so because of the random assignment of students to teachers. Dee claims that the experimental nature of the study eliminates any preexisting student placement mechanisms, such as placing high achieving students with more experienced teachers. Examining the effect of racial teacher matching Dee found that “assignment to an own-race teacher significantly increased the math and reading achievement of both black and white students” (Dee 2004: 195).

However, these findings of Dee (2004, 2005) have recently come under question. Building on the racial matching analyses of the Tennessee STAR data, Howsen and Trawick (2007) employ Dee's methodology of determining if sorting [of students] presents a problem with respect to an own-race teacher using a different database” (Howsen & Trawick 2007: 1024). Howsen and Trawick find that, in a natural educational setting, students are sorted to an own-race teacher as a result of not only race, but also ability. The authors' note that —since Dee failed to control for student innate ability —this calls into question [his] statement that there is no association between own-

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1 Howsen and Trawick's study is based on data from a sample of more than 4,000 third-grade students in Kentucky, which was collected in the early 1990's.
race assignment and student characteristics” (Howsen & Trawick 2007: 1025). When controlling for why teachers and students of the same race are matched (i.e. race and innate ability) Howsen and Trawick find no statistically significant effect of race matching on achievement.

Similarly, other recent regional studies at the elementary school level have found a null effect of racial teacher matching on student achievement. For example, Pigott and Cowen (2000) analyzed a data set of 445 elementary school students in a racially mixed urban school and found no significant teacher-student race interactions. Klein, Le and Hamilton (2001) analyzed a sample of 4th grade students in California and also found no relationship between student achievement and a student-teacher racial match. The academic literature concerning the relationship between racial teacher matching and achievement is both incomplete as it currently lacks a large scale nationally representative study at the elementary and middle school levels as well as inconsistent as past studies have found contradicting results.²

² On the other hand, the research on the relationship between racial teacher matching and teachers’ subjective evaluations of students is much more consistent. Ehrenberg et al. (1995), controlling for prior achievement scores, did find that teacher matching by race had a strong effect on the teachers’ evaluations of students and indicated that this result has implications for educational opportunities. Similarly, Dee (2005) analyzed teachers’ subjective evaluations of students in NELS: 88 using fixed effect econometric specification in order to identify how two demographically diverse teachers evaluated the same student and concluded that “the racial, ethnic, and gender dynamics between students and teachers have consistently large effects on teacher perceptions of student performance” (Dee 2005: 163).
National research on teacher matching by race has been predominately focused on the high school level (Table 1), while studies that have been conducted at the elementary level are often based on smaller samples that are not nationally representative (Dee 2004, 2005; Klein, Le & Hamilton 2001; Pigott & Cown 2000), which may be unduly influenced by local issues, demographics or policies, and as a result are not generalizable. Currently, the state of the academic literature on racial teacher matching is both inconclusive and incomplete. Several studies have demonstrated significant effects of racial teacher matching on achievement, while others have shown null effects. Moreover, the effect of racial teacher matching on achievement has yet to be systematically examined on a national scale at the elementary school level.

In an attempt to address the lack of a nationally representative study on the effects of racial teacher matching and the discrepant findings concerning the effect of racial teacher matching on student achievement, I use piecewise achievement growth modeling and all seven time points from the Early Childhood Longitudinal Study of the 1998 Kindergarten Cohort to compare the achievement growth in reading and math of racially matched and racially unmatched students.
1.2.2. Summer Learning and the Achievement Gap

Recent research indicates that the black-white achievement gap in the early years of schooling is stable in the summer and expands during the school year. These findings of Downey et al. (2004) and Entwisle and Alexander (1994) suggest that schools are in some way exacerbating the black-white test score gap. The academic literature on summer learning indicates that schools are largely equalizers of educational opportunities in that students of varying backgrounds make academic gains at relatively similar rates during the school year and that achievement gaps expand during the summer months when lower SES children experience slower rates of academic growth compared to children from high SES families (Downey et al. 2004; Entwisle & Alexander 1992; Heyns 1974). However, there is one peculiar exception to this general finding: the black-white test score gap expands during the school year (Downey et al. 2004; Entwisle & Alexander 1994). Specifically, Entwisle and Alexander (1994) found that African-American students “progress in winter (when schools are open) at a slower pace than would be expected” (454) and Downey et al. (2004) concluded that “schools increase the black-white reading gap” (630).

Furthermore, the black-white test score gap at the elementary school level has been shown to be stable during the summer months (Downey et al. 2004; Entwisle & Alexander 1994) and it may be the case that young black students have a slight advantage over their white peers in terms of reading achievement growth during the summers (Downey et al. 2004). In Entwisle and Alexander’s 1994 study of elementary school students in Baltimore, MD black students attending integrated schools gained more points over the summer on the Reading Comprehensive Test than did their white peers in
integrated schools. However, the opposite was true for black and white students who attended segregated schools, where black students lost more points on the Comprehensive Reading Test than did their white peers. More definitively, Downey et al. (2004) found that on average, black children fall behind by .16 points per month during kindergarten and .20 points per month during first grade. In the months before kindergarten, however, black children fall behind by just .05 points per month, and during summer vacation they pull ahead by .16 points per month. The two school-year gaps favor white children by an average of .18 points per month, whereas the two non-school gaps favor black children by an average of .06 points per month. The .24-point difference between the school-year and non-school gaps estimates the degree to which schools increase the black-white reading gap” (Downey et al. 2004:630).

Entwisle and Alexander (1994) and Downey et al. (2004) are not alone in their conclusions that schools and schooling are potential drivers of the expanding achievement gap. Several other scholars have suggested that socioeconomic, demographic and familial factors are incomplete explanations of the achievement gap. For instance, Phillips, Crouse and Ralph (1998) concluded that even when black and white children have the same prior scores, the same measured socioeconomic status, and attend the same schools, black children still gain on average about 0.02 standard deviations less in math, 0.06 standard deviations less in reading, and 0.05 standard deviations less in vocabulary each year. Future research therefore needs to look for less obvious causes of this learning gap.” Jencks and Phillips (1998) suggest that successful theories, which will presumably explore these less obvious causes, will acknowledge the role of schools in the expansion and perpetuation of the achievement gap. Specifically,
they posit that successful theories will pay more attention to the way black and white children respond to the same classroom experiences, such as having a teacher of a different race or having a teacher with low expectations for students who read below grade level” (325).

These quantitative findings, which indict schools and schooling as potential drivers of the expanding achievement gap, are buoyed by the qualitative findings of Tyson (2003), whose work suggests that “the schooling experience, particularly achievement outcomes, plays a central role in at least the development of attitudes toward school” (1184). For Tyson black students’ negative attitudes about school are a result of experiences in school and therefore logically the development of negative attitudes about schooling is predicated on black students having negative experiences at school.

Thus, it appears that the schooling environment or schooling experience may in some way be driving the early expansion of the black-white test score gap. Moreover, this line of research seems to indicate that the main cause of the early expansion of the black-white test score gap is likely not a result of factors external to the schooling environment, such as disparate home environments. If this is indeed the case, that the schooling environment or schooling experience is causing the early expansion of the black-white test score gap, any school reform, which strives to reduce the black-white test score gap, must directly and positively affect the schooling experiences of black students.

This analysis of racial teacher matching attempts to provide nuance and insight into this relationship between students and teachers by examining the potential effects of teacher matching over a longer time period, namely kindergarten through 8th grade, than
has been done previously with a nationally representative sample. Furthermore, the effects of racial teacher matching will be used to assess the adequacy of two prominent educational theories for the black-white test score gap: 1) the oppositional cultural hypothesis and 2) the sociolinguistic hypothesis.
1.2.3. The Oppositional Culture and Sociolinguistic Hypotheses

Given the finding of prior research that the black-white test score gap in elementary school actually expands during the school year and narrows or at least remains constant during the summer (Downey et al. 2004; Entwisle & Alexander 1994), it follows that the source driving this expansion is internal to the schooling experience of young students. Accordingly, this study uses racial teacher matching to assess two possible theoretical explanations for racial teacher matching, namely the oppositional culture hypothesis (Ogbu 1991; Ogbu & Simmons 1998; Willis 1977) and the sociolinguistic hypothesis, which has recently been put forth as a possible explanation for the expansion of the black-white test achievement gap during elementary school (Downey et al. 2004; Entwisle & Alexander 1994). If black students, ceteris partibus, do in fact learn more from black teachers than white teachers, then is this a result of a positive or negative classroom dynamic, that is, is the effect of racial teacher matching: 1) due to black students experiencing greater linguistic alignment with black teachers which promotes achievement; or 2) due to black students acting out more frequently and rebelling when they have white teachers which prevents achievement?

Broadly the oppositional culture framework, developed by Ogbu (1978, 1998), is premised on the assumption that students‘ beliefs and attitudes about academic success, which are linked to behaviors, are highly influenced by the structure of social mobility in America (Harris 2005, 2008). Specifically, black students perceive more numerous barriers to occupational and economic success and in turn become disillusioned about the prospects of future success and the worth of schooling. Accordingly, the oppositional culture hypothesis posits that black students develop counterproductive academic
attitudes and behaviors (e.g. greater levels of ambivalence and affective dissonance
toward academic success as well as toward the academic efforts that leads to such
success), which cause them to perform poorly in the American schooling system relative
to their white peers (Fordham & Ogbu 1986).

In theory, these counterproductive academic attitudes, which are a result of
perceived limitations in the American opportunity structure, are consistently reinforced
by the collective identity of the black peer group. Fordham and Ogbu (1986) argue that
the black adolescent peer group functions as a form of fictive kinship, which is premised
on a collective opposition to the white American social identity. If the actions of a
―brother‖ or ―sister‖ are deemed to be at odds with the oppositional identity of the group,
he or she is said to be acting white and is ostracized from the kinship group. Actions that
garnered the ―acting white‖ label at Capital High in the early 1980’s included working
hard, getting good grades, spending time in the library and attending a Rolling Stones
concert among others (Fordham & Ogbu 1986).

