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Reasoning About Race and Pedagogy in Two Preservice Science Teachers:

A Critical Race Theory Analysis

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Abstract

This study describes the experiences of two preservice science teachers as they progress through their respective teacher education programs, and uses critical race theory to examine the manner in which conceptions about race and its pedagogical implications change over time. Using a longitudinal case study method, participants’ conceptual ecologies of race and pedagogy are mapped both before and after student teaching, and each case is analyzed for evidence of conceptual change in these areas. Findings show that conceptions about race and the pedagogical implications of race changed in ways that likely would have gone undetected in earlier studies because they did not result in wholesale changes in beliefs or teaching practice. This study suggests that the difficulty of fostering an understanding of structural racism and difference may often be underestimated, as revising one’s model about race is mitigated strongly by learners’ existing conceptual ecologies.
Reasoning About Race and Pedagogy in Two Preservice Science Teachers:

A Critical Race Theory Analysis

This study begins with the proposition that teachers’ views about the concept of race exert a meaningful influence on their pedagogy, an idea with long historical roots in the United States. In the early 20th century, Woodson (1933) noted that in cases where White teachers taught Black students, such influence often took the form of “race hate, segregation, and terrorism,” (p. 28). As the concept of race came to be understood as more of a social construct than a biological phenomenon, the pedagogical implications for teachers’ conceptions about race grew to include a wide range of practices, from the effects of racism on students of color (e.g. Morris, 2006; Noguera, 2008; Pollock, 2004; Rist, 1970) to explicit efforts at prejudice reduction in schools (Allport, 1979; Burkholder, 2011; Sleeter & Grant, 1994) to the development of culturally relevant and responsive approaches to teaching that hold modern understandings about human difference at their core (Gay, 2002; Ladson-Billings, 1995; Villegas & Lucas, 2002a). The claim that pedagogy is influenced by individual teachers’ conceptions about race now has broad support in the fields of educational psychology (Martin, 2006; Okagaki, 2006; Steele, 1997), curriculum and instruction (Banks, 1995; Grant & Sleeter, 1993; Howard, 2006), and teacher preparation (Banks et al., 2005; Dilworth & Brown, 2008; Gollnick, 2008; Zeichner, 1996). Scholarly and practitioner publications intended to address the intersection of race and teaching continue to proliferate and reach a wide audience (e.g. Delpit, 2012; Landsman & Lewis, 2006; Milner, 2010; Singleton & Linton, 2006; Tatum, 2003).

Perhaps the continued attention to the intersection between race and pedagogy is evidence enough that the topic remains a salient issue for investigation, but it also is the case that our understanding of human reasoning about race is still quite limited—particularly in the
context of teaching. Over two decades ago, Grant and Secada (1990) made the following observation:

A basic tenet of education is that instruction should follow development. Yet we have no maps of how teacher cognitions, beliefs and skills with respect to the teaching of diverse student populations actually develop. We do not know what a beginning teacher really knows versus what successful, experienced colleagues might know about the teaching of diverse student populations. If we could map how teachers move from the former to the latter, we might be able to plan teacher education programs to help teachers better develop these skills. (p. 419)

We conceive of the present study as part of this “map-making” project, and are convinced of its necessity by the continuing disparities in educational outcomes for students of color, as reported by measures such as the National Assessment of Educational Progress (Hemphill, Vanneman, & Rahman, 2011; Vanneman, Hamilton, Baldwin Anderson, & Rahman, 2009). Understanding how teacher thinking develops in regard to race has profound implications for teacher education. For teacher educators, learning more about the vast conceptual terrain to be covered concerning the pedagogical implications of race holds much promise for preparing new teachers for 21st century classrooms.

In this study we work from the premise that each person has a unique conceptual scheme—that is, a model that is both explanatory and predictive—for understanding and explaining human difference, and that the social construct of race is part of this model in some way. To make sense of such models, we use the theoretical lens of critical race theory, which begins with the premise that race continues to be a “powerful social construct and signifier” despite attempts to marginalize the salience of race in public and political discourse (Ladson-
Billings, 1998, p. 8). Throughout this work we ask the question, “To a given individual, what does the concept of race explain?” In other words, how is the idea of race deployed as an explanatory framework to make sense of phenomena, experiences, and situations? What predictive power does the concept of race have for a given individual? And in what ways are individuals’ conceptions about race connected and shaped over time with other conceptions of human difference and diversity? Such questions have even more salience during a period of learning to teach, given that the curriculum of most teacher education programs includes outcomes related to ensuring that teachers are prepared to teach students from all backgrounds (Hollins & Guzman, 2005).

The present study examines teacher reasoning about the concept of race through the experiences of two preservice science teachers as they progress through their respective university-based science teacher education programs. The focus of each case is on the participant’s thinking about issues of race—along with ethnicity and culture as each relates to race—as intersecting with thinking about pedagogy.\(^1\) Research on teacher learning has highlighted the need to examine learning to “teach for diversity” within disciplinary contexts (Borko & Putnam, 1996; Feiman-Nemser, 2001; Zumwalt & Craig, 2005), the underlying argument being that transferring knowledge and skills from teacher preparation courses is a much more difficult task than is commonly acknowledged. Therefore, situating this research within a disciplinary context—specifically physics and biology—highlights aspects unique to the development of thinking in preservice science teachers and provides some useful contrast to similar research in other disciplines.

The argument we make in this paper is that race is a conceptual model with explanatory power, and that attempts to change people’s thinking about race must take into account all of the
phenomena explained by that model. The contribution of this study is in the way that critical race theory is used to make sense of such changes in cognition through the notion of a conceptual ecology (Hewson, 1985)—that is, an individual’s interrelated set of organizing concepts, beliefs, and epistemological commitments—to link the operation of societal privilege and power to cognition about race in a pedagogical context.

Specifically, this article will examine the following research questions:

• How do conceptions about race and its pedagogical implications change during a teacher education program?

• How does critical race theory help to explain the nature and/or absence of such changes within an individual’s conceptual ecology?

In this article, we suggest that learning the pedagogical implications of race is a much more difficult task than most research has previously indicated, but we also find evidence of learning experiences that may provide support for such an endeavor. In particular, we will demonstrate how conceptions about race were already deeply interwoven into the participants’ conceptions about pedagogy. Our findings suggest that potential levers for conceptual change about race and pedagogy include a deeper understanding of both the role of student ideas in learning and the operation of structural racism in society.

We begin this article by defining our use of the terms “race,” and “culture,” in this study, and by discussing the epistemology of race. This is followed by a discussion of the metaphor of a conceptual ecology in describing conceptual change. We then describe critical race theory, with particular focus on its utility as a tool for theorizing the process of learning to teach. Next, we describe our methodology and process for developing the subject-specific interview protocols used for this study. The next two sections each present a case of a preservice secondary science
teacher learning to teach science, a description of the changes that occurred concerning the participant’s thinking about race, pedagogy, and the pedagogical implications of race, an analysis of these changes through the lens of critical race theory, and the role of the conceptual ecology in these changes. This is followed by a discussion that draws from the cases to demonstrate the role of a critical race theory lens on understanding conceptual change. Finally, the conclusion considers the implications of this study for the future recruitment and preparation of teachers for diverse classrooms, as well as more general efforts to foster understandings about the connections between pedagogy and race.

The Epistemology of Race

Race and Culture

It is necessary to define the terms race and culture as they are conceptualized here because understanding how an individual reasons with these concepts is an important feature of the present study. As authors who identify as a White man and two African American women respectively—all socially located in the middle-class—we also do so to establish a reference point for critiques of our interpretations of findings that may result from our own biases.

In its statement on race, the American Anthropological Association (AAA Executive Board, 1998) states:

In the United States both scholars and the general public have been conditioned to viewing human races as natural and separate divisions within the human species based on visible physical differences. With the vast expansion of scientific knowledge in this century, however, it has become clear that human populations are not unambiguous, clearly demarcated, biologically distinct groups. (p. 712)
Though race currently holds little salience as a biological concept, it retains power as a construct that has social, political, legal, and even religious dimensions (Omi & Winant, 1994). Haney López (2000) notes that “Race must be viewed as a social construction. That is, human interaction rather than natural differentiation must be seen as the source and continued basis for racial categorization” (p. 196). Further consideration of the concept of race through the lens of critical race theory will be explored below.

In contrast to race, the term culture is used and understood in a myriad of ways. An ethnographic approach to educational research informs the definition of culture used in this study, exemplified by the work of George and Louise Spindler, who write, “We think of 'culture' as a process. It is what happens as people try to make sense of their own lives and sense of the behavior of other people with whom they have to deal” (Spindler & Spindler, 1990, p. 2). From this perspective, talk about culture solely in behavioral terms is an impoverished view of the concept, particularly if it is only applied to “the other” and not to oneself. Culture has a cognitive component in that it is a way of making sense of the world (Shweder, 2003), and in many respects can be likened to a scientific paradigm (Kuhn, 1970) in that culture orients individuals to interpret phenomena in particular ways and shapes learning (Nasir, Rosebery, Warren, & Lee, 2006).

Yet these academic descriptions of race and culture only go so far, and folk beliefs about race in particular continue to emerge in public and private discourse, confounding efforts to build public understanding about human diversity through insights from the fields of molecular genetics and genomics (Fields & Fields, 2012). Smedley and Smedley (2005) detail the ways in which perceptions about race may diverge greatly from modern understandings among particular populations. They note that the some of the social characteristics of “race-based” societies in
North America are that they view racial groups as biologically discrete, designate certain physical characteristics as markers of race status, assume each race has “distinctive cultural behaviors linked to their biology,” and assume “that both physical features and behavior are innate and inherited” (p. 20). Discredited as such ideas may be scientifically, they still have the potential to occupy and influence personal conceptions about race. It is this larger consideration of the nature of knowledge about race in individual cognition—the epistemology of race—to which we now turn.

Race as a Cognitive Model

In the practice of science, as well as in science education, one common use of the term model is as a framework for making sense of phenomena, and its quality is judged by how well it explains data and makes accurate predictions (Duschl & Grandy, 2008; Stewart, Cartier, & Passmore, 2005; Windschitl, Thompson, & Braaten, 2008). Models may be evaluated by a number of criteria as well, including internal consistency, generalizability, and goodness of fit with general understandings about the way the world works (i.e., how well it corresponds with other models used to explain related phenomena). It is our contention that “race” itself can be usefully considered as a model, yet in order to deploy it as such we must engage in a race-conscious scholarship that acknowledges the inherent contradictions in working with the idea of race as if it were a “real thing,” (Warmington, 2009). As a form of “common sense,” the concept of race acts as a paradigmatic conceptual scheme in the same manner as other scientific concepts. Omi and Winant (1994) note that is this is because race operates as “a way of comprehending, explaining, and acting in the world” (p. 13).

Of course, one’s personal explanatory model for any phenomena may not be consistent with an accepted scientific model. Therefore each individual’s conceptions and overall model of
race may be very different than the modern sociological understanding. As a scientific model in biology, race has been discarded because it does little to explain data, such as intra-racial group genetic variation that is greater than that within racial groups (Koenig, Lee, & Richardson, 2008), or make predictions, even as some phenotypic markers for race retain their explanatory power—such as the link between melanin levels and risk of skin cancer. As a social construct however, race still has very strong predictive power, such as in graduation from high school, involvement in the criminal justice system, or the likelihood of receiving proper cancer diagnoses (Alexander, 2010; Cole, 1999; McMahon et al., 1999; National Center for Education Statistics, 2013).

All of this social knowledge concerning the concept of race is available to individuals as they consider race. Whether supportable by scientific evidence or not, these ideas about race are the raw materials out of which individuals’ models about race are built, evaluated, and revised over time as needed. Such models can be examined by asking, “For a particular individual, what does the concept of race explain?” Answering this question entails consideration of the model itself as well as the data that the model is designed to explain. Included in that data is the way that race factors into the interpretation of personal experiences.

For example, in the case of a teacher who seeks to understand why a group of Black students are seated together in a cafeteria filled primarily with White students, it is likely that race will be part of an explanation that makes sense personally, is internally consistent, and fits with the teacher’s existing models about the way the world works. Whether the teacher thinks that the students are seeking the safety of a socio-emotional refuge or that the Black students themselves are being racist, the concept of race will likely be deployed as part of the explanation (Tatum, 2003; Thompson, 2004).
Other aspects of the personal cognitive model of race include racial identity formation (Helms, 1990; McAllister & Irvine, 2000), as individuals consider the role of the concept of race as part of a sense of who they are. Sleeter (1993) has noted that many White teachers consider themselves to be without race or culture, and that from this perspective, the concept of race only has explanatory power to understand the behavior of individuals who are not White.

In the learning sciences literature, it is common for researchers to identify a concept—such as air pressure—and conduct empirical research that seeks to understand the operation and development of that concept in the minds of individual learners (Duncan & Hmelo-Silver, 2009; Sawyer, 2005). In this study, race is the concept under investigation, and we seek to understand its operation and development in the minds of people learning how to teach. While there have been efforts to identify learning progressions for teachers in regard to diversity more generally, by and large these have been framed more as desired practices, components, and outcomes of teacher education programs (e.g. Interstate New Teacher Assessment and Support Consortium, 2013; Villegas & Lucas, 2002b; Zeichner et al., 1998), rather than as detailed studies of empirical data tracking how and why individuals’ conceptions about race change.

The Metaphor of a Conceptual Ecology

The word “ecology” originally comes from the discipline of biology, and is generally used to denote the study of the relationships of organisms to one another as well as to their physical surroundings. As a philosopher of science, Toulmin (1972) was critical of the “revolutionary” view of conceptual change offered by Kuhn (1970), and sought instead to draw comparisons between scientific ideas and organisms using a Darwinian lens, emphasizing the features of “populational mode of thought” (p. 325), or what is often termed today as evolutionary thinking in consideration of the variation and selective perpetuation of ideas. Much
like the survival of organisms depended on their adaptations for surviving in a particular environment at a particular time, so too, argued Toulmin, did the systematic survival of ideas as part of scientific knowledge depend on their fitness to the wider system of ideas in existence. Toulmin termed this system of ideas an “intellectual ecology” to highlight the interrelationships between the ideas in this system, as well as the fact that they transformed over time in accordance to the principles of evolutionary change.

This idea was synthesized with the emerging Piagetian implications for learning in a 1982 paper by Posner, Strike, Hewson, and Gertzog to examine how college physics students learned the principles of special relativity. What is notable and relevant to the present study is that Posner et al. shifted the ecological metaphor from one in which knowledge claims competed within a social environment to one that focused on individual cognition and the rational internal processes by which an individual judged one idea to be superior to another. Thus, the intellectual ecology of Toulmin reflected a social system of knowledge, while the “conceptual ecology” of Posner et al. represented an individual and cognitive view of knowledge. Later, Strike and Posner (1992) called for researchers to expand the consideration of the factors that influence the conceptual change process to also include motivations and emotions. A conceptual ecology underscores the relationships between knowledge, beliefs, affective considerations, and epistemological commitments (Hewson, Beeth, & Thorley, 1998). Such a model is quite consistent with research on learning that emphasizes the centrality of knowledge organization and metacognition to the learning process (Bransford, Brown, & Cocking, 1999; Hennessey, 2003) as well as broader research that looks at how individuals draw upon epistemological resources in various learning contexts (Hammer & Elby, 2002). Hewson also notes the importance of epistemological commitments, particularly internal consistency and
generalizability, when characterizing the nature of individuals’ conceptions. Without a strong commitment to internal consistency, it becomes more likely that conflicting conceptions will go unrecognized as irreconcilable. Without a strong commitment to generalizability, conflicting conceptions may be recognized as such, but may remain compartmentalized or contextualized as an alternative to rejecting a less plausible conception.

Of primary interest in the present study is an understanding of how individuals’ personal models concerning race and pedagogy change over time and interact with other conceptions held by that person. With the notion of a conceptual ecology at its core, the theory of conceptual change is particularly well-suited for analyzing the process by which ideas change over time. It highlights the explanatory and predictive power of racial conceptions for learners, and thus accounts for outcomes that might appear puzzling when changes in learner thinking occur outside of the intended direction (for example, in Haberman and Post (1992), which demonstrated how urban tutoring programs can reinforce prospective teachers’ stereotypes about race and class).

We recognize that using conceptual change theory for examining teacher learning may strike some as unusual, given that conceptual change theory has primarily been used in science education to understand the ways in which students learn science concepts. The first author has written an expanded argument elsewhere for this approach to researching teacher learning in regard to preparation for diverse classrooms (Larkin, 2012b). In fact, the framework of conceptual change has already been deployed to analyze cognition about the pedagogical implications of student diversity in snapshot or episodic cases that were brief in duration (Dooley, 2008; Gregoire, 2003; Philip, 2011). Yet it may also be the case that for a topic as complex as race, multiple instances of conceptual change in sub-domains may be necessary for
change in the larger organizing conception to be recognized. It is as if multiple ropes anchor an object; loosening one rope may allow for more movement, but only when all of the ropes are loosened will the object be able to move somewhere else.

One contribution of the current study is that teacher learning is examined through the same lens over a longer period, while incorporating factors identified by critical race theory—helping to identify the “ropes” constraining conceptual change—in the analysis, a topic to which we now turn.

**Critical Race Theory**

Originally conceived in the 1980s by legal scholars as a response to critical legal studies (Bell, 1995; Crenshaw, Gotanda, Peller, & Thomas, 1995), the first critical race theorists emphasized that historical racial oppression and present-day racial domination were being overlooked as foundational premises in studies of the law and of U.S. society. Critical theories in general require an unpacking of assumptions about the nature of knowledge and power, challenge existing forms of knowledge, and introduce new epistemologies (Giroux, 1983; McLaren, 2003). A distinguishing feature of critical race theory, however, is that it foregrounds the endemic nature of racism as a kind of racial superstructure, and highlights the pervasive, permanent nature of racism as it exists in U.S. society in particular (Bell, 1992; Delgado, 1995; Dixson & Rousseau, 2006). Critical race theory is interdisciplinary, insists on contextual-historical analysis, and centralizes experiential knowledge and narratives of oppressed peoples. Through this approach, critical race theorists are able to challenge popular claims of colorblindness, race neutrality, objectivity, and meritocracy.

Critical race theory was first applied to an analysis of institutional racism in U.S. education by Ladson-Billings & Tate (1995) in order to illuminate the hidden ways in which...
interrelated systems of domination have ordered common policies and practices throughout the history of American schooling. There have since been many iterations of critical race theory applied to the study of various features of U.S. education. Scholars use it to theorize curricula and standards (Ladson-Billings, 2003; Solorzano & Yosso, 2001; Vasquez Heilig, Brown, & Brown, 2012), teaching and pedagogical practices (Chapman, 2007; DeCuir & Dixson, 2004; Rousseau & Tate, 2003), educational scholarship (Ladson-Billings, 2005) and activism and resistance (Solorzano & Bernal, 2001).

We selected critical race theory as the theoretical framework for this study because of its ability to shed light upon the nature of change in individuals’ conceptions about race and highlight the impact of structural forms of racism on individual human cognition. Simply put, critical race theory is being used here to disentangle the components of an individual’s conceptual ecology when it comes to understanding race. Though typically deployed as a way to reframe and highlight structural features in law and policy that sustain inequalities based in race, here we use these insights as a way to better understand the effects of such features on cognition. Given that there are multiple tenets of critical race theory, we highlight three here that are most salient to analyses of individual preservice teacher learning. First, racial realism: that racism is endemic, pervasive and permanent in all aspects of U.S. society, institutions, and human relations; that race is a social construct, but racism is real and consequently has real effects. Second, Whiteness-as-property, where Whiteness and White privilege confer particular rights and privileges, including the right to enjoyment and the right to exclude. Third, critical race theory challenges the notions of objectivity, color-blindness, and meritocracy common in educational discourses. Each of these tenets is discussed in more detail below.

Racial realism.
Critical race theory seeks to uncover the hidden mechanisms of racism, and presses for descriptions of the ways that racism is presented as normal or natural in society (Bell, 1992; Delgado, 1995; Du Bois, 1903/1993). From the perspective of racial realism, the binary of being racist/not-racist is nonsensical; a view that contrasts sharply with the self-conceptions of White preservice teachers who view themselves as not being racist because of an absence of overt malice towards others on the basis of race (Sleeter, 1993). King (1991) refers to such a stance as “dysconscious” racism, which can be described as “an uncritical habit of mind (including perceptions, attitude, assumptions, and beliefs) that justifies inequity and exploitation by accepting the existing order of things as given” (p. 135). A preservice teacher exhibiting dysconsciousness might condemn racial discrimination, yet still cite explanations for racial inequity that have no basis in empirical evidence or even their own experience. In the absence of explanations invoking racial realism, the effects of structural and institutional racism may be interpreted as the result of individual choices, and uncritical assumptions about the operation of race in society may influence the meanings individuals make of their own experiences.