The oppositional culture hypothesis has spawned a large body of research,
especially focused on the connections between: 1) the role that black peer culture plays in
academic achievement of black students; and 2) black students‘ attitudes about the
opportunity structure and the connection between these attitudes and achievement
outcomes. Despite the early findings of Fordham and Ogbu (1986), the ―acting white‖
phenomenon does not appear to be prevalent among black peer groups as recent research
indicates that black peer groups are open to diverse academic identities (Akom 2003;
Carter 2005; Cook & Ludwig 1997; Harris 2006; Horvat & Lewis 2003; O‘Conner 1999;
Tyson, Darity & Castellino 2005).
The research findings concerning the relationship between black students’ attitudes about the opportunity structure and their achievement outcomes are less conclusive. Several studies have found that black students believe that academic achievement leads to social mobility and success within the American opportunity structure (Ainsworth-Darnell & Downey 1998; Harris 2006; O’Connor 1999; Steinberg, Dornbusch & Brown 1992), while several other studies conclude the opposite, namely that black students do not believe that their educational efforts will be rewarded within the American opportunity structure (Fordham & Ogbu 1986; Mickelson 1990; Ogbu 2003). The finding, in some studies, that black students are at least as likely (Steinberg et al. 1992) if not more likely (Ainsworth-Darnell & Downey 1998) to hold positive attitudes about school, has been questioned by proponents of the oppositional culture hypothesis because of the apparent misalignment between black students’ attitudes and behaviors. This apparent contradiction is commonly referred to as the attitude-achievement paradox (Farkas et al. 2002; Mickelson 1990; Ogbu 1991).

Investigating this apparent paradox, Mickelson (1990) advanced the research literature on the connection between attitudes and achievement drawing distinction between abstract and concrete attitudes. She found that abstract attitudes, which are ideologically based and essentially reflect the belief that opportunity through education is a core component of the American Dream” and do not vary by race, have no influence on black students’ academic achievement, whereas concrete attitudes, which are derived from a person’s experiences in her or his family and community” and vary by race, have a positive influence on academic achievement (46). Mickelson found that black students are less likely than white students to hold positive concrete attitudes about schooling and
therefore concluded that when the distinction between concrete and abstract attitudes is accounted for that the apparent attitude-achievement paradox among black students disappears.

Considering that this study is aimed at examining the expansion of the achievement gap during the elementary and middle school grades, it is important to note that the oppositional culture hypothesis was derived from research focusing solely on adolescents (Fordham & Ogbu 1986; Giroux 1981; Willis 1977) and that the vast majority of subsequent research, with the exceptions of Tyson (2002, 2003) and Downey and Pribesh (2004), has also focused on adolescents (Ainsworth-Darnell & Downey 1998; Cook & Ludwig 1998; MacLeod 1987; Mickelson 1990; O’Connor 1999). After all, as Harris and Robinson (2007) point out, it makes sense to test the oppositional culture hypothesis —using high school samples because these students are expected to have a more developed understanding of the opportunities that are available within the system of social mobility for members of their minority group” (142). Similarly, Tyson (2003) citing (Fordham [1996], MacLeod [1995] and Willis [1977]), notes that adolescents —have acquired a better sense of what schools want and a greater awareness of the cultural divisions between them and their teachers.”

However, this tendency toward adolescent research has lead the findings of oppositional culture research to be over-generalized and applied to black and/or low-SES students at all levels of schooling (i.e. elementary, middle and high school). Tyson’s (2002) findings suggest that this generalization may not be justified as black elementary school students, while they underachieve relative to their white peers, start school with positive and pro-school attitudes. Moreover, Tyson (2002) concluded that —the schooling
experience...plays a central role in at least the development of attitudes toward school” (1184) and that “there is also no support for the thesis that a rejection of school norms as part of a larger black culture” (1181).

The work of Tyson (2002) and Mickelson (1990) suggest that a longitudinal process of cumulative disadvantage is at work in the development of oppositional culture among black students. The conclusion that attitudes, concrete attitudes for Mickelson, are a result of experiences in school, predicates that black students must have negative schooling experiences in order to develop negative attitudes toward schooling. This implies a cumulative function in that black students' opposition to the schooling environment becomes stronger and more solidified as they grow older and have more negative experiences with the schooling environment. In this way, oppositional culture takes time to develop as it takes time to transform the pro-school attitudes that black students appear to bring to elementary school into oppositional attitudes, dissonance and disillusionment.

Mickelson’s distinction between concrete and abstract attitudes and their relation to black students' academic achievement has been the topic of much debate in academia (See, Ainsworth-Darnell & Downey 1998; Downey & Ainsworth-Darnell 2002; Farkas et al. 2002). If Mickelson is right and concrete attitudes, which result from tangible experiences, contribute to the underachievement of black students relative to their white peers, it seems to follow that having a black teacher would provide direct and concrete evidence for black students that success in school does translate into success in the American opportunity structure. One might argue that this logic is not supported underneath the oppositional culture hypothesis on the grounds that the hypothesis posits
that black students resist the entire process of schooling. However, since the oppositional
culture hypothesis posits that this resistance stems from blacks oppressed status relative
to whites, it seems logical to assume that this resistance to schooling would be lessened
by the presence of a black teacher (Downey & Pribesh 2004: 268).

Therefore, if the oppositional culture hypothesis holds in the ECLS-k data, one
would expect racially matched black adolescents to experience significantly greater
achievement growth rates than their unmatched black peers. A black teacher may
concretely demonstrate the possibilities that the American education system holds for
black students. In this way, “the presence of a black teacher may encourage…[black
students more than white students] to update their prior beliefs about their educational
possibilities” (Dee 2004: 196).

Under the oppositional culture hypothesis, racial teacher matching should lead to
increased achievement amongst black students who become increasingly aware of the
possibilities that the American education system has to offer them. The presence of a
teacher of the same race may lead to increased levels of engagement, effort and
enthusiasm amongst black students (Villegas & Clewell 1998; King 1993) as they may
no longer have to “cloak their ability in other activities,” “maintain a low profile” or “put
the brakes on academic performance” (Fordham & Ogbu 1986). After all, Fordham and
Ogbu (1986) recommended that one potential way to address the phenomenon of
oppositional culture in American schools is to “provide visible and concrete evidence for
black youths that the community appreciates and encourages academic effort and
success.”
Alternatively, the early underachievement of black students relative to their white peers, especially the language acquisition and reading abilities of young black students, may be impaired by linguistic differences between their home and schooling environments (Downey et al. 2004; Entwisle & Alexander 1994). Linguistic differences between racial groups (Foster, 1987, 1989; Heath 1982; Laosa 1973) and social class groups (Collins 1986; Mehan 1992) have been shown to influence the rate at which students learn to read. This may be a result of the variability in the manner in which English is spoken as vocabularies, pronunciations and dialects vary across social class and racial groups.

In general, children develop the ability to speak well before the ability to read. Furthermore, children develop the ability to speak before beginning school, whereas they often develop the ability to read during the schooling process. When students are learning how to read during the first few years of schooling they rely on their knowledge of spoken language, which was developed at home. In this way, a child’s verbal language skills, both expressive (how she speaks) and receptive (how she understands), form the scaffolding around which her non-verbal linguistic skills, also both expressive (how she writes) and receptive (how she reads), are developed (Farkas & Beron 2004). The sociolinguistic hypothesis posits that if significant differences in the oral language skills, which the child begins to learn before attending school, and the non-verbal language skills, which the child learns largely while attending school, may delay that child’s non-verbal language development (Downey et al. 2004; Entwisle & Alexander 1994) or at least decreases the measured non-verbal capacity of this child as it is the non-
verbal skills (i.e. reading and writing), opposed to the verbal (speaking and auditory understanding), that are assessed on standardized tests of achievement.

This misalignment, which negatively affects black students learning to read, may be a result of differences in linguistic structures or differences in linguistic styles. First, it may be that young black students use a different English dialect at home than the Standard English dialect, which is required by the schooling environment, and that as a result black students have difficulty reconciling the verbal dialect learned at home with the dialect required at school.

This argument rests on the finding that upon entering kindergarten, the average black student pronounces words differently than the average white student. It is well documented in the field of sociolinguistics that dialects of the English language vary by many characteristics—one of which is race (Entwisle & Alexander 1994). Specifically, it has been demonstrated that linguistic differences between minority students and white teachers hinders “the children’s success in learning to read Standard English” (Ogbu

3 It is important to note that black and white students not only enter kindergarten with different dialects and narrative styles, but also with different levels of verbal skills. Upon entering kindergarten the average black student has heard and knows less words than the average white student. Farkas and Beron (2004) use the National Longitudinal Survey of Youth (NLSY) and Peabody Picture Vocabulary Test the to assess racial and class differences in vocabulary growth rates at five distinct time points (preschool, kindergarten and first-grade, second and third grade, fourth and fifth grade and sixth and seventh grade). In each age grouping, the mean vocabulary growth rate of white students was higher than that of black students—a pattern which holds when SES is included in the regression models. Furthermore, similar to Hart and Risley (1995), the authors find that vocabulary growth rates for both black and white children differ significantly by social class. Hart and Risley (1995), who were primarily concerned with social class differences, meticulously measured the words used and heard by young children of varying racial and socioeconomic backgrounds in 42 Kansas City families over 2½ years and found that the “most important aspect of children’s language experience is its amount,” which differed immensely according to socioeconomic status. However, these differences in the initial status of verbal skills, may only account for the initial achievement gap in the fall of kindergarten and cannot explain why the gap continues to grow after children enter school. Furthermore, differences in initial status cannot explain why the black-white achievement gap appears to expand during the school year, while remaining constant during the summer.
1999: 149). There exist both phonological and syntactic differences... (um' brella versus umbrel' la; po' lice versus police'; "two cent" versus "two cents"; "he be doing" versus "he is doing")” between English dialects used in the home and schooling environments of young black children (Entwisle & Alexander 1994: 447). To receptively hear words one way at home (e.g. "two cent") and to receptively read and hear words with the same meaning but a different appearance and pronunciation (e.g. "two cents") at school may hinder young black students’ reading development (Entwisle & Alexander 1994: 447).