**The operation of Whiteness-as-property.**

Harris (1993) describes the core characteristic of the concept of Whiteness-as-property as “the legal legitimation of expectations of power and control that enshrine the status quo as a neutral baseline, while masking the maintenance of white privilege and domination” (p. 1715). Used as part of an analytical framework for cognition here, examining understanding how Whiteness-as-property shapes assumptions and expectations, particularly concerning access, use, and enjoyment. In a classroom setting, White privilege and domination may influence access to knowledge, and perceptions about the right to include or exclude. In order to unmask the operation of racism in maintaining power and privilege, the identification of the benefits of
Whiteness is equally important in such an analysis.

**Challenging claims of objectivity, color-blindness, and meritocracy.**

Claims of objectivity, color-blindness, and meritocracy often serve as camouflage for the self-interest of dominant groups in American society (Ladson-Billings & Tate, 1995). Underlying all of these claims is the assumption of a level playing field for individuals in society. This view places undue emphasis on the internal qualities of a person to explain human behavior while minimizing external factors, making actions and situations largely attributable to the individual. This is a classic commission of the fundamental attribution error (Kennedy, 2010; Ross, 1977). From a “color-blind” perspective, equitable teaching entails treating individuals without any regard for their racial identities, with the assumption that doing so is the fairest approach. This may even be taken to the extreme in that even the mention of race is viewed as racist (Pollock, 2004). The problem with such a view is that it denies the salience of race in the experience of students. As an analytical tool in the present study, it is crucial to identify when and how these claims of objectivity, color-blindness, and meritocracy influence individual cognition and sense-making about race.

While critical race theory has been used to understand a wide range of social and institutional practices and structures as described above, the contribution of this study is to apply the theoretical lens of critical race theory to individual cognition, specifically within the process of learning to teach. Critical race theory has the potential to illuminate teachers’ conceptual ecologies by addressing previously unconsidered influences on the various interconnected conceptions involved in learning to teach science in diverse classrooms. Doing so will help to better make sense of the nature of changes in teachers’ conceptions, as well as to explain the absence of change in other conceptions.
Study Design and Data Sources

Methodology and Selection of the Participants

This research was conducted as an instrumental case study (Stake, 2000, 2006), and its qualitative methodology is consistent with the approach taken by the Teacher Education and Learning to Teach (TELT) study (Kennedy, Ball, & McDiarmid, 1993; NCRTE, 1988, 1991), and the University of Wisconsin Educating Prospective Teachers of Biology study (Hewson, Tabachnick, Zeichner, & Lemberger, 1999). The present study sought to replicate aspects of these studies on a smaller scale with greater focus on the nature of changing conceptions about race and pedagogy within the disciplines of secondary school science.

In case study research, it is of primary importance to both define the case and identify its boundaries (Stake, 2000; Yin, 2006). The orientation of the present study towards changes in teacher thinking requires the unit of analysis to be the individual preservice teacher. In this study, participants’ experiences during their teacher preparation program and attendant changes in thinking regarding race and pedagogy comprise the clearest boundaries of each case. For the purposes of this study, we define conceptions about pedagogy broadly, and include any organizing conceptions related to pedagogical knowledge, pedagogical content knowledge (Shulman, 1987), content knowledge for teaching (Abell, 2007; Ball, Thames, & Phelps, 2008), and conceptions of teaching science (Hewson & Hewson, 1989). Though this study primarily examines changes in conceptions about race and pedagogy, overlapping conceptions about culture and the subject matter of science are included where appropriate in the analysis.

(insert Table 1 approximately here)
The participants in the present study are: Jethro, a prospective physics teacher, and Donna, a prospective biology teacher. Their cases were drawn from a larger study—described more fully in Larkin (2010, 2012a)—for which data was collected from 14 preservice secondary science teachers in four different university-based teacher preparation programs in a single Midwestern U.S. state for one year. The two cases here were selected for further analysis because they both appeared to illustrate different facets of understanding the concept of race and its implications for pedagogy. The participants come from two different university-based teacher education programs, and their demographic information is shown in Table 1.

Qualitative and quantitative data was collected over the course of a year and included at least two semi-structured interviews, three administrations of the Learning to Teach Science questionnaire (described below), and electronic copies of written coursework and lesson-planning materials (shared with the researchers via a USB drive). The first author conducted at least four naturalistic observations of each participant’s student teaching experiences, collected data on each teacher education program by examining program documents and syllabi, and interviewed methods course instructors and program directors using the TELT protocols. Data from cooperating teachers was limited to brief informal conversations and therefore not included in the analysis. We used state reporting data to describe student demographics at each of the teaching placements. Table 2 provides a summary of each participant’s experiences and a timeline of the data sources. In the following section, we detail each of the tools used for collecting this data.
Development of the Knowledge in Science Teaching Protocols

Given that the view of cognition used in this study invokes the model of a conceptual ecology, it was necessary to use instruments that had the potential to illuminate changes in the relevant parts of individuals’ conceptual ecology over time. In investigating how conceptions about race and pedagogy change while learning to teach, it is also necessary to probe other closely related conceptions in order to make sense of the nature of such changes. The central research questions of this study examine the space where conceptions about race, teaching, and science overlap. In order to make sense of this space, participants’ conceptions about each of these areas separately must also be probed over time in order to build up a clear picture of longitudinal conceptual change. Therefore it was crucial that the instruments had the potential to identify the presence of commonly held conceptions about teaching, about teaching topics in a particular science discipline, and about race. The instrument would also need to be able to determine the relative strength with which such conceptions were held by various preservice teachers.

Given persistent calls for teacher education researchers to begin using common instruments and build upon one another’s work (Darling-Hammond, 2006; Windschitl, 2005; Zeichner, 2005, 2006), a number of the instruments from the TELT study were adapted for use in this study including the demographic survey, questionnaire, participant interview, and classroom observation protocol (Kennedy et al., 1993; NCRTE, 1991). The TELT study was focused particularly on learning to teach elementary and secondary writing and mathematics, therefore all subject-specific items within the tools were revised to focus solely on learning to teach secondary science. These revisions are discussed below and the main interview tools used in this study are available in Appendix A. One salient difference in the survey used for this study as
compared with the original TELT survey is that that the question that sought the racial/ethnic identification of the participant was removed, and instead of simply asking participants to self-identify their race and ethnicity, they were first presented with the race and ethnicity identification questions from the 2000 Census, and asked what they think about when they see such questions. Then they were asked what they do when presented with such a question. In this way, not only was the self-identification information obtained, but information about individuals’ thinking about race and racial categories was also collected.

**Questionnaire.** A modified questionnaire with science-specific questions was created for this research study, with four sections that mirrored the original TELT questionnaire: (a) The Teaching and Learning of Science, (b) School Students, and Society, (c) Teaching and Learning in General, and (d) Teaching as a Career. The last three sections of the questionnaire were used without any modifications, but the section on the teaching and learning of science was heavily altered in terms of science content, though the overall intent of the section to map teacher thinking across a wide range of topics was maintained.

**Classroom observation protocol.** The protocol was used as written for the TELT study, however given logistical constraints and the prevalence of electronic communication, many of the pre-conference meetings were simply brief email exchanges. After each observation of teaching practice, this protocol was summarized into observation summaries, and analytic notes were included as part of this process. The observation summaries were the documents subject to further data analysis in the coding process.

**Preservice teacher interview.** Subject-specific protocols were created to follow the general teaching protocol administered to all participants; the biology and physics versions will be discussed below. With the exception of the baseline questions that probed personal history
and recent experiences in student teaching, most of the questions presented the participants with
a particular teaching scenario and asked them to describe their thinking, as well as how they
might proceed in each case. Like the questionnaire above, some of the interview prompts were
drawn directly from the TELT interview protocol, while others were modified to either probe
more deeply into participants’ conceptions about the pedagogical implications of race, teaching
their particular subject, or both.

**Part A: General teaching.** As in the original TELT interview protocol, the initial
questions serve to acquaint the interviewer with the participant and gain some sense of her/his
personal experiences in learning science as well as the rationale to become a teacher. The section
on the views and nature of subject matter were adapted by replacing “mathematics” or “writing”
with “science.” The questions on the organization of the curriculum were used verbatim, as were
the question probing a response to student diversity in terms of gender and a situation that
involves marginalization and possible stereotyping of a group of Native American students. It is
worth referring to the original TELT study rationale for the inclusion of this question:

Question A17 was designed to help us learn interviewees' views about majority
and minority groups of students. We presented them with a relatively common
situation in schools, one in which one group has become segregated and
marginalized, through no apparent action on the teacher's part. Interviewees'
responses to this scenario indicate both how they view their responsibility for
dealing with such situations and how they interpret the situation itself. (Kennedy
et al., 1993, p. 32)

The final two questions were designed to probe participants’ conceptions about the pedagogical
implications of race, and are derived from real events in classrooms observed by the first author.
The original TELT question that probed for these conceptions featured an elementary classroom situation that would likely be unfamiliar to secondary teachers in this study, and was replaced with two questions that probed participants’ process of making sense of a classroom situation where the teacher appears to be engaging in a differential treatment of students, and where the race of the teacher and the student is a potential factor. At the end of the second scenario, participants are asked to consider how they might react if a supervisor raised such an issue about their own teaching. Both of these interview prompts are designed to illuminate the conceptions under consideration in each participant’s conceptual ecology.

**Part B: Subject-specific protocols.** For this study, subject-specific protocols were developed for physics and biology, and each consisted of two main parts combined into a single instrument. The first part of the protocol consisted of the Conceptions of Teaching Science interview protocols for biology (Hewson, Tabachnick, Zeichner, Blomker et al., 1999), and physics (Hewson, personal communication, 22 October, 2007). These protocols consist of 10 statements, each of which is read to the respondent, who is then asked to describe why the scenario represents, or does not represent, an instance of science teaching. Data gathered from this part of the interview helped to establish the participants overall conception of teaching and its relationship to students and the act of learning, and subsequent administrations aided in mapping changes in these conceptions.