The linguistic differences, as well as their effects on academic performance, noted by Alexander and Entwisle (1994) were thought to be so significant that in December, 1996 the Oakland Board of Education passed Resolution No. 9697-0063, which has become known as the “Ebonics Resolution.” This resolution acknowledged that numerous validated scholarly studies demonstrate that African-American students as a part of their culture and history as African people possess and utilize a language described in various scholarly approaches as “Ebonics’ (literally ‘Black sounds’) or ‘Pan African Communication Behaviors’ or ‘African Language Systems.” Furthermore, The “Ebonics Resolution” officially acknowledge the linguistic differences between the home and schooling environments of black students and reasoned that the application of

4 The linguistic differences between the home and school environments of young black students may also affect their oral language development as it has been suggested that the problematic implications of these linguistic differences for young black students learning to read may be compounded by the teachers’ constant correction of the student’s verbal dialect. Such correction [of Ebonics] increases cognitive monitoring of speech, thereby making talking difficult” (Delpit 1998). In this way, it becomes difficult for young black students to communicate expressively, especially elaborately, because they are constantly monitoring the nuances of their language usage.
a program featuring African Language Systems principles …[would] move students from the language patterns they bring to school to English proficiency.”

Secondly, it may be that young black students have developed a different narrative style than what is required in the schooling environment, which may in turn lead to poor academic performance and to inaccurate assessments of young black students’ verbal abilities (Delpit 1995). Upon entering kindergarten, which requires students to narrate in a structured call-and-response format, the average black student has acquired a narrative style that emphasizes free form story-telling in their home environment (Heath 1983). Heath argues that black students are not socialized in the linguistic tradition that is required and rewarded in American education and that as a result the academic efforts of young black students are misinterpreted by white teachers.

Specifically, Heath (1983) concluded that the reason the white working-class students in her ethnographic work fared far better in the first few years of schooling than did working class black students was that the white children had been “socialized into the initiation-reply-evaluation sequences repeatedly described s the central structural feature of classroom lessons” (320). In Heath's work, these white working class parents walk their child through the reading process frequently stopping to ask “what questions” in order to check the attention and understanding of the child. Similarly, teachers ask young students —“what questions” looking for certain predetermined answers. Both of these processes, one at home and the other at school, proceed in a linear fashion for young white children: information is presented, a direct question is asked and answered, feedback is provided and the process is then repeated.
Conversely, in the working-class black families in Heath's ethnographic work—preschool children are not asked for what-explanations…instead they are asked a preponderance of analogical questions which call for non-specific comparisons of one item, event, or person with another” (Heath 1982: 66). So while young white children are being asked through a direct and linear questioning process to decontextualize content (e.g. What color is the dog?), young black children are being asked through an indirect and circular questioning process to contextualize this same information (e.g. What’s that dog like?).

When these young black children begin school they are unfamiliar with the linear call-and-response style of questioning and answering, which is often required by teachers, reading books and standardized tests. As a result, the highly structured call-and-response pedagogical style may be ineffective for young black students. Heath (1982, 1983) argues that the free form narrative style of black children is not less valuable than the structured call-and-response style of narration that is predominate in white homes and is required by the schooling environment; rather she posits that this free form narrative style is one that is reward in secondary and post-secondary education. However, Heath notes that many black students have become disenchanted with the schooling environment by this time, largely because their academic efforts are not rewarded in the early years of schooling. Specifically, young black students' free form narrative styles may be misread by white teachers and interpreted as disruptive and defiant. Accordingly, young black students—may be puzzled to find that white teachers are angered by behavior that is unnoticed or even rewarded in the students' homes and neighborhoods” (Downey & Pribesh 2004).
According to the logic which undergirds the “Ebonics Resolution” as well as recent work in the sociology of education (Downey et al., 2004; Entwisle & Alexander, 1994), the expansion of the black-white test score gap in reading may be a result of the variability in the manner in which English is spoken in the home and schooling environments of young black children as vocabularies, pronunciations and dialects vary across racial groups. In general, this application of the sociolinguist hypothesis puts forth the following logic: 1) children develop the ability to speak well before the ability to read; 2) young children often rely on their knowledge of spoken language when learning how to read by sounding out words; and 3) a misalignment between the manner in which English is spoken in a child’s home and schooling environments may delay that child’s reading development.

If the language acquisition of young black students is in fact impaired by linguistic differences between their home and schooling environments as the “Ebonics Resolution” and recent work in the sociology of education suggest (Downey et al., 2004; Entwisle & Alexander 1994) it seems plausible that racial teacher matching would have a positive effect on the reading achievement growth of young black students. Underneath the sociolinguistic hypothesis, teachers are agents, who bring there own “cultural comprehensive knowledge,” which entails a teacher’s particular set of experiences as well as their interpretations of these experiences, to the classroom (Milner 2003). In this way, teachers, consciously or unconsciously, gear courses, curriculum and instructional practices toward students of same race (Ferguson 1998; Taylor 1979) and classrooms taught by teachers who are racially and/or culturally similar to their students have been shown to differ from classrooms taught by teachers who are of a different race and/or
culture than the majority of their students (Barnhardt 1982; Cazden 1988; Erickson & Mohatt 1982; Foster 1987, 1989; Lipka 1991; McCullom 1989).

Specifically, the logic of the sociolinguistic hypothesis predicts that the effect of racial teacher matching on a student’s reading achievement growth should be observed early, when students achievement growth rates are most susceptible to context effects, because black teachers would be better able to understand and bridge the linguistic disjuncture between black students home and schooling environments, for on average a black teacher and a black student are more likely to speak similar dialects of the English language and/or that black teacher is less likely than a white teacher to misinterpret the narrative styles of black students.
CHAPTER 2:
ANALYSIS

2.1. Hypotheses

Prior research on racial teacher matching has produced ambiguous results concerning its relationship to cognitive outcomes. Examining this relationship in the ECLS-k data set will speak to the adequacy of oppositional culture and sociolinguistic hypotheses as explanations for the early expansion of the black-white test score gap. The adequacy of each of these two hypotheses to explain the early expansion of the black-white test score gap will be tested on two dimensions, that is the sociolinguistic and oppositional culture hypotheses will be evaluated on the degree to which they accurately predict the following:

1) Temporal variation in the effect of racial teacher matching

2) Cross-disciplinary variation in the effect of racial teacher matching

Future studies of racial teacher matching and its relationship to academic achievement may also test the oppositional culture and sociolinguistic hypotheses by assessing three additional dimensions: 1) variation in the effect of racial teacher matching by levels of prior achievement, 2) variation in the effect of racial teacher matching across school contexts, and 3) variation in the effect of racial teacher matching by students’ socioeconomic status. Underneath the oppositional culture hypothesis, if young black students do not have negative academic experiences then they would not develop anti-academic attitudes. Accordingly, one would expect that the effect of racial teacher matching would be strongest for black students with lower levels of academic performance in kindergarten through third grade. Furthermore, since the oppositional culture hypothesis is based on students’ development of broad negative academic attitudes, one would expect to see similar effects of racial teacher matching on black students’ achievement growth rates in both reading and mathematics (Entwisle & Alexander 1994). Lastly, prior research indicates that oppositional culture may be stronger in integrated schools and non-existent in predominately black and private schools.
Under the oppositional culture hypothesis, which suggests that a longitudinal process of cumulative disadvantage is responsible for the anti-academic attitudes and poor academic performance of black students, one would expect the initial effect of racial teacher matching on the achievement growth rates of black students to be zero or near zero. However, as black students grow older and accumulate more and more negative academic experiences, which may lead to the perception of more numerous and more significant mobility barriers to occupational and economic success and in turn to disillusionment about the worth of schooling, one would expect the effect of racial teacher matching to be stronger in integrated schools and near zero in private schools.

On the other hand, it seems intuitive that under the sociolinguistic hypothesis that high SES blacks students are significantly more likely to learn to speak in ways that are more compatible with the schooling environment than are low SES black students. Furthermore, it also seems intuitive under the sociolinguistic hypothesis that black students with high levels of prior reading achievement have already developed the requisite linguistic skills to be successful in the American schooling system and therefore would not benefit from the potential greater linguistic alignment that racial teacher matching may offer lower achieving black students. Lastly, the potential linguistic misalignment of black students and the schooling environment and in turn the potential for a positive effect of racially matching black students and teachers is greatest in integrated schools, for "children's growth in reading comprehension in integrated schools could be hindered more than that of their counterparts in segregated schools because in their classes, other youngsters—and perhaps the teacher—speak dialects different from theirs" (Entwisle and Alexander 1994: 455). Accordingly, the sociolinguistic hypothesis predicts that the effect of racial teacher matching on black students' achievement growth rates in reading will be especially strong in schools with a racially integrated student body.
teacher matching on the achievement growth rates of black students to become significant and positive. The expected emergence of this positive effect follows from the logic that having a black teacher may concretely demonstrate the possibilities that the American education system holds for black students.