The second part of the subject-specific protocols followed the template established by the TELT study, in which a particular teaching task was used to situate teacher thinking within the content of the discipline. The data collected from these protocols helped to give shape to the conceptual ecology of each participant. Each of the interview prompts follows the same design of presenting participants with a scenario in which they must describe both their thinking as well
as how they might proceed with students. Teaching tasks were situated in the context of biology 
and physics (see Table 3). While some of the original TELT categories were discarded in order 
to keep the interview length manageable, one category “Responding to the presence of race 
within the science subject matter” was added in order to probe more deeply the conceptions held 
by participants regarding the intersection of race, teaching, and science subject matter.

The questions in this latter category—honied through a series of pilot study interviews—
are at the core of the present study. Over time, we began to think of these questions as the 
“floodlight” questions because of the way in which they appeared to illuminate, albeit briefly, 
each participants’ conceptual ecology at once, at least in the areas under consideration in this study. Each of the questions is carefully designed to ensure that the concept of race is given 
salience in the subject matter of secondary school science, and therefore cannot be dismissed as 
irrelevant. All of the prompts also include a follow-up question asking if the racial or ethnic 
composition of the class would influence their actions in the situation. It is worthwhile to discuss 
the biology and physics questions in detail here, and the full biology and physics protocols are 
available in the Appendix.

(insert Figure 1 approximately here)

*Biology*: Given that conceptions about race often have a biological basis, this part of the protocol begins by asking participants to examine some pages from a widely-used high school biology textbook (Biggs et al., 2000). One page uses an unsourced graph to demonstrate the fact that human skin color is determined by multiple genes (as shown in Figure 1). The graph is questionably constructed, because the categorical labels on the x-axis, “Classes of skin color,”
offer a veneer of scientific authenticity without any empirical backing. After prompting the participant to respond to student questions about the graph, the participant is then asked, “Suppose a student asked during this discussion how genes for skin color are related to other genes. How might you respond?” In answering this prompt, participants’ conceptions about genetics are proximal to conceptions about skin color and the biological indicators of the social classification of race. For participants who foregrounded notions of “colorblindness” in their conceptions about the pedagogical implications of race, this question was particularly difficult.

The follow-up question asks how the racial and ethnic composition of the class might influence their response, further situating race and biology within the context of their students.

(insert Figure 2 approximately here)

*Physics:* As in the biology “floodlight” question above, the physics version (shown in Figure 2) involves a situation that forces the participant to reckon with the concept of race in the context of the subject matter. The scenario asks participants to imagine that they are teaching a lesson on static electricity, and during a demonstration of a Van de Graaff generator, a student asks, “This works better on White people’s hair, right?” One aspect of this question simply seeks to discover whether the participant would avoid answering. While such a question may be at the limits of a physics teachers’ knowledge, observing how respondents address the role of race within the context of a physics question is instructive. For participants who attempt to dismiss the salience of race, this question probes whether or not doing so gets in the way of the physics. One possible response is that the question could be addressed somehow by using it as an opportunity for inquiry. Probing how one might structure such an activity—particularly if there
were few students of color in the class—serves to sketch participants’ consideration of their students socio-emotional needs, in addition to their ideas about the nature of inquiry; all illuminate the connections between various components of participants’ conceptual ecologies.

In this question, we might appear to be reducing the concept of race to biological characteristics presumably shared by all members of a racialized group; unintentionally reproducing the notion that races have distinct biological traits. Our intent is to provide a question about physics content in which the issue of race cannot be avoided. We seek to uncover the manner in which the teacher responds to this invocation of race as well as understand their rationale.

**Data Analysis**

The first stage of the data analysis was to identify participants’ conceptions at the start of the year in order to track those conceptions for evidence of change. The initial step in this process was to compare the quantitative data from the questionnaire and answers to the interview questions across multiple administrations of each instrument. The purpose of the questionnaire was to cast light on participant conceptions that had changed over the course of the study. It was not intended for statistical analysis, nor was the intent simply to make claims based upon the changes in answers to these questions. Once such conceptions were tentatively identified, evidence for the nature and significance of the change was sought in the other data sources.

The second stage of analysis was the organization of the multiple sources of data to facilitate coding, comparison, and the subsequent development and elucidation of themes. Each of the data sources, including transcriptions of interviews, field notes, and documents were imported electronically into NVIVO 9 qualitative analysis software, and initially coded according to the themes and sub-themes suggested by Hewson & Hewson (1989). The goal of
this coding was to be able to create a *conception statement* (Larkin, 2012b), which was a phrase or single sentence that represented a précis or “theme statement” of the conception as a whole in the mind of the person holding it (Hewson & Hewson, 1989; Hewson, Kerby, & Cook, 1995). In many ways this is similar to the construct of “naturalized axioms” used in Philip’s (2011) study, which he described as, “cognitive elements of commonsense that people use in their social sensemaking,” (p. 302). During the course of the data analysis it became clear that the *a priori* themes did not always appear to offer the best way to group the data, and so emergent themes were generated and identified with conception statements using a constant comparative analytical approach (Glaser & Strauss, 1967). Conception statements concerning similar topics were then examined to identify those that had changed during the study. Those ideas that remained unchanged by participants’ experiences were as important to the research as those that did change. Also salient were any justifications participants articulated for the plausibility or explanatory power of various conceptions about race that they held.

**Construction of the Cases**

Each case consists of an introductory section that describes the participant’s background and experiences in their teacher education program. Using the conception statements identified in the analysis, we then constructed a narrative detailing the set of conceptions each participant held about race at the beginning of the study. This is followed by a similar narrative concerning the participant’s initial conceptions about the pedagogical implications of race.

In the subsequent section, conception statements drawn from the longitudinal data are used to identify changes in conceptions about race, pedagogy, and the pedagogical implications of race. Each of the initial conceptions is tracked over time, and changes to these conceptions are identified and examined. Summaries of each participant’s changes are detailed in Tables 3, 4,
This section is followed by an analysis of the individual’s changed conceptual ecology through the lens of critical race theory. We examine the role of racial realism, Whiteness-as-property, and notions of legal neutrality, objectivity, color-blindness, and meritocracy as influences on teacher thinking and opportunities for conceptual change. These three aspects of critical race theory are discussed with respect to each individual within their respective cases.

Finally, each concludes with a short summary section that details the overall changes in each participant’s conceptual ecology, along with any influences on those changes identified in the critical race theory analysis.

Both participants read and commented on a draft of their own case, and verified its authenticity. Each was helpful in pointing out connections in his or her own thinking that had been overlooked or otherwise mischaracterized. As a result, we have increased confidence in the validity of the data and claims presented below.

The Case of Jethro

Jethro’s Background and Teacher Education Program Experience

Jethro, a self-identified White male in his early 50s, came to the teacher education program at Briggstown University after retiring from a long career in the information technology industry. It was a homecoming of sorts, because he had grown up in the area, and had graduated from Briggstown University in the 1970s with one of the school’s first degrees in computer science, and another in electrical engineering. His subsequent career took him to the southeastern United States, referred to here as “Mountain County,” where he lived and worked for the next thirty years. In Mountain County, Jethro had worked primarily with adults, and first encountered teaching while conducting technical workshops as part of his job, and again in later volunteer
work. Further involvement in organizing and coaching a youth bowling league had led him to consider teaching as a career. Retirement from his job, the end of a personal relationship, and a desire for a fresh start with meaningful work led him to return to his home town to become a teacher.

Returning to Briggstown from Mountain County held a number of challenges for Jethro, many of which influenced his experiences in the teacher education program. He needed to adjust to the major change from the corporate world to university life as well as the generational disconnectedness he felt as an older member of his cohort. One of the most direct consequences of returning to college for Jethro was that despite his engineering background, the experience of taking science courses was largely one of learning new content. He noted that the field of genetics had advanced tremendously in the 30 years since he had taken college-level biology, and in physics and chemistry courses he found himself with a newfound appreciation for the topics he thought he had previously mastered, as well as for the underlying mathematics.

Jethro’s practicum took place at Moshi Middle School of the Arts, a medium-sized magnet school located about a mile from the city center of Briggstown. Like the other Briggstown University students, Jethro participated in a daily practicum experience at Moshi Middle School for ten weeks during the fall of 2008. In this experience, Jethro had been partnered with three other practicum students to plan and teach lessons in a sixth-grade science class under the supervision of a cooperating teacher. Jethro’s practicum class contained little racial or ethnic diversity; all but one of his students were African American. Nearly 90% of the students in the school were identified as African American in state reporting documents.

Jethro’s start in the classroom that October was rough, and he used words such as “nightmare,” and “meltdown” to describe his first experiences in front of the sixth-graders. His
university supervisor’s observations, as well those conducted for this study, corroborated this view. Both Jethro and his university supervisor explained the issue as one of classroom control, exacerbated by Jethro’s tendency to speak louder and become visibly angry when students were talkative or off-task. Most of his spoken communication and actions during his practicum teaching focused on securing student compliance so that instruction could proceed.

In this placement, he reported feeling constrained by the curriculum as well as by the cooperating teacher’s insistence on sticking to particular procedures, particularly when he had ideas of his own about improving lessons. Over the course of the practicum semester, Jethro adopted a number of management strategies and suggestions from his university instructors and team members, and while he quite visibly grew more confident after his initial stumbles, he remained somewhat rigid in his expectations concerning student engagement with the subject matter. On the one hand, he was very accepting of the fact that students ought to talk with one another about the content. On the other, he frequently sought the attention of the whole class in order to continue transmitting the content of the lesson. These contradictory messages sometimes led to conflict with students.

He also appeared to hold very low expectations of his African American middle school students’ abilities. Once, in a practicum group planning session in which he and his teammates were designing a quiz, Jethro commented “Multiple choice tests are difficult for kids at this level.” His colleague, the sole member of the SAMTEP cohort who did not identify racially as White, responded forcefully, “I think you think these kids are handicapped!” (Observation, 5 November 2008). Other members of the cohort reinforced Jethro’s views of his students’ abilities, however, and as a result, the tasks he presented to students were often not very demanding.
The following spring, Jethro was placed in a physics classroom at Briggstown Language Academy, a public magnet school specializing in world languages and housing both middle and high school students. Jethro assumed responsibility for four physics classes at the start of the semester. His cooperating teacher, Mr. Wilson, retained a single ninth-grade physical science class in order to ensure Jethro’s workload was not overwhelming. According to state data, the demographic profile by race of the school population during Jethro’s time was 52% Black, 31% White, 10% Hispanic, 7% Asian and less than 1% Native American. Nearly 54% of students were eligible for free or reduced lunch.

**Jethro’s Initial Conceptions Regarding Race**

In conversations over the thirteen months of his participation in the study, Jethro rarely referred to race, ethnicity, or culture unless explicitly asked. More commonly, when discussing the salience of diversity in the classroom, he would use the word “heritage,” and occasionally the word “background” as proxy labels for race, ethnicity and culture. He expressed a desire for demographic questions, such as those on applications or the census, to give him an opportunity to claim his eastern European heritage. He would however, always answer “White” with the justification, “As far as heritage, you know what they’re getting at,” (Jethro interview, 6 June 2008). He recognized that the major problems associated with racism had not been solved, but often used language that tended to downplay the salience of race in a given situation, a practice not uncommon in U.S. schools (Pollock, 2004). In fact, he seemed hesitant to assign race itself any importance at all, often seeking other variables beside race to explain disparate treatment or bias in situations both hypothetical and real.

His comments about his thirty-year residence in Mountain County are instructive on this point. In the 1980s, Mountain County had attracted national attention when two White
supremacist groups clashed with civil rights demonstrators in a series of protests that eventually led to a First Amendment case in the U.S. Supreme Court. Jethro compared living in Mountain County during this time to growing up in Briggstown during the late 1960s, when racial tensions over segregated housing policies escalated, and the National Guard was mobilized in an attempt to avert the urban unrest flaring across the nation:

The community that I lived in, when I moved there, there was not an African American in the community at all. None. I lived in [Mountain] County; it made the news and it was ugly. Very ugly. The African Americans would bus themselves into the county and hold demonstrations and so on, and this was like the KKK headquarters in the state. If you wanted to go into town just to sit on the sidelines for the excitement, power to you. But that was ugly. It was just like when I grew up here in the 60s. I didn't know enough about it when I was in the 60s, and in the 80s I was a mature adult, I didn't think much of what was going on, why should people be treated like that? I thought, man, just, no way. (Jethro interview, 6 June 2008)

This passage, as well as others from the interview data, offered evidence that Jethro associated race with notions of conflict, and made distinctions between race and the concept of heritage, which he perceived as more benign. In interviews with Jethro, he found the existence of contemporary systemic discrimination to be rather implausible. In reading this account, Jethro confirmed that this had indeed been his perspective.

**Jethro’s Initial Conceptions Regarding the Pedagogical Implications of Race**

Like many preservice teachers, Jethro expressed a preference for seeing all students as individuals, and resisted categorizing students by racial or ethnic group membership (Paine,
1990), though he occasionally did so. For example, during our initial interview Jethro said, “From the student groups I've worked with, I don't see many minority students who are interested in science, interested in math, and taking the advanced classes that get them into the college placement programs,” (Jethro interview, 6 June 2008). Describing the characteristics of a particular group was not problematic for Jethro, as long as the description was based on his own experiences. Consequently, he ascribed minority student placement in math and science courses to the motivations of individual students, rather than appeal to institutional or systemic explanations (Gamoran, 1992; Oakes, 2005).

More broadly, Jethro felt that issues of diversity had little salience in teaching physics. When first presented with a hypothetical scenario involving a Van de Graaff generator in which a student asks, “This only works on White people’s hair, right?” Jethro erupted with laughter. He responded that he was unprepared for such a question, and viewed it representative of a “bizarre” student misconception. Jethro stated, “Hair is hair,” though he admitted that it was possible that hair products or styles could conceivably influence the effect of electrostatic charges on hair. “Why would my hair be any different from anybody else's hair?” he said. “I'd have to do a few questions and explore why they have a feeling why race has anything to do with hair and conducting electricity.” (Jethro interview, 6 June 2008). This statement represents an insight into the distance within Jethro’s conceptual ecology between conceptions about race and conceptions about pedagogy. Rather than viewing the question as something that connects the student’s life experiences and prior ideas to the physics content at hand, his interpretation is that the question is somewhat absurd—though he does express a willingness to probe further into the nature of the question. It must also be stated that Jethro did not grasp the importance of the ways in which hair has been a marker for race and racialized experiences in the history of the United States (e.g.
Rosette & Dumas, 2007). For Jethro, at least in this early point of his teacher education program, race was about the past, implied a potential for conflict, and had little salience in physics.

Changes in Jethro’s Conceptions about Race and the Pedagogical Implications of Race

Overall, there was little evidence for large-scale changes in Jethro’s organizing conceptions about race or the pedagogical implications of race throughout his teacher education program. Yet, there exists some evidence for smaller changes in these conceptions (see Table 3). These include an emerging acceptability of categorical thinking about race, a more conditional view on race as a marker for conflict, and recognition of a minor role for the relevance of race in the physics classroom.

The emerging acceptability of categorical thinking. Jethro began to generalize about groups of students categorically in ways that had not been previously evident, and it appeared that the idea that certain groups of students might share similar characteristics or behaviors was becoming more plausible to him. In the following example, Jethro deployed culture as a concept to explain the behavior of his Hmong students in class, before retreating to the more familiar idea of heritage:

I think that as a rule, kids now are much more social than kids in the past were, and boys and girls talk equally as much. I don’t think that’s something that’s differentiated by sexes. Might be by race, possibly. Might be by culture. (Interviewer: In what way?) I’ve got a few Hmong in my class, and they rarely speak out in class, they rarely talk in class. So if I had for instance, a classroom full of a particular culture, it might be more so or not so more so, but that would have to do with the heritage more than anything else. (Jethro Interview, 7 June 2009)
After he noted in the same interview that groups of students tended to form “by heritage,” he was asked if these groupings had any impact on student learning. He responded, “It’s especially so among the Hmong kids….They don’t tend to socialize with all the other kids in the school. They tend to be very much alone, kind of like isolated little islands.”

His earlier observation about the limited placement of minority students in math and science courses was based on the perception that choices to enroll in such courses were primarily individualistic. Yet there was evidence that even if he still held onto this idea, he had begun to recognize systemic factors that influenced students’ ability to be successful in such courses. In a written response to a clip from the movie “Freedom Writers” viewed for his Change Strategies in Urban Education class, Jethro wrote “I wonder how many standards could be covered in a science or math classroom while trying to deal with the extremes of this urban classroom,” (written reflection, April 7, 2009). While no new conceptions about math and science enrollment emerged to replace his earlier one, this response suggests that his earlier individualistic conception had become a little less plausible.

The association of race with conflict. In many ways, the idea of race was still associated with conflict for Jethro. He stated that he saw the diversity of his school as a “very positive thing,” yet he was still on the lookout for trouble when students appeared to cross racial boundaries—particularly among student groups. In talking about students grouped by “heritage,” he said, “Yeah, there are individuals that cross, and those are things you have to watch in class,” (Jethro interview, 7 June 2009). The only change in this conception that can be noted is that it appears that race was less a marker for conflict in the classroom than he had anticipated.

Attending to race pedagogically means exploring heritage instead of doing physics. From a pedagogical perspective, Jethro also saw the increasing value of tapping into student
interests as a way to get students engaged in science. The trouble for Jethro was recognizing those interests in the first place, and the markers of generational and geographical differences he identified made much more sense to him than any based on race, culture, class, or language. While Jethro’s conceptions of race and ethnicity remained under his umbrella of “heritage,” the idea of culture, and what this meant for the classroom, proved to be more challenging for him to understand. He indicated that he felt that learning the cultures of his students was important, but what this meant exactly remained uncertain to him, and in his reading responses to articles on the topic, he yearned for tangible examples of ideas he could put into practice. “We’re left to invent these things from scratch...” he lamented in one response (Jethro reading response, 26 April 2009).

In both his practicum and student teaching placements, it appeared as if student diversity held little relevance for Jethro. In talking about what he learned as a result of his middle school experience, he ascribed his difficulties to his students’ age level, rather than making any reference to possible cultural differences. Drawing upon students’ culture for curriculum or pedagogy, or as a resource for understanding and solving classroom problems was something he had not been prepared to do.

For example, in his Change Strategies in Urban Education class, Jethro was assigned an article called “Enhancing the science interest of African American students using cultural inclusion,” (Key, 2003) that explicitly defined and explored Banks’ (1995) concepts of content integration and equity pedagogy in the context of teaching science. In a written reaction to the article, Jethro saw content integration from both an individual and historical perspective. Though he perceived value in, as he put it, “rewriting science topics statements to include scientists with specific heritages,” he concluded:
In my opinion this is not practical. I can and do include heritages with long histories in science achievement. In physics, very little time is spent dealing with modern physics and it’s usually left as the last unit to be covered, in case there is little time left. There are a few scientists of African American and Hispanic heritage in modern physics and these can be highlighted. This means teaching content out of order….As I completed this reading I couldn’t help but think how impractical this is in the field that I teach. (Reading response, Jethro, 26 April 2009)

**Awareness of an authentic role for race in physics teaching.** During the second interview, between his practicum and student teaching, Jethro had laughed again at the Van de Graaff scenario, and was even more emphatic about the irrelevance of students’ race and ethnicity to the physics demonstration:

(Laughter). I remember I had the same reaction! Why? Why would you think it would perform differently on anybody’s hair except possibly if there was some coating on the hair? So my question would have to be, what would lead you to believe there’s a difference? (Jethro interview, 14 January 2009)

Prodded further, and asked how he would respond if the student said, “C’mon, White people’s hair and Black people’s hair are different, right?” He responded:

And I would say, from a biological standpoint, I don’t believe they are. The color may be a little different, they may be a little thicker, they may be a little thinner. But they have the same types of materials in them, and again, I go back to the
same thing. If you use a hair product on your hair, that may make a difference, but that’s got nothing to do with race. (Jethro interview, 14 January 2009)

What is interesting about this is that Jethro appears to have greater confidence in his knowledge of physiology than his teaching or his personal history would support. In our first interview he had reported that much of the content had been new to him in the introductory biology courses he had just completed. Jethro’s insistence that the irrelevance of race to this demonstration appeared to be driven not by his knowledge of the underlying science, but by his desire that race should not matter. Nonetheless, he recognized that such a question about the role of race in the Van de Graaff physics demonstration might provide an opportunity to study something of interest to the students:

We could spend some time exploring some of that. Give me an opportunity to do that multicultural thing, as far as the classroom goes. I’d have to make a sidetrack on it, but that doesn’t bother me any. If we have an opportunity to learn a little bit more about backgrounds, our heritage, why not? (Jethro interview, 14 January 2009)