On the other hand, under the sociolinguistic hypothesis, which posits that linguistic differences between black students’ home and schooling environments are responsible for the early expansion of the black-white test score gap, one would expect to see the positive effect of racial teacher matching on the achievement growth rates of blacks students emerge early. The sociolinguistic hypothesis predicts that the effect of racial teacher matching on black students’ achievement growth rates in reading will be especially strong in the first few years of schooling. This is because the sociolinguistic explanation implies that home-school linguistic misalignment may have strong effects on a student’s learning to read (i.e. students in kindergarten -3rd grade) and because language based interventions have been shown to be most effective early in a child’s cognitive development (Campbell & Ramey 1994; Ramey, Campbell & Blair 1998).
Recent research in the sociology of education, which puts forth the sociolinguistic hypothesis as an explanation of the early expansion of the black-white test score gap, argues that “if negative social influences or discrimination explained the African-American children's shortfall in reading comprehension in integrated schools, one would expect their performance in math to show the same kind of deficit” (Entwisle & Alexander 1994: 455). Thus, the sociolinguistic hypothesis would be supported by null effects of racial teacher matching on black students’ mathematics achievement growth rates.

On average, young white and black children learn to speak differently. They use different pronunciations of the same words and different narrative styles to express similar ideas. The ways in which white students learn to speak more closely resemble the structure and style of English that will be presented in the predominately white schooling environment. Under the sociolinguistic hypothesis, it follows that if the style and structure of black teachers’ speech (relative to those of white teachers) are more similar to narrative styles and pronunciations of black students that racial teacher matching would have a positive effect on the racially match black students may experience more home-school linguistic alignment.
2.2 Data and Models

This study uses the data from the seven time points (fall kindergarten, spring kindergarten, fall 1st grade, spring 1st grade, 3rd grade, 5th grade, 8th grade) of the Early Childhood Longitudinal Study (ECLS-K), which is a nationally representative data set of approximately 20,000 students in 1,000 schools. The data analyzed in this study is strictly limited to include cases in which the student was either black or white. The primary reason for this limitation is to allow for straightforward testing of the sociolinguistic and oppositional culture hypotheses. Initially, cases with missing values on key variables (i.e. race, SES, teacher's race, teacher's experience and school demographics) were excluded from the analysis. In subsequent analyses values for case's with missing data were imputed (with the exception of race and test score performance). The estimates using both list-wise deletion of missing data and imputation were consistent and highly similar.

In this study, hierarchical linear models are used to test the sociolinguistic and oppositional culture hypotheses for several reasons. First, substantively achievement is not a cross-sectional phenomenon. Rather achievement is a continual process that researchers can only measure on several occasions and an attempt to model the continual nature of achievement as best as possible with the available data should be made. In this way, the repeated longitudinal measurements of students' abilities in the ECLS-k data may be viewed as a sample of infinite possible measures of achievement.

Secondly, achievement growth modeling will take full advantage of the ECLS-K data's potential. Achievement growth modeling will not only allow all seven time points in the analysis, but it will also allow the number of tests taken to vary from case to case as well as the time between tests, which greatly simplifies issues of missing data. This is
especially important as NCES did not test the full sample of students in the fall of first grade.

Lastly, longitudinal data are a special case of nested data with repeated measures of achievement nested within students. Standard OLS regression procedures produce biased standard errors when analyzing hierarchical or nested data because the observations being analyzed are not independent as observations that are nested are more likely to share characteristics than observations that are not nested (Raudenbush & Bryk 2002).6

Achievement growth rates in both math and reading are analyzed. At each time point in the ECLS-K data students completed untimed mathematics and reading assessments, which covered skills that are commonly learned in school. These tests were conducted in two-stages in order to minimize the likelihood of floor and ceiling effects. The first stage was used as a routing test and contained a diverse array of questions with varying degrees of difficulty. The child’s performance on the first stage determined the appropriate difficulty level for the second-stage of the test.

The reading assessments are meant to measure each child’s basic non-verbal linguistic skills including print familiarity, letter recognition, beginning and ending sounds, recognition of common words (sight vocabulary), and decoding multisyllabic words; vocabulary knowledge such as receptive vocabulary and vocabulary-in-context; and passage comprehension” (NCES ECLS-K Electronic Codebook). The assessments in kindergarten and first grade are primarily focused on general reading skills, whereas the

6 Future iterations of this paper will also use HLM to examine cross level effects, such as how variables that occur at the student level (i.e. SES, race, gender) affect variables that are internal to the student (i.e. a student’s achievement growth rate).
assessments in later grades focus more on reading comprehension. The mathematics assessments are designed to measure conceptual knowledge, procedural knowledge, and problem solving within specific content strands” (NCES ECLS-K Electronic Codebook).

Growth rates calculated in this study use Item Response Theory scores, which place students' reading and math scores onto standard scales. The distributions of Item Response Theory scale scores for both reading and math indicate that ceiling and floor effects are of limited concern as the distributions have thin tails at both extremes. The Item Response Theory scale scores increase the reliability and validity of the achievement growth rate estimates relative to the basic number-right scores, standardized scores, item cluster scores, and proficiency level scores because Item Response Theory Scale scores acknowledge the existence of low-discriminatory questions, which are easier to answer correctly by guessing, and apply less weight to such questions (Downey et al. 2004; Rock & Pollack 2002).  

7 Beyond the logic of the sociolinguistic and oppositional culture hypotheses, it is important to note that students with lower initial statues (i.e. lower test scores in the fall of kindergarten) have more room to grow and therefore are more likely to experience greater growth. Initial status will be controlled for in the models. However, researchers must be mindful of the fact that all growth rates of the same magnitude are not equal. Said simply, a growth rate of two points per month when a student increases his test score from 10 points in the fall of kindergarten to 26 in the spring of kindergarten is not the same as a growth rate of two points per month for a student who increases her test score from 30 to 46 over the same time period. NCES explicitly addresses this point relating to ECLS-K, saying that “it would be incorrect to conclude that because different subgroups of children are gaining quantitatively the same number of scale score points, they are learning the same things, or that these gains are qualitatively comparable in any sense. The problem is non-equivalence of scale units: children who gain 10 points at the low end of the scale, for example, by mastering letter recognition and letter sounds, are not learning the same things as more advanced children, who are achieving their 10 point gains by learning to read words and sentences” (Rock & Pollack 2002). This implies that it may be easier to gain points in the bottom half of the test distribution than it is in the top half. This is in fact a common phenomenon in studies of test scores as the correlation between a students' initial statuses and students' gain scores is usually negative (Markus 1980). This leads one to believe that since black students on average have lower initial statuses that they have both more to gain and easier gains to make and therefore, if all else were equal, should exhibit greater rates of achievement growth than white students.
2.3 Functional Forms

In order to determine whether there is sufficient and systematic variation in the dependent variables (i.e. Reading Achievement and Mathematics Achievement) I first fit two unconditional linear multilevel models for change to the ECLS-K data. Then I employ a taxonomy of hierarchical models that systematically adds both fixed effects and residual terms to the model (Table 6, Table 6a). The achievement growth rates of both black and white students are clearly non-linear (Figure 1; Figure 2). Accordingly, instead of a linear growth model, piecewise growth models will be used as the final models in order to account for the non-linearity in the data structure (Figure 3).

Model A in Table 6 (Reading) and Table 6a (Math) are the unconditional means linear growth models. These models do not refer to the change in students’ achievement or achievement growth over time, but simply partition the variance in students’ achievement into within student variance and between student variance. The unconditional means model is the most basic multilevel model in that it has no predictors at either level 1 (Y = Π₀i+Eᵢ) or at level 2 (Π₀i=B₀₀+ζ₀i). Since there is no slope

Latent variable growth models were fit to the data in order to address this issue. In this model, B11 and B21 now represent the expected difference in black and white students’ achievement growth rates while initial status is held constant (Seltzer, Choi and Thum 2003: 274). In a latent variable framework, the equations for the piecewise growth model can be represented as follows:

Level I:  \( Y_{it} = Π₀i+Π₁i(Age₁it)+Π₂i(Age₂it)+ E_{it} \)

Level II:  \( Π₀i=B₀₀+ B₀₁(\text{Black})+ζ₀it \)
\( Π₁i=B₁₀+ B₁₁(\text{Black})+ b(Π₀i)+ ζ₁it \)
\( Π₂i=B₂₀+ B₂₁(\text{Black})+ b(Π₀i)+ ζ₂it \)

Further analyses, assess whether the slope that relates rates of change and initial status differs for black and white students (i.e. black* Π₀i). These latent variable models do not significantly alter the significance or directionality of the matching coefficients for black or white students. However, once initial status is controlled for the differences in achievement growth rates during each growth period of the piecewise model in both math and reading are significantly reduced.
parameter at level 1 there can be no change in students’ individual change trajectories. Said differently, each student’s change trajectory is a flat line with a slope of 0.

The parameter \( \Pi_{0i} \) indicates the constant value or intercept level of each student’s individual growth trajectory. \( B_{00} \) is an estimate of the grand mean of reading achievement encompassing all students' achievement at all times that are included in the data set. \( \zeta_0 \) may be most easily thought of as the “between-student variance.” \( \zeta_0 \) is an overall measure of the spread of the mean reading achievement around the grand mean and \( \zeta_{0i} \) indicates the deviation of any individual student from the grand mean. \( V(E) \), on the other hand, may be thought of as the “within-student variance.” \( V(E) \) is an overall summary measure of the spread of students’ reading achievement scores around their individual means, while \( E_{it} \) is the deviation of any individual student from her individual mean achievement at time \( t \).

The unconditional means model for reading achievement (Table 6: Model A) estimates the variance of \( \zeta_0 \) as 4.41 and \( V(E) \) as 3014.14. The unconditional means model for math achievement (Table 6a: Model A) shows a similar pattern with estimates of the variance of \( \zeta_0 \) as 6.9 and \( V(E) \) as 1960.73. It is readily apparent that the majority of the variance lies within students rather than between students. This is to be expected given the longitudinal nature of the achievement data.

To further explore the extent to which the variance lies within students the inter-class correlation can be calculated as follows for reading achievement:

\[
ICC = \frac{\zeta_{0i}}{\zeta_0 + V(E)} = \frac{4.41}{(4.41+3014.14)} = .001.
\]
The ICC for math is:

\[
\text{ICC} = \frac{\zeta_0}{\zeta_0 + V(E)} = \frac{6.9}{6.9 + 1960.73} = .003
\]

The ICC reveals that .1% of the variation in reading achievement and .3% of the variance in math achievement lies between students. Thus, it appears that only a small amount of the variation in reading achievement over time is attributable to differences between students and the vast majority of this variation is a result of students' development as they age.\(^8\)

Model B in Table 6 and Table 6a is the linear unconditional growth model. The only predictor introduced to this model is time, which is represented by the variable Age (measured in months and centered around the average age at kindergarten entry, 68 months). In this model, the achievement growth rates of students are allowed to grow in a linear pattern unconditionally over time, for there are no conditions or controls placed on students' achievement growth rates. Most of the within student variance examined in the unconditional means model is due to time as one would expect given the longitudinal growth patterns.

\(^8\) The HLM ICC’s should be thought of as lower bounds on the amount of variance in achievement that occurs between students. This is because the Empirical Bayes techniques employed in HLM estimation rely heavily on the grand mean of achievement when the number of observations per group is small. Since this analysis has on average approximately four achievement scores measuring each students’ math ability and four achievement scores measuring each student’s reading ability, the Bayesian estimates of variance may overestimate the amount of variance that occurs within students as the intercept values used to calculate between student variation will all be shrunk toward the grand mean. However, several other procedures for variance estimation confirm that the variance that the vast majority of the variance in achievement growth occurs within rather than between students. The ICC calculated using the Stata Loneway command, which is based on an Ordinary Least Squares estimation procedure that corrects for the number of cases per group, indicates that approximately 1% of the variance in reading achievement growth and 2% of the variance in math achievement growth occurs between students. Furthermore, the OLS estimates, which HLM uses as starting values for the Bayesian estimation procedures, indicate that only 2% of the variation for reading and 3% for math occurs between students (Table 8).
structure of the data set with seven repeated measures within students. In fact, the
unconditional growth model reveals that 94% \[
\frac{(3014.14-174.95)}{3014.14} = .942
\] of the
within student variability in reading achievement and 96% of the variability in math
achievement growth are systematic linear functions of time. Said simply, the spread of
each student’s own reading achievement scores around her own mean is largely
accounted for by the change in her age.

Furthermore, the fact that this variance component is statistically significant in
Model B indicates that meaningful and unexplained within student variation remains at
Level-1. Accordingly, additional time-varying predictors will be introduced at Level-1
(i.e. an additional growth parameter) in an attempt to explain more of this remaining
variation. When an additional growth parameter is included in the piecewise form of the
unconditional growth model the within student variance is reduced another 68% to 56.13
for reading (Table 7: Model A) and another 52% to 40.29 for math (Table 7: Model A).

The piecewise unconditional growth models for reading (Table 7: Model A) and
math (Table 7a: Model A) achievement take the following form:

\[
\text{Level I: } Y_{it} = \Pi_0 + \Pi_1(Age_{1it}) + \Pi_2(Age_{2it}) + E_{it}
\]

\[
\text{Level II: } \begin{align*}
\Pi_0 &= B_{00} + \zeta_{0it} \\
\Pi_1 &= B_{10} + \zeta_{1it} \\
\Pi_2 &= B_{20} + \zeta_{2it}
\end{align*}
\]

In this model, the achievement of student \(i\)” at time \(t\” \((Y_{it})\) is a function of the
level one intercept \((\Pi_0)\), which is a measure of student ‘i”’s achievement in third grade
(i.e. \(t=5\)) and two separate growth parameters: \(\Pi_1\), which represents student \(i”’s

38
achievement growth rate leading up to the third grade assessment and \( \Pi_{2i} \), which represents student \(-i\)'s achievement growth rate following the third grade assessment. The two age variables (i.e. Age1 and Age2) in the level one equation are constructed so that the growth parameters \( \Pi_{1i} \) and \( \Pi_{2i} \) are distinct rather than incremental, which allows the growth rates of a student in each piece of the model to be directly compared. Said simply, \( \Pi_{1i} \) is a linear measure of student \(-i\)'s achievement growth rate from the fall of kindergarten to the third grade assessment and \( \Pi_{2i} \) is a statistically separate linear growth parameter that represents student “i”'s achievement growth rate from the third grade assessment to the eighth grade assessment (Figure 3).

The piecewise models shift in slopes at third grade for two reasons. First, statistically, students’ achievement growth rates clearly have steeper slopes during the early years of schools and therefore the piecewise models assessment provide a more accurate estimation model based on the available data. Second, substantively, the third grade assessment is positioned as a unique theoretical tipping point, for the oppositional culture hypothesis would predict that the effect of racial teacher matching on the achievement growth rates of black students would become significant and positive after
third grade, whereas the sociolinguistic hypothesis would predict that the effect of racial
teacher matching would be strongest for black students with lower levels of academic
performance in kindergarten through third grade.

The particular construction of the age timing parameters is as follows: Age1 is a
measure of the number of months prior to the third grade assessment that student “i” took
the assessment in question. For example, if student “i” was 68 months old at the 1st
assessment and 111 months old at the fifth assessment (i.e., the 3rd grade assessment)
then student “i” would have a value of -43 months for Age1. This means that student
“i” took the first assessment 43 months prior to taking the fifth assessment (Table 5).
Constructing the Age1 variable with negative values allows the first achievement growth
parameter (i.e. Π1_i) to be positive and directly comparable to the second growth
parameter.

<Table 5>

The level two variance components of the piecewise unconditional growth model
(i.e. ζ0, ζ1 & ζ2 ) are measures of the unpredicted variation in the individual growth
parameters. ζ0 is a summary of between student variability in initial status that is
unpredicted in the model (i.e., the scatter of the individual initial statuses around the
mean initial status or in notation the scatter of Π0i around B00). ζ1 and ζ2 are summaries of

between student variability in rates of change that are unpredicted (i.e., the scatter of the individual growth trajectories around the mean growth trajectory or in notation the scatter of \( \Pi_{1i} \) around \( B_{10} \) and \( \Pi_{2i} \) around \( B_{20} \)).

All three between student variance components are significant and non-zero, accordingly level-2 predictors will be included in subsequent models to attempt to explain this heterogeneity in each residual parameter. Once additional predictors are included at Level-2 these parameter values in the unconditional growth model (i.e., \( \zeta_0 = 354.10 \), \( \zeta_1 = .12 \) & \( \zeta_2 = .06 \)) will serve as a baseline on which the effects of the predictors will be evaluated. For example, when the time invariant predictor black is added to Model B (Table 7, Table 7a), \( V(E) \) remains constant because the time invariant variable Black is not capable of explaining changes that occur within students, but the level 2 residual variances all decrease. This implies that the time invariant predictor black explains some of the between student variation in initial status and rate of change.

The piecewise growth models are applied for two main reasons: 1) they allow the non-linearity of the data to be modeled more accurately and 2) they explicitly allow for the effect of racial teacher matching on students’ achievement growth rates to be tested during two different time periods (Raudenbush & Bryk 2002). The later is substantively appealing as it pertains to the research question of whether the effect of racial teacher on students’ achievement growth rates varies over time, while the former is statistically appealing in that the piecewise models provide more accurate estimates of students’ achievement growth rates. Furthermore, these models increase the reliabilities of the parameter estimates compared to the linear unconditional growth model by nearly 100% and decrease the deviance of the unconditional growth model by over 20%, which
indicates that the estimates produced by piecewise model are closer to those that would be produced by the saturated model. 9

9 A quadratic growth model was also fit to the ECLS-k reading and math data. The quadratic growth models (i.e. those that include an age^2) parameter allows the mean achievement growth rate to vary over time. In the linear growth models the achievement growth rates (i.e. the slopes) of both black and white students are constant (Figure 4), whereas in the quadratic growth models (Figure 5) the achievement growth rates of both black and white students are free to vary over time. To illustrate this point examine the most basic quadratic growth model:

\[ Y = \Pi_0i + \Pi_1i(Ageit) + \Pi_2i(Ageit)^2 + Eij \]

In this quadratic growth model, \( \Pi_0i \) represents the reading achievement level of student \( i \) at age=0 months old and \( \Pi_1i \) is the instantaneous growth rate of student \( i \) at 0 months old. \( \Pi_1i \) and \( \Pi_0i \) are particular to the age measure, meaning that they will change over time as the student grows older, whereas \( \Pi_2i \) represents the acceleration of the student \( i \)'s growth rate over the entire span of the data, meaning that this parameter will remain constant for student \( i \) at each time point. Accordingly, the growth rate of student \( i \) at any particular time point in the data set is the first derivative of the growth model at that time point:

\[ \frac{d}{dx}[Y] = \Pi_1i + 2\Pi_2i*(Ageit) \]

The quadratic growth model confirms that the growth rates of students are non-linear as \( \text{V(E)} \) for the quadratic model relative to the linear model decreases by over 60% for both reading and math, which means that more than 60% of the remaining — within student” variance in achievement growth is explained by transforming the model from a linear to a quadratic growth model. The piecewise growth model proved to be a slightly better fit in that it showed even greater reductions in \( \text{V(E)} \) and also proved to have higher reliabilities and a lower deviance than the quadratic model.
3.1. Describing the Racial Achievement Gap

Fitting a linear growth model to the ECLS-K data (Figure 4 & Table 8) reveals that in the fall of kindergarten black students on average score more than 3.5 points lower than white students in reading and nearly 5 points below their white peers in math. This represents more than a 12% gap in the reading achievement and more than a 20% gap in the math achievement between black and white students upon entering kindergarten. This gap continues to grow throughout elementary and middle school as the average black student’s achievement growth rates are 1.41 and 1.13 points per month compared to 1.60 and 1.28 points per month for the average white student in reading and math, respectively. This means that the black-white test score gap in reading for the average students expands by .19 points every month in reading and .15 points per month in math. Said differently, white students are growing at a rate more than 12% faster than black students in both reading and math ability. Underneath the linear growth model, the relative growth in the test score gap in reading and math achievement between black and white students remains constant over time at 12% because the achievement growth rates of black and white students are fixed in a linear growth model specification (Figure 5).
However, the growth in reading achievement of students in the ECLS-K data is not linear (Figure 1; Figure 2). Furthermore, it seems illogical to assume that a student consistently grows in reading and math ability at the same rate throughout elementary and middle school as the linear growth model assumes. A piecewise growth model does a significantly better job of fitting the ECLS-K data (Table 7, Table 7a) largely because it allows achievement growth rates to vary over time (Figure 3). Students grow significantly faster in the first growth period from kindergarten to third grade than they do in the later growth period from third grade to eighth grade. For example, the average white student's growth in reading achievement is more than 50% greater in the initial growth period as this student grows at a rate of 2.19 points per month from kindergarten entry through third grade and then slows to a rate of 1.07 points per month in the later growth period (Table 7).