While he did not necessarily view such an opportunity as relevant to physics or having inherent value, he did view it as a way to motivate students and encourage their participation in the class. He could also “do that multicultural thing,” which to him represented an externally required imposition on his classroom time. When asked what concerns he might have in taking this approach, he stated, “I just have to make sure that we stay focused and there’s no slurs that are thrown around the classroom.” This notion of student diversity as primarily a source of conflict was still evident in his student teaching at Briggstown Language Academy.
In an interview at the end of his program, Jethro described his school’s diversity as benefiting himself as a teacher. He noted, “My class was so diverse, I got to experience a little bit of everything” (Jethro interview, 7 June 2009). These benefits of diversity apparently extended to the students themselves, as was evident when Jethro used his cooperating teacher’s Van de Graaff generator during a lesson on electrostatics. Appreciating the irony, he reported that the question he had found so funny in the previous interviews had actually been posed to him by a student during this demonstration:

‘Will it affect my hair differently than your hair?’ was the way it came up. I said well let’s look and see how it affects my hair first. So you guys can see. So you’re going to come up and volunteer right? Yeah no problem, okay we can do that. Now we need some other comparisons. Well our hair is both short. Mine is gray yours is not. What’s the difference? I use nothing on my hair, you probably use something else…Well, I had plenty of girls with long hair, so I could go with that. But I had, this class was so mixed, I had Hmong in the class, I had Spanish heritage, I have African American heritage, I had a lot to choose from. But all the boys predominantly had short hair …I had one boy with medium length hair, and fortunately he volunteered. (Jethro interview, 7 June 2009)

While this conversation held no discomfort for Jethro, as it might have for others, the question of the role of race as a factor in the demonstration was quickly subsumed into a long list of other potential influences. Yet, for the first time, he was aware of race and ethnicity affecting his teaching in the present, not in the past, as his conception of heritage would have demanded.
Furthermore, even though the salience of race was downplayed, it was not denied, and remained a variable connected unambiguously to the physics content of his lesson.

**Jethro’s Case Through a Critical Race Theory Lens**

**Racial realism.** As noted above, critical race theory seeks to uncover the hidden mechanisms of racism, and presses for descriptions of the ways that racism is presented as normal or natural in society. For Jethro, racism appeared as natural in two different ways: race as a marker for conflict, and in individualistic explanations for systemic and institutional racism. Both of these resulted from Jethro’s historical framing of race and racism as artifacts of the past with little contemporary explanatory value beyond their occasional and anomalous reemergence.

**Race as a marker for conflict.** Jethro’s conceptions about the role of race in modern society were often framed in terms of conflict. He viewed the protests he encountered in both the northern and the southern United States as being marked by the presence of race-based conflict, and over time he came to see the mere mention of race as an indicator of potential conflict. Even though race ostensibly played little role in his conceptions of pedagogy, Jethro noticed the tendency of his students to form groups that were racially or ethnically homogenous and was wary that “mixing groups” could lead to conflict. Over time, this mixing became less of a concern for him, but it remained natural for him to continue to view any non-homogenous group as potentially unstable. As a result, the idea of connecting race and pedagogy seemed mostly implausible for him because doing so would be an act of introducing unnecessary conflict into his teaching. Framed historically, as in the study of the “heritage” of scientists, this sense of conflict did not exist, but also seemed far-removed from science teaching for him.

**Individualistic explanations for systemic and institutional racism.** For Jethro, contemporary systemic and institutional racism above the level of individual discrimination did
not exist, even as his daily experience might have told him otherwise. Jethro voiced optimism that segregation was less of an issue in Briggstown—the location of his university and his school fieldwork sites—than it had been in Mountain County. In fact, Briggstown has regularly been named one of the most residentially segregated metropolitan areas in the nation (Iceland, Weinberg, Steinmetz, & United States Bureau of the Census, 2002; U.S. Census Bureau, 2012). The racial composition of his middle school classes was often homogenously Black, in a magnet school with a population who identified as nearly 90% African American and 7% White. Instead, Jethro continued to view residential and schooling segregation patterns as either the result of self-selection or randomness. Similarly, Jethro viewed minority student participation in advanced and college placement math and science classes as an issue of individual interest, rather than as an issue with roots in students’ access to social and cultural capital, as well as ongoing institutional and systematic marginalization of these students in schools as research suggests (e.g. Berliner, 2013; DeWitt et al., 2011). Therefore the “natural” explanation for Jethro for both racial segregation in schools and minority participation in advanced science were rooted in the idea of individual choice, a framework that denied the salience of race and racism in each situation.

**Racial realism and Jethro’s conceptual ecology.** Recalling the point that a person’s intellectual environment “favours the development of some concepts and inhibits the development of others” (Hewson, 1985, p. 165), these findings demonstrate that for Jethro to rethink his ideas about race, this naturalness of racism in his conceptual ecology would also need to be addressed. The first idea represents the idea of equity in education, which Jethro appeared to embrace fully, even as his understanding about race was mediated by his preferred conception of *heritage*. Another is his view of race as a marker for conflict. His unwillingness to view to
racism as a permanent feature of society forces him to interpret race itself as the source of racial conflict, as opposed to attributing it to the circumstances surrounding the operation of race in social settings. Finally, his notion of racism as individualistic remained strongly held for the same reasons, and so his ideas about race remained largely unchanged.

The operation of Whiteness-as-property. Harris (1993) describes the core characteristic of the concept of Whiteness-as-property as “the legal legitimation of expectations of power and control that enshrine the status quo as a neutral baseline, while masking the maintenance of white privilege and domination,” (p. 1715). From the perspective of critical race theory, analyzing Jethro’s changing conceptual ecology entails identifying the aspects of his thinking that demonstrate these expectations, which includes the right to use and enjoyment. Jethro appeared to claim most readily the privilege to be free from conflict, particularly when issues of race appeared to be at the source.

Jethro’s continuing stance on the inapplicability of race to teaching science represents a desire to enjoy the right of engaging in his work—which was teaching physics—without having to address race. Given his association of race with conflict (and his discomfort with that conflict) it seemed natural from Jethro’s perspective to pointedly avoid the discord he envisioned any racial conversation might produce. Even when the issue of race actually came up in his class from a student’s question about the possible effect of the Van de Graaff generator on her hair, he acknowledged the validity of the question, but then quickly moved away from any further discussion of race.

The operation of Whiteness-as-property and Jethro’s conceptual ecology. In many ways, the areas of Jethro’s conceptual ecology that touched upon pedagogy were strongly linked not just to his conception of teaching, but his ideas about work and education more generally.
For Jethro, classroom management fit into the same niche as being able to carry out the teaching tasks assigned to him, and it troubled him that there was an absence of the same clear directives in his teaching work that he had come to expect in the corporate world. Jethro’s overall stance toward learning in school is relevant as well, given his overarching conception of teaching as the controlled delivery of knowledge. Consequently, the work of teaching forced him to reckon with making choices about what to teach, how to teach, and who to teach that were fundamentally unfamiliar to him.

We argue here that Jethro’s own Whiteness positioned him over the course of his life to view the notion of “work”—and the profession of teaching more specifically—in narrow and instrumental ways. Though Jethro’s conceptions about teaching reflected a desire to make connections with students and aid them in acquiring information, there was little evidence in the data that Jethro saw his work as non-coercive. His ideas about teaching and learning mitigated the possibility of fostering internal motivation in his students, because in his view coercion was the way to get students to do their jobs. In Jethro’s conceptual ecology, the idea of what it means to do a job was often in tension with competing ideas about what it meant to teach physics to students with whom he did not share racial, cultural, or generational backgrounds. Similarly, Jethro’s ideas about the nature of education were more assimilationist than emancipatory, which ultimately limited the influence of incoming ideas from his teacher education program that had pedagogical implications for student diversity.

**Challenging claims of objectivity, color-blindness, and meritocracy.** Claims of objectivity, color-blindness, and meritocracy often serve as camouflage for the self-interest of dominant groups in American society (Ladson-Billings & Tate, 1995). Jethro clearly and repeatedly minimized the role of race in teaching, and his stance was consistent with the majority
of students in earlier studies of learning to teach (Paine, 1990), in that he much preferred to take an individualistic approach to student diversity.

**Objectivity, Color-blindness and Meritocracy.** Jethro’s belief in a meritocratic society was very much in evidence in his views about minority student participation in advanced science classes. To Jethro, individual motivation was the primary factor in student achievement, and it was this idea that drove the majority of his classroom management strategies. Color-blindness can be seen in his early exhortations about the irrelevance of race to the Van de Graaff demonstration. A race-conscious approach to this activity might have recognized that White students were more likely to have experienced seeing someone like themselves in a textbook and other public images of such a demonstration (Berit, 2013; Sleeter & Grant, 1991). Thus a question about the role of race in this demonstration would appear logical because it formed a substantial part of all students’ prior knowledge concerning this apparatus. Instead, Jethro’s contention that race should not matter overrode his otherwise logical thinking about scientific knowledge. Yet, it would be a stretch to claim that Jethro was actively discriminating against students of color, because he also had noticeable difficulty in thinking about the role of student prior knowledge generally.

**The role of objectivity, color-blindness and meritocracy in Jethro’s conceptual ecology.** In terms of Jethro’s conceptual ecology, one of the concepts most strongly impacting his learning was that of *heritage*, which consequently relegated *race* to an ancillary role in any explanations besides racism. Historically, the concept of heritage has been intertwined with capitalism, imperialism, the nation-state, blood lineage, property, land, and “high-culture” (Hall, 1999; Littler, 2004), but clearly Jethro ascribed a more objective meaning of historical groupings to the term, which stripped it of any sense of connoting power relations. His use of *heritage* was the
anchoring concept in his conceptual ecology for understanding human difference, likely reinforced by living as a White man in Mountain County for 30 years, and this made the likelihood including race as a component of his pedagogy very unlikely. Consequently—from the viewpoint of conceptual change theory—the concept of a pedagogy that was responsive to student diversity was barely intelligible to Jethro.

There was also little evidence for a place for the role of power relations as operating in school and society in Jethro’s conceptual ecology. This absence also led him to view the consequences of social differences in power—for example, academic tracking and segregated schools—as unproblematic. Such an outlook made it much more difficult for him to recognize structural inequity in schooling, even as he felt strongly about general principles of equality in his teaching.