Since the piecewise growth model allows for variable growth rates the black-white test score gap as measured by a percentage of white students' achievement is no longer static. The piecewise growth model estimates that the black-white test score gap at the beginning of kindergarten is 2.36 points in reading and 3.98 points in math, which correspond to a 11% and 20% gap in the initial status of reading and math achievement, respectively (Table 9). The piecewise growth model indicates that by third grade these gaps have grown to 16.22 and 16.35 points and 24.66 and 20.57 points by 8th grade.
Under this modeling framework, the black-white test score gaps continue to grow as students progress through elementary and middle school. The gaps in achievement grow quickly in the earlier grades at rates of .32 and .29 points per month in reading and math and expand at significantly slower rates during the later grades (.14 points per month for reading and .07 points per month for math).

When examining gaps researchers should remain conscious of the relative growth or change in the gaps over time in addition to the absolute changes in growth rates. From this perspective, the black-white gap in reading achievement growth rates remains relatively stable as students progress through elementary and middle school. In the initial growth period, white students' reading achievement on average grows at a rate of 2.19 points per month compared to 1.87 points per month for black students. This represents a 14.5% gap in reading growth rates between black and white students at the start of their schooling experiences. In the later growth trajectory, white students' reading achievement growth slows to a rate of 1.07 points per month compared to .93 points per month for black students, which represents a 13% gap in reading achievement growth rates.
This means that in absolute terms the black-white test score gap in students' average rate of achievement growth in reading converges during elementary and middle school. However, because the growth rates also slow over time the relative black-white test score gap in reading achievement growth rates remains stable from kindergarten to eighth grade. Said simply, in 8th grade the average black student's growth in reading ability is more similar to the average white student's growth than it was in kindergarten. However, because both the average white student and the average black student are growing at a slower rate in the 8th grade than they were in kindergarten the relative gaps in reading achievement growth are highly similar in 8th grade and kindergarten.

Conversely, a significant reduction in the relative growth rate gap in math may be observed over the course of students' academic developments in the ECLS-k data. In the initial growth period, white students' math achievement on average grows at a rate of 1.66 points per month compared to 1.37 points per month for black students. This
represents a 17.5% gap in math growth rates between black and white students at the start of their schooling experiences. In the later growth trajectory, white students' math achievement growth slows to a rate of .96 points per month compared to .89 points per month for black students, which represents only a 7% gap in reading achievement growth rates. Although, the relative growth rate gap in math is wider at the beginning of kindergarten than the corresponding measure for reading achievement, the reduction in the relative growth rate gap for math achievement is markedly greater from 17.5% in the initial growth period to 7% in later growth period.

<Table 6a>
3.2. Describing the Effects of Racial Teacher Matching

The uncontrolled main effect of racial matching is significant and positively related to reading and math achievement ($p<.001$). This indicates that on average students who are racially matched with their teachers score higher than the non-racially matched students at any given age represented in the ECLS-K data. However, once student race is added to the model the effect of racial matching is actually negative in the piecewise model predicting growth in reading achievement (Table 7: Model C) and is no longer significantly different than zero in the math model (Table 7a: Model C). This implies that the uncontrolled effect of racial matching is a function of there being both more white teachers and white students in the ECLS-K data. Thus, white students are more likely to be racially matched and on average achieve at higher levels than black students.\(^{10}\)

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\(^{10}\) Probabilities predicting the likelihood that a student would be matched with a teacher of her own race indicate that black students are more than 60\% less likely to be racially matched than their white peers.
Both the linear and piecewise growth models indicate that the main effect of racial matching is significantly different for black and white students. The point estimate of the effect of race matching on achievement for white students in both math and reading is positive, but the effect is not statistically distinguishable from zero (Table 7: Model D, Table 7a: Model D). The point estimate for the effect of race matching on achievement for black students relative to white students is significantly lower for both math and reading during the initial growth period. This pattern holds in both subjects for the later growth period, however the effect is no longer statistically different than zero in the later growth periods.

Interestingly, once the probability of a student being matched\textsuperscript{11} is controlled for (Table 7: Model E, Table 7a: Model E),\textsuperscript{12} racial teacher matching does not have a

\begin{table}[h!]
\centering
\caption{Table 7a}
\end{table}

\textsuperscript{11} Students probability of being matched were predicted using both one and two level logistic regression models. The models included relevant student characteristics (i.e. prior achievement, gender and SES), teacher characteristics (race, gender, experience and highest level of education) and school characteristics (percent in poverty, region, urbanicity and percent minority).

\textsuperscript{12} Three level piecewise growth models that estimated the teacher and school effects of the variables used in the calculation of a student’s probability of being matched were also calculated and did not reveal significantly different results.
significant effect on the achievement growth rates of either black or white students in either math or reading. This finding is consistent with the previous work of Howsen and Trawick (2007), who when controlling for why teachers and students of the same race are matched (i.e., race and ability), found no statistically significant effect of race matching on achievement.

Moreover, including racial teacher matching in the piecewise growth models does not explain a significant portion of the remaining between student variation as the between student variance parameters ($\zeta_0$, $\zeta_1$ and $\zeta_2$) remain relatively stable in Table 7 and Table 7a. Statistical tests of model fit also indicate that including racial matching in the piecewise growth models does not significantly improve the predictive capabilities of the models. Considering the high reliabilities of the piecewise growth models (Table 7, Table 7a), which indicate that the models have a strong ability to detect significant effects in the data, it appears that the bottom line in the ECLS-k data is that racial teacher matching does not have a statistically significant effect on students' achievement growth rates in either math or reading.
3.3. Updating the Literature on Race Matching

Currently, there is no nationally representative study concerning the effect of racial teacher matching on students' achievement growth rates during elementary school. This study advances the literature by going beyond regionally based studies (Dee 2004; Howsen & Trawick 2007; Klein, Le & Hamilton 2001; Pigott & Cowen 2000), which are not generalizable, and studies based on high school students (Ehrenberg et al.1995; Ehrenberg & Brewer 1994), who are less susceptible to contextual effects, such as the race of their teachers. Said simply, the main substantive contribution of this study is an assessment of the relationship between racial teacher matching and student achievement growth rates in both mathematics and reading using the ECLS-K data. This study also aimed to make larger theoretical contributions to the sociology of education literature by testing two common explanations of the black-white test score gap (i.e the sociolinguistic and the oppositional culture hypothesis).

The results of this study support neither the sociolinguistic nor the oppositional cultural hypothesis, which are frequently cited as explanations of the black-white test score gap in American education. Specifically, the effect of racial teacher matching on the achievement growth rates of black students does not vary over time or across academic subjects in a way that is consistent with either of the theoretical frameworks. Under the oppositional culture hypothesis, one would expect the effect of racial teacher matching to have a positive and significant effect on the later half of the growth trajectory ($\Pi_2i$) in both math and reading, whereas under the sociolinguistic hypothesis one would expect racial teacher matching to have a positive and significant effect on the former half of the growth trajectory ($\Pi_1i$) in reading.
Initially, in both piecewise and linear growth models, it appears that racial teacher matching may even have a negative effect on the achievement growth rate of black students. However, once a student's predicted probability of being racially matched with her teacher is included in either the piecewise or linear achievement growth models the effect of racial teacher matching is not statistically different than zero. This seems to indicate that black teachers are not de facto better educators of black students. This is a rather uplifting finding for it lends support to the argument that teachers are not racially biased and reiterates the idea that students do not learn better in segregated environments (Cizek 1995: 82).

The Probability of Match variable shows that it is not matching per se that has a negative effect on the achievement growth rates of black students, but rather it appears to be the mechanisms by which black students are sorted to classrooms with black teachers that has a negative effect on the achievement growth rates of black students in elementary and middle school. This indicates that the racial matching of black students and teachers is not a random process and that the racial matching of black students and teachers is more likely to occur in school contexts that are less conducive to achievement growth. The fact that the initial negative effect of race matching on black students' achievement growth rates becomes indistinguishable from zero once a student's probability of being matched is entered into the model, seems to indicate that the initial negative effect of racial teacher matching for black students could be a function of school composition and context as there is a differential likelihood of racial matching occurring in certain school environments for black students (i.e. black racial matches are more likely to occur in predominately black schools and the negative rate of change is likely a result of growth
rates increasing slowly in these schools for some other school context and composition reasons independent of the direct effect of teacher matching).

Furthermore, analyses of black students' probabilities of being racially matched indicate that black teachers either seek out or are disproportionately assigned to teach black students as the predicted probability of a black student having a black teacher greatly surpasses the simple ratio of black teachers to black students. This is consistent with prior findings that show that —selecting of students with respect to an own-race teacher is significantly affected by student innate ability and teacher race. This indicates that placement of students with an own-race teacher is influenced by both student innate ability and teacher race” (Howsen & Trawick 2007: 1025). Thus, estimates of the effect of racial teacher matching, which do not control for the probability of being matched, may inappropriately estimate the effect of racial teacher matching on achievement.

In this way, despite the null effects of racial teacher matching, the contribution of this study goes beyond simply updating the academic literature on racial teacher matching in that the findings indicate that future studies on teacher matching should seriously consider and account for the ways in which students are sorted and assigned to teachers. The overall finding that racial teacher matching does not have an effect on elementary and middle school students' rates of achievement growth in math and reading is also consistent with several prior small scale studies as Howsen and Trawick (2007), Pigott and Cowen (2000) found and Klein, Le and Hamilton (2001) all found that racial teacher matching had a null effect in samples of elementary school students from Kentucky, an unidentified small southern city and California, respectively.
3.4. Null Effects in the Context of the Accountability Movement

Positioning the findings of this study within the current era of accountability in American education leads to two possible interpretations of the null effect of racial teacher matching on the achievement growth rates of black students: 1) the null effect may be viewed positively as a result of the increasing professionalization of the teaching profession, or 2) the null effect may be viewed negatively as a result of the increasing standardization of the task of teaching.

The data collection period for the ECLS-k study is uniquely positioned in the midst of the accountability movement in American education. Although, the No Child Left Behind (NCLB) Act was not passed until January 8th, 2002 and initial data collection for ECLS-k took place in 1998, the roots of the current era of accountability in American education can be traced back to the publication of *A Nation At-Risk* in April, 1983. More pointedly, the major tenet of NCLB, increasing the achievement of all students, can be clearly seen in the Improving America's Schools Act (IASA) of 1994. IASA, like NCLB, required states to implement standardized tests, which were aligned with state content and achievement standards, in elementary, middle and high school. Furthermore, IASA also required states to make adequate yearly progress and had mechanisms and sanctions for schools that failed to do so (albeit more vague and ambiguous corrective actions than NCLB).

Furthermore, several states had also implemented their own accountability systems prior to the passing of NCLB. For example, the Massachusetts Education Reform Act of 1993 required that students take the Massachusetts Comprehensive Assessment (MCA), which was based on a common core curriculum taught in all public
schools. Also in 1993, the Texas legislator created a statewide educational accountability plan based on the Texas Assessment of Academic Skills (TASS), which was used to determine student promotion and to assess teacher performance.

A few years later, the Chicago Public School district tied similar stakes to the Iowa Test of Basic Skills (ITBS) in an effort to end social promotion. Specifically, the district used the ITBS to retain underperforming students in 3rd, 6th and 8th grades and to reassign or dismiss teachers based on the performance of their students (Nichols 2008: 377). The aura of the accountability movement was pervasive in the American education system prior to the initial data collection effort of ECLS-k in 1998.

Interpreting the null effect of racial teacher matching within the context of the accountability movement, it may be that high stakes testing and teacher accountability has forced teachers to be concerned with the achievement of all students, especially students who are traditionally low achievers. In this way, the accountability movement may have followed through on one of its major tenets, namely accounting for the achievement of students of all demographics (No Child Left Behind Act 2001). This perspective implies that teachers can not afford to discriminate and treat their students differently based on race under the accountability movement. Moreover, since educational accountability systems based on high stakes tests call attention to the achievement of all students, teachers are arguably forced to pay more attention to traditionally low achieving student populations. Thus, it may be that racial teacher matching does not have an effect on the achievement growth rates of black students because all teachers are now highly concerned with the achievement growth of all students and especially of students who have been traditionally labeled as low achievers.
This potential effect of the accountability movement may also be seen in an emphasis in teacher training programs on providing teachers with the skills and abilities to raise the achievement of an increasingly diverse national student body (Hammond 2000) and in the creation of many non-traditional teacher education programs specifically focused on closing the achievement gap, such as Teach for America (Decker, Mayer & Glazerman 2004). In this way, the null effect of racial teacher matching may be a result of an increased emphasis on raising the achievement of all students, especially those who are low performing and have been traditionally neglected in the American education system.

Conversely, within the context of the accountability movement, the null effect of racial teacher matching could be explained as a result of the increased standardization of the task of teaching. It may be that the increased emphasis on standardized assessments has lead to the standardization of teaching and that this rote method of teaching and learning does not leave much time for meaningful relationships and connections to be made between students and teachers, regardless of if they are of the same or different racial backgrounds. In this way, the accountability movement may have had the (un)intended consequence of limiting the ways in which teachers and students interact and thus making it nearly impossible to establish bonds of belonging and feelings of security under current curricula constraints” (Berliner 2008: 369). Racial achievement gaps may or may not be shrinking as a result of NCLB and the accountability movement, but the curriculum and instructional practices of teachers appear to be as teachers are excessively preparing students for high stakes tests through rote learning techniques at the exclusion of other subject matter and teaching methods (Nichols & Berliner 2007).
For example, before the passing of NCLB, more than 80% of elementary school teachers in North Carolina reported spending at least 20% of their instructional time on preparing students for high stakes tests (Jones et. al 1999). Extrapolating this percentage out over an entire school year shows that more than 35 full school days are spent on test preparation. Furthermore, over a quarter of these teachers report spending more than 60% of their instructional time on test preparation. The shrinking of the academic curriculum and corresponding decrease in the quality of student-teacher relationships may be especially problematic in poor and minority schools, which are at a higher probability of suffering sanctions under federal and state accountability legislation and as a result spend even more time concerned with test preparation. Said simply, the American education system disproportionately teaches black students to take tests (Berliner 2008: 367). This increased emphasis on standardized assessments, which has lead to the increasing standardization of teaching and rote methods learning, may contribute to the null effects of racial teacher matching on the achievement growth rates of black students as such standardization does not leave much time for meaningful relationships and connections to be made between students and teachers, regardless of if they are of the same or different racial backgrounds.
3.5 Directions for Future Research:

In addition to the contextual arguments for the null effect of racial teacher matching presented above, it may be that the effect of race matching is muted or mediated on the standardized assessments, which are administered as part of the ECLS-k data collection process, by the race of the interviewer from the National Center of Education Statistics. Steele's research (1995) on stereotype threat indicates that activating racial or gender stereotypes prior to administering assessment can have significant effects on academic performance, especially among underrepresented minority students. The existing body of work on stereotype threat is limited in that the hypothesis was developed based on experiments conducted at an elite college with academically successful students. Steele's work also used demographic questions to activate positive or negative stereotypes among participants. However, it is conceivable that the race of the test administrator could have a similar effect and may also activate certain stereotypes among test takers. The stereotype threat hypothesis has not been thoroughly assessed outside of the collegiate environment nor has it been tested with different activation mechanisms, such as the race of the test administrator.

Future studies could explore the effect of race matching between test administrator and test taker rather than teacher and student. Addressing this gap in the

13 If the stereotype threat hypothesis holds at the elementary school level, the fact that the ECLS-k student questionnaires, which contain demographic questions, were administered before the ECLS-k assessments may significantly contribute to the observed differences in both achievement growth rates and initial achievement status between black and white students.

14 I attempted to explore this hypothesis further. However, there is no variable in the ECLS-k data set for the race of the test administrator and further communication with the National Center for Education Statistics confirmed that this information was not available to researchers (Personal Communication 02/01/2010).
literature on stereotype threat may provide an interesting and potentially fruitful direction for future research as well as a possible interpretation of the above null findings for racial teacher matching. If race matching between test administrator and test taker is shown to have a positive effect on the achievement of black students then it is plausible that racial teacher matching between students and teachers in the ECLS-k data may also be having a positive effect on black students' achievement growth rates.
Figure 1
Mean Achievement Growth

Figure 2
Figure 3

Piecewise Growth Model: Achievement as a Function of Age

- $x = 113.2$
- $y = 96.6$

Plot showing age in months on the x-axis and IPT Scale Score on the y-axis.
Figure 4

(Green=Black Student Achievement; Red=White Student Achievement)
Figure 5

(Green=Black Student Achievement; Red=White Student Achievement)
TABLE 1

<table>
<thead>
<tr>
<th>Literature Review on the Effects of Teacher Matching by Race</th>
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<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Quantitative effect on academic achievement</td>
</tr>
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</tr>
<tr>
<td>-----</td>
</tr>
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<td>Total Count:</td>
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<table>
<thead>
<tr>
<th>National data sets used:</th>
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<td>1960 Coleman data</td>
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By School Level

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<th>III</th>
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<th>II</th>
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<td>0</td>
<td>0</td>
<td>I</td>
</tr>
<tr>
<td>High School</td>
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<td>III</td>
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# TABLE 2

<table>
<thead>
<tr>
<th>Testable Dimension</th>
<th>Sociolinguistic Hypothesis</th>
<th>Oppositional Culture Hypothesis</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Reading</td>
<td>Math</td>
</tr>
<tr>
<td>Temporal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall K</td>
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<td>0</td>
</tr>
<tr>
<td>Spring K</td>
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<td>0</td>
</tr>
<tr>
<td>Fall 1&lt;sup&gt;st&lt;/sup&gt; Grade</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Spring 1&lt;sup&gt;st&lt;/sup&gt; Grade</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Grade</td>
<td>++</td>
<td>0</td>
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<td>5&lt;sup&gt;th&lt;/sup&gt; Grade</td>
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<td>0</td>
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<td>8&lt;sup&gt;th&lt;/sup&gt; Grade</td>
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<td>0</td>
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<td>Prior Achievement</td>
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<tr>
<td>Low Achiever</td>
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</tr>
<tr>
<td>Mean Achiever</td>
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<td>0</td>
</tr>
<tr>
<td>High Achiever</td>
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<tr>
<td>School Context</td>
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<td>Segregated School</td>
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<tr>
<td>Private School</td>
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<td>Socioeconomic Status</td>
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<td>Low SES</td>
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<tr>
<td>Mean SES</td>
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<td>0</td>
</tr>
<tr>
<td>High SES</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