**Summary of Jethro’s Case**

Jethro’s case represents an example of the tenacious grasp that prior conceptions about race and racism hold on an individual’s conceptual ecology. While Jethro did exhibit some minor changes in his ideas about the pedagogical implications of race, his earlier notions about race as a marker for conflict remained firmly in place, as did his notion of “heritage” as a historical proxy for race with very limited salience for physics teaching. As a result, he had no way to view race as part of the total life experiences that his students brought with them to class. Jethro’s conceptions about pedagogy remained very teacher-centered throughout his student-teaching experiences, and his view of physics teaching as the controlled delivery of information combined with problem-solving activities left very little space in his conceptual ecology for the role of student ideas—including those perceived through the lens of race—in learning.
At the same time it is also quite clear that in his teacher preparation program, Jethro did not learn about the pedagogical implications of race in a manner that was plausible to him. The only message he gleaned from these efforts was that addressing heritage in a physics class (something he perceived as peripheral to the subject matter) was permissible only because doing so satisfied certain prescribed goals of schooling. This case suggests that Jethro would have benefitted greatly from a more detailed study of the role of race, particularly in regard to systemic discrimination, which would challenge Jethro’s idea that individual histories have more explanatory power than race. Jethro sought to build relationships with his students because he felt this would increase student motivation to learn, and learning to mine these relationships for information about his students’ thinking would appear to be the most likely path forward for him to learn about the role of race, language, gender, culture, and age in influencing these ideas. In short, Jethro did not have the opportunity to learn what role race currently plays in student learning in schools, despite his student teaching placement in a school that was racially diverse. Instead he was driven by the idea that race does not—and should not—matter in learning, which allowed him to pay the concept of race very little attention at all.

It may be tempting (and even correct) to describe Jethro as holding deficit views about students (Delpit, 1995; Valencia, 1997), but the theoretical framework of this study takes a different stance toward such a judgment. Instead, we point out that—at least in Jethro’s mind—his conceptual ecology consists of models that have explanatory power for the phenomena he experiences, shaped by his social contexts and life history. Within Jethro’s conceptual ecology, race has very little explanatory power, particularly when held alongside his ideas about heritage, learning, work, power, and the purposes of education. Any attempt—even driven by Jethro
himself—to find a role for the pedagogical implications of race and student diversity, would need to reckon with these high-status elements within his conceptual ecology.

The Case of Donna

Donna’s Background and Teacher Education Program Experience

As a young girl living on a farm under the care of her grandparents, Donna grew up exploring barns and fields, tending gardens, and asking her grandmother to identify the edible mushrooms she would bring in from her wanderings. She recalled becoming interested in science in school when a fourth grade teacher obtained pig lungs from a butcher and blew them up with her own mouth. Throughout her parochial schooling in later grades she maintained a love of science, and did not believe her teachers when they told her that neither dinosaurs nor evolution were real.

Donna finished college in her early 20s with a degree in biology and a minor in art. She also had a young daughter, and found work after graduation with a biological supply company, raising *xenopus laevis* frogs for medical research. After three years in what she described as a “cold, windowless lab” she realized that the aspect of her job that she enjoyed the most was giving tours to occasional groups of visitors, and this led to the realization that she might find greater satisfaction as a biology teacher. She soon found employment as a substitute teacher in her local district, and subsequently enrolled in the post-baccalaureate teacher certification program at Central State College.

A conscientious student, Donna engaged fully in her two-year sequence of professional education coursework at Central State, though the professor who served as her methods instructor and field supervisor reported that there were times when Donna’s work as an advocate
for various agricultural issues—most prominently a backyard-chicken ordinance that Donna had championed through the local town council—served to distract her somewhat from her studies.ix

In the semester prior to student teaching, Donna had come to realize the importance of lesson planning and setting learning objectives for students, and had recognized the need for strengthening her content knowledge for teaching. In a reflection paper written for her methods of teaching science class, her primary goal for the coming semester was to create a healthy and safe environment for her students.

Donna’s student teaching placement was in an exurban community at a very large high school that served students from both agricultural and well-to-do backgrounds. There was also very little racial or ethnic diversity at the school; during the semester when Donna did her student teaching, state demographic data reported that 96% of the students identified as White. Her cooperating teacher, Mr. Edmund, was a well-regarded member of the science department with a reputation for weaving recent innovations in biotechnology and genetics into his curriculum. Over the course of the semester, Donna gradually took over teaching and planning for his four molecular biology classes, but he retained control of the single bioengineering class section.

From a managerial perspective, Donna was quite concerned with ensuring that her students were doing the things they were supposed to do, and she spent a great deal of time and effort trying to solve issues of student behavior that she identified as problematic. She wrote weekly progress reports to her university supervisor that included regular mention of her battle to enforce the school’s policy of no cell phone use (i.e., texting) in class. Finding ways to motivate students to complete homework was similarly a struggle.
From all accounts, including the observation data, Donna was quite comfortable in the classroom from the beginning, and apparently had little difficulty with classroom management, despite the predominance of these issues in her written work. In fact, much about her student teaching semester could be characterized as relatively straightforward and without conflict. While such an outcome may seem desirable, it also appeared that she was not pushed very hard by either her cooperating teacher or her university supervisor in rethinking some of the habits and assumptions she had developed as a substitute teacher. For example, during one observation that the first author conducted concurrent with an observation visit from Donna’s university supervisor, the lesson ended with nearly 20 minutes remaining in a 55-minute period. Having completed her plan for the day, Donna was content to let the students sit and talk for the remainder of the period. No mention of this questionable usage of time was made by either the cooperating teacher or the supervisor in the post-observation discussions after class.

**Donna’s Initial Conceptions Regarding Race**

Regarding Donna’s family history, she had one biological parent who was Filipino and another who she identified as German. When she was nine years old, she and her sister were adopted by a family with a different background. “My adopted mom is Caucasian and my adopted dad is Hispanic,” she explained. She noted that not only did she receive a Hispanic surname at that time, but “when we were adopted he changed my social security number to being Hispanic.” She recounted how her adopted father attempted to raise her with an understanding of Spanish language and Hispanic culture, but summed up the experience this way: “…I was nine, it’s kind of a hard time to instill a Hispanic background.” In describing her experiences with race as a child in the rural Midwest, she said:
We were the only brown kids in school growing up, my sister and I, and we were well-liked. And there were two little Indian girls that were adopted and then there were four of us so, and we were welcomed. We didn’t see racism in school; I saw it more in church, ironically. In high school, there were a couple of Hispanic kids, and there was one African American girl, but none of us were singled out, or I didn’t feel there was racism. (Donna interview, 8 December 2008)

When shown the U.S. Census question on racial and ethnic identification and asked to comment on what she thinks about when she sees it, she recoiled visibly. “I hate this question,” she said. “I always hit other, because I consider myself American, and I’m kind of a girl without a race. I don’t identify with anything, but I like Asian food, German food, Hispanic food. I love everything so I’m very open,” (Donna interview, 8 December 2008).

For Donna, the concept of race had very little explanatory power, except perhaps as a marker for the precipitation of racism in certain situations. She discussed her common experience of being labeled racially, typically incorrectly:

…people are looking at me and, “bam you’re Hispanic. You’re brown-eyed, brown hair, that’s what you are, you know Spanish, a little Spanish.” It’s like, no…Filipinos know I’m Filipino. Caucasians generally think I’m Hispanic. I’ve actually had some African Americans think I’m half African American. (Donna interview, 8 December 2008)

The mention or raising of race at any time was a source of frustration for her, because of the way it usually meant having to address the racist behavior and microaggressions of others, and the experiences she reported are similar to those reported by Filipino Americans in the literature
Obscuring her own background became part of her strategy early on as a substitute teacher to avoid this conflict:

> When I was single—I’m married now—my name was [Hernandez]. And so I started off subbing and I’d have kids go “Oh Ms. [Hernandez]!” and they’d do some racial stuff and I’d have to address it cause I can’t let them get away with it. I always felt like, I don’t want any stereotypes; I don’t want to encourage that. So I just started calling myself Miss H. And they’d ask what’s your name, and I’m like, it’s Miss H., it’s hard to say. Don’t worry about it. Now I’m Mrs. D. which is [Doughterty], which is Irish, but anyway, so that’s how I dealt with it. I just had them adjust to Miss H. I never felt that they stereotyped me then. (Donna interview, 8 December 2008)

The use of descriptive race labels was generally unproblematic for her, but she gave these very little weight, stating that she felt that the U.S. Census question didn’t even need to be asked anymore. Nonetheless, she had little difficulty in using the terms Caucasian, African American, Hispanic, Native American, and Asian in discourse where such labels are common, but rarely initiated the use of such labels herself.

In summary, Donna’s felt that discussions concerning race were rarely necessary. In her view, it was necessary to address race talk when it caused problems, and it was completely appropriate to take preventative measures to mitigate any potential damage such talk could cause. In a broader sense however, the concept of race had little value to Donna, even as she maintained a certain vigilance to its presence. From her perspective, this might take the form of acknowledging the scientific contributions of individuals from various racial or ethnic groups, or
being candid about the use of race labels when discussing demographics. Race itself, however, had little to no explanatory power for her.

**Donna’s Initial Conceptions Regarding the Pedagogical Implications of Race**

One of the questions previously described from the interview protocol concerns a situation in which a group of Native American students sit together in a classroom, but do not raise their hands to answer questions or otherwise participate in class discussion. The scenario continues into the teachers’ lounge where one of the other teachers describes the Native Americans as naturally shy and that asking them questions embarrasses them. Respondents to this question are asked for their reaction to the teacher’s explanation, and what they would do about the Native American students in the class. Donna is quite forceful in her response:

> I’m sorry, my sister-in-law is Native American and she’s not shy at all, she’s very outspoken. I think that’s very stereotypical….They’re in their little group because they feel secure. I hate to break them up. But then I’d also want to integrate them to show how they can work with other kids too. I’d want them to participate verbally, but I’d want to be sensitive to them too, where I don’t what to insult them….If they are shy, it’s not because they’re Native American. I’d have to feel them out and figure out if they’re participating, if they’re not participating for a reason. But I would definitely not agree on not calling on them. I’d still want to call on them and encourage them to feel like part of the group. (Donna interview, 8 December 2008)

In this example, Donna is quick to point out what she feels is stereotyping, yet at the same time demonstrates a resistance to generalizing about students, thus rejecting any hypothesis in which the students’ identity as Native Americans might be part of a contextual explanation for not
raising hands or participating in group discussions. This resistance to generalizations disallows for the possibility of cultural patterns of communication being salient in this scenario. Haberman (1995) portrays such resistance to making categorical generalizations as problematic for teachers because of the way it keeps explanations for student behavior focused on individual factors, rather than those better characterized as cultural, institutional, or systemic.