++ = Strong positive effect  
+= Positive effect  
~ = Weak positive effect  
0 = Null effect

<sup>15</sup> One would expect that racial teacher matching would not have an effect in the fall of kindergarten underneath either the oppositional culture or the sociolinguistic hypothesis. At this time, students have neither developed anti-academic attitudes nor had significant verbal interactions with their teacher. However, the assessments administered as part of the ECLS-k data were individually administered to each student in the sample (NCES ECLS-k Psychometric Report), which creates the potential for a race of interviewer effect. The race of an interview has been found to have significant effects on the answers respondents provide (Anderson et al. 1988; Barnes et al. 2008; Davis 1997; Hatchett & Schuman 1975; Kaiser & Miller 2001; Schaeffer 1980; Schuman & Converse 1971; Stangor et al. 2002). Thus, this process of data collection creates the potential for a stereotype effect to influence students’ performances on the cognitive assessments. I will revisit these possibilities after completing the analysis.
<table>
<thead>
<tr>
<th>Hypotheses Testing the Oppositional Culture Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H1</strong>: The initial effect of racial teacher matching on the achievement growth rates of black students will not be significantly different than zero.</td>
</tr>
<tr>
<td><strong>H2.1</strong>: Racial teacher matching will have a significantly positive effect on the reading achievement growth rates of black students in the later grades of elementary school and in middle school.</td>
</tr>
<tr>
<td><strong>H2.2</strong>: Racial teacher matching will have a significantly positive effect on the mathematics achievement growth rates of black students in the later grades of elementary school and in middle school.</td>
</tr>
</tbody>
</table>
### Table 3B

<table>
<thead>
<tr>
<th>Hypotheses Testing the Sociolinguistic Explanation</th>
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<tbody>
<tr>
<td><strong>H1.</strong> The early effect of racial teacher matching on the achievement growth rates of black students will be significant and positive.</td>
</tr>
<tr>
<td><strong>H2.1:</strong> Racial teacher matching will continue to have a significantly positive effect on the reading achievement growth rates of black students in the later grades of elementary school and in middle school.</td>
</tr>
<tr>
<td><strong>H2.2:</strong> Racial teacher matching not have a significantly positive effect on the mathematics achievement growth rates of black students in the later grades of elementary school and in middle school.</td>
</tr>
</tbody>
</table>
### TABLE 4

<table>
<thead>
<tr>
<th>Analytical Sample</th>
<th>Fall K</th>
<th>Spr. K</th>
<th>Fall 1&lt;sup&gt;st&lt;/sup&gt;</th>
<th>Spr.1&lt;sup&gt;st&lt;/sup&gt;</th>
<th>Third</th>
<th>Fifth</th>
<th>Eighth</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>13,270</td>
<td>13,120</td>
<td>3,730</td>
<td>11,850</td>
<td>9,990</td>
<td>7,780</td>
<td>6,630</td>
</tr>
<tr>
<td>Black</td>
<td>21%</td>
<td>21.10%</td>
<td>21%</td>
<td>20.20%</td>
<td>18.60%</td>
<td>16.50%</td>
<td>14.40%</td>
</tr>
<tr>
<td>Age</td>
<td>68.7</td>
<td>74.9</td>
<td>80.3</td>
<td>87.2</td>
<td>111.34</td>
<td>134.94</td>
<td>171.64</td>
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<tr>
<td>Delta Age</td>
<td>6.2</td>
<td>5.4</td>
<td>6.9</td>
<td>24.14</td>
<td>23.6</td>
<td>36.7</td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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**TABLE 5**

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TABLE 6

| Taxonomy of Linear Multilevel Models for Change Fitted to the ECLS-k Longitudinal Reading Data |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| **Level I Parameters** | **Level II Parameters** | **Model A Unconditional Means** | **Model B Unconditional Growth (age-68)** | **Model C** | **Model D** | **Model E** | **Model F** |
| **Initial Status (Ii0i)** | Intercept B00 | 75.13 (.21)*** | 27.19 (.10)*** | 27.93 (.11)*** | 27.93 (.11)*** | 27.93 (.11)*** | 27.93 (.11)*** |
| | Black B01 | | -3.59 (.26)*** | -3.59 (.26)*** | -3.59 (.26)*** | -3.59 (.26)*** |
| **Rate of Change (IIIi)** | Intercept B10 | 1.57 (.003)*** | 1.60 (.003)*** | 1.63 (.01)*** | 1.58 (.02)*** | 1.63 (.03)*** |
| | Black B11 | -1.19 (.007)*** | -2.21 (.01)*** | -0.15 (.02)*** | -1.19 (.03)*** |
| | Match B12 | | -0.03 (.01)* | | 0.02 (.02) | 0.02 (.02) |
| | MatchXblack B13 | | | -0.09 (.02)*** | -0.05 (.03) |
| | P Match B14 | | | | |-.05 (.003) |
| **Variance Components** | | | | | | |
| **Level 1 w/in students** | Initial Status V(E) | 3014.14 | 174.95 | 175.91 | 175.92 | 175.91 | 175.91 |
| **Level 2 b/w students** | Initial Status (ζ0) | 4.41 | 66.58 | 63.57 | 63.57 | 63.60 | 63.62 |
| | Rate of Change (ζ1) | .045 | .038 | .19 | .04 | .04 |
| | Racial Match (ζ2) | | | | | | |
| **Deviance** | 689848.64 | 532948.83 | 532861.86 | 532861.03 | 532853.31 | 532853.71 |
| **Reliability P0** | .007 | .442 | .430 | .430 | .430 | .430 |
| **Reliability P1** | | .419 | .391 | .390 | .390 | .390 |
### TABLE 6A

<p>| Taxonomy of Linear Multilevel Models for Change Fitted to the ECLS-k Longitudinal Math Data |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Level I Parameters                               | Level II Parameters                             | Model A Unconditional Means                    | Model B Unconditional Growth (age-68)           | Model C                                        | Model D                                        | Model E                                        | Model F                                        |
| Initial Status (I1i0)                            | Intercept B00                                   | 61.21 (.18)***                                | 22.71 (.07)***                                 | 23.69 (.08)***                                | 23.69 (.08)***                                | 23.69 (.08)***                                | 23.69 (.08)***                                |
|                                                  | Black B01                                       | -4.88 (.18)***                                | -4.88 (.18)***                                 | -4.88 (.18)***                                | -4.88 (.18)***                                | -4.88 (.18)***                                | -4.88 (.18)***                                |
| Rate of Change (I1i1)                            | Intercept B10                                   | 1.26(.002)***                                 | 1.28(.002)***                                 | 1.31(.007)***                                 | 1.28 (.01)***                                 | 1.39 (.03)***                                 | 1.39 (.03)***                                 |
|                                                  | Black B11                                       | -.15(.005)***                                 | -.17(.007)***                                 | -.03(.01)***                                 | -.22(.03)***                                 | -.12 (.03)***                                 | -.12 (.03)***                                 |
|                                                  | Match B12                                       | -.02(.007)***                                 | -.02(.007)***                                 | .002(.01)                                    | .006 (.01)                                    | -.02(.02)                                    | -.02(.02)                                    |
|                                                  | MatchXblack B13                                 |                                              |                                              |                                              |                                              |                                              |                                              |
|                                                  | P_Match B14                                     |                                              |                                              |                                              |                                              |                                              |                                              |
|                                                   |                                                   |                                              |                                              |                                              |                                              |                                              |                                              |
| Variance Components                              |                                                   |                                              |                                              |                                              |                                              |                                              |                                              |
| Level 1 w/in students                            | Initial Status V(E)                             | 1960.73                                       | 84.19                                         | 84.36                                         | 84.34                                         | 84.34                                         | 84.34                                         |
| Level 2 b/w students                             | Initial Status (ζ0)                             | 6.9                                           | 66.58                                         | 37.59                                         | 37.61                                         | 37.61                                         | 37.61                                         |
|                                                   | Rate of Change (ζ1)                              | .03                                           | .02                                           | .02                                          | .02                                          | .02                                          | .02                                          |
|                                                   | Racial Match (ζ2)                                |                                               |                                               |                                               |                                               |                                               |                                               |
| Deviance                                         |                                                   | 689848.64                                     | 496185.84                                     | 494984.97                                     | 494982.00                                     | 494982.00                                     | 494967.25                                     |
| Reliability P0                                   |                                                   | .016                                          | .502                                          | .480                                          | .480                                          | .480                                          | .480                                          |
| Reliability P1                                   |                                                   | .478                                          | .456                                          | .456                                          | .456                                          | .456                                          | .456                                          |</p>
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<th>Level II</th>
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<th>Model B</th>
<th>Model C</th>
<th>Model D</th>
<th>Model E</th>
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<td>114.02 (.21)***</td>
<td>114.02 (.21)***</td>
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<td>-16.22 (.49)***</td>
<td>-16.22 (.49)***</td>
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### TABLE 7A

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<th>Model C</th>
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#### Variance Components

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<td>.02</td>
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<p>| Deviance | 397446.39 | 395995.22 | 396017.93 | 396017.93 | 396015.90 |
| Reliability P0 | .905 | .890 | .890 | .890 | .890 |
| Reliability P1 | .710 | .677 | .677 | .677 | .677 |
| Reliability P2 | .472 | .465 | .465 | .465 | .465 |</p>
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TABLE 9

Modeling the Black-White Test Score Gap (Piecewise Model B from Tables 7.1 & 7.2)

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<th>Spr. K</th>
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<th>Spr. 1st Grade</th>
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REFERENCES