Yet Donna also recognized that the identity of a teacher might be a source of pedagogical conflict. In another hypothetical scenario, respondents are asked to interpret a situation in which students of color are disengaged from a lesson taught by a White teacher. In providing details on possible explanations for the disengagement, Donna stated:

Well, he’s White. It’s a male White 30 year old, and…just experience. He’s young, maybe hasn’t been exposed to different, I don’t know…ethnic diversity maybe. Maybe he doesn’t know how to relate to them, or make connections that are meaningful to them between them and the content. (Donna interview, 8 December 2008)

In Donna’s view, student diversity has pedagogical implications for teachers, but they are somewhat vague and unspecified in nature. When asked how she might respond if a student asked how genes for skin color are related to other genes, she said:

I guess I’d have to brush up my background knowledge of genes. Aren’t they independent? Just because you have the gene for brown skin, doesn’t necessarily mean you’ll have the gene for something else. It’s a mix of what you get from your parents. (Donna interview, 8 December 2008)

Prodded on whether the racial or ethnic composition of the class would affect her answer to this question, she replied:
I want to say no. But I’m not sure. I definitely have to review my knowledge of genes. As a going-to-be-teacher, I just feel kind of…I know my weaknesses in certain areas…My biggest fear of my first year is being so textbook dependent just to help teach myself, re-teach myself concepts and things that I was fuzzy on or not so strong in. (Donna interview, December 2008)

For Donna, the pedagogical implications of race at the beginning of her student teaching were rooted in her own concern about understanding the content. Her response to a hypothetical student question concerning single-celled organisms as the origin of life on Earth is quite similar, in that she states that she is uncertain how to respond because of her content knowledge:

You’ve got to talk about evolution…I don’t know…I’d probably want to look on the Internet about what things define a living thing. Start with bacteria…. I’d definitely want to look into the textbook and see how they approach it. (Donna interview, December 2008)

In both of these instances, Donna’s ability to respond pedagogically is constrained by the limits of her biology knowledge. In other words, there is a connection in her conceptual ecology between her knowledge of biology and how she is able to represent that knowledge for students pedagogically.

**Changes in Donna’s Conceptions About Race and the Pedagogical Implications of Race**

There appeared to be little evidence for change in Donna’s understanding of the pedagogical implications of race during her field experiences, and if anything, the status of her central conceptions about race increased. Evidence of this is presented below, along with one exception when the racial and ethnic composition of her class appeared to exert an influence on the way she thought about her teaching.
Race talk has the potential to threaten students’ feelings of safety in the classroom. Donna remained very aware of stereotypes and racial slurs, and in her practice she sought to minimize race talk as much as possible. For example, during an activity in her biology class, one of the students examined a photocopied image of a chromosome and said, “This one is all black!” Another boy at this lab table turned to him and said, “All black, that sounds racist!” Donna, who was right there helping another student, looked at the boy who had said “racist” and said, “Christopher, please,” and gave him the icy stare of a master teacher. He replied, “What?” and then quickly returned to work. From Donna’s perspective, she had successfully shut down race talk in the classroom, and prevented the possibility of any racist behavior from emerging. Her preference to minimize generalizations about students remained intact as well. When presented with the Native American student scenario again, Donna said:

**Donna:** Oh this one. I’ve been thinking about this one [finishes reading the scenario].

**Interviewer:** What do you think of the teachers’ explanation of the Native American student’s behavior?

**Donna:** I think that’s a big generalization.

**Interviewer:** Is that bad?

**Donna:** Yeah.

**Interviewer:** How come?

**Donna:** It’s just saying all Native Americans are naturally shy. Maybe they’re just shy in that class because the dynamics are different. If you get them in a different classroom perhaps they’re chatterboxes. (Donna interview, December 2008)
As in the scenario above, most of her answers to the interview questions were very similar to her responses six months prior. In an effort to probe further, she was asked directly “How much does race matter in a science classroom, in terms of teaching…What effect does student diversity have on what teaching goes on?” Donna answered:

It shouldn’t. I mean, we should all be equal in the classroom, that’s my take.

We’re all equals in the classroom, and that’s why I want to create a safe environment. So it doesn’t matter, you’re brown, you’re white, you’re rich, you’re poor. In my classroom you’re all equal, and I don’t care what kind of iPod [you have] or car you drive. (Donna interview, December 2008)

To Donna, the racial identity of her students both mattered and didn’t matter. It mattered in the sense that racism from teachers or other students could be a barrier to learning. In her own teaching however, race did not matter because she had chosen to see her students as individuals. By the end of the semester, the primary connection that Donna had drawn between race and pedagogy was in the creation of a safe environment for her students.

**Race as unproblematic in a scientific context, but a salient factor in pedagogy.** At times, race labels were used as part of her course content, and there was little mention of race outside of such descriptors. In one instance, groups of students were researching hereditary diseases, one of which was sickle-cell anemia, and Donna had little difficulty in conveying the fact that African Americans were a higher risk group for this disease given the genetic link to malarial resistance that this particular genetic mutation confers.

There were other instances of her presenting the topic of race as straightforwardly unproblematic in the context of biology, yet there was also at least one time when an opportunity to raise valid scientific criticisms of the concept of race was overlooked. In April, she handed out
a packet of one-page readings about biology-related careers that also included a list of questions. A page titled *Forensic Anthropology* had a section titled: “What was the person’s race?” Underneath, it read, “Using variation in the shape of the eye sockets and the nose, forensic anthropologists can categorize people in one of three racial groups: Mongoloid (Asian), Negroid (African), and Caucasoid (European). In Negroids and Mongoloids, the ridge of the nose is often broad in relation to its height; in Caucasoids, it is narrower.” etc. There was a related question to this reading in the handout: “What two features can help distinguish race?” While Donna’s use of this handout may be explained by the fact she was simply working with her cooperating teacher’s curricular materials, its presence is a reminder that students continue to receive inaccurate information regarding the physiological basis for racial categorizations. She considered race, as presented in a scientific context, as unproblematic in and of itself. The only exception, as noted above, is when such topics might be appropriated by some students to create a threatening environment for others.

In contrast to her original view prior to student teaching, Donna found that the racial and ethnic composition of her class would influence her pedagogy. Participants in the study were asked to comment on how they would help students understand a figure from a commonly used high-school biology textbook, and this happened to be the textbook used by the district where Donna did her student teaching (see Figure 1). The transcript of Donna’s response to the graph, including the follow-up questions, is presented in full because of the manner in which this discussion captures her thinking about the influence of race on pedagogy at the conclusion of her student teaching, even in a school with limited diversity:

**Interviewer:** *Suppose a student is looking at this and asks what “observed distribution of skin color” means?*

*distribution of skin color” means?*
Donna: I would assume that that’s a population that they’ve taken… I don’t know how big a population. Of the world? Observed distribution of skin color. In a city? or… cause it doesn’t say. I’d assume it’s the world.

Interviewer: What if a student asked about the classes of skin color?

Donna: [Looks at figure again and chuckles slightly.] See, that’s why I think it’s confusing, I don’t know what the classes of skin color, is that like, okay you’ve got the… the extremes really, really, dark and really, really, light, and in the middle is… ranges of the in between. And the bell curve, and you’ve got less people on the ends and the large populations in the middle for skin color. So you got your really, really pale-skinned people living in like Sweden and Norway, Iceland, up there where they’re all really pale. And then you’ve got your really, really dark… but in general the population is in the middle, somewhere in between that.

Note that Donna does not question the nature or construction of categories based on skin color, but that she comes up with a seemingly reasonable explanation for what the graph might mean. Her response to this part of the question is very similar to others in which she attempted to answer a question at the limits of her scientific knowledge. The tentativeness on display in this response can be contrasted with the near certainty with which she answers the subsequent interview question:

Interviewer: Do you think the racial or ethnic composition of your class would affect your answer?

Donna: Yeah, there’s one class where I have one African American girl, and she’s dark, dark, dark. And then I have Maggie who’s Irish and as white as you
can get, and yeah I wouldn’t want to be like, “It’s like Maggie and Kezia and then everybody else is in between.” I would definitely not want to say that because I don’t want to make them feel bad.

**Interviewer:** Why would that make them feel bad?

**Donna:** Because they already pick on Kezia, for being so dark and being adopted and being African American, and for having her hair done the way that it is, and they always ask her questions like, “Kezia, do you burn? Do you peel?” And I’m like, “Maggie, do you burn? Do you? She’s got skin right? She still can burn,” and I explained radiation, “And you’re killing skin cells, and she’s still human. Please treat her like one.” So that’s a class where I’d be afraid to do that with. But otherwise, I don’t know, I guess my classes weren’t that diverse. So yeah, I guess it would affect it.

**Interviewer:** So what would you do then? You said you wouldn’t pull kids out as examples…

**Donna:** I wouldn’t. Right, no. I would just say, you know, people of really, really pale skin and people of really, really dark pigmented skin…

**Interviewer:** But you know if you have a classroom full of ninth graders, somebody’s going to say, “Like Maggie, like Kezia!”

**Donna:** Yeah, I’d be like, yeah, she’s got dark, pigment she’s got a lot of melanin in her skin.

**Interviewer:** What do you think about that? Is that dangerous territory?

**Donna:** It kind of is, yeah. It’s kind of like treading on eggshells. It’s kind of like, well, yes and no, you have to be aware of it…I wouldn’t go too in-depth with it. I
would say, let’s just move on. Basically it’s a bell curve, you’ve got your extremes and you’ve got your general population that’s in the middle. I then move on.

**Interviewer:** What if you had a much more heterogeneous class? In terms of pulling people for examples, would you still do that?

**Donna:** I think I would be more inclined because then you’re not singling out one person. Say you had a third of the class African American, well then you could say, darker skin like so and so. And then, cause they still have a group of kids they associate with then, that are dark skinned. Versus the one and only black kid in the class. (Donna interview, May 2009)

As seen in the above example, one of Donna’s primary concerns remained that of establishing a safe environment for learning, and she was quick to recognize when discussions around topics in biology might threaten the socioemotional welfare of her students. The discussion of skin color as a topic in biology was in itself unproblematic, and the mention of race in such a lesson only had pedagogical implications for students when the students themselves were taken as examples of the content. Yet she also felt that a critical mass of students of color was needed in order to maintain a safe classroom environment for students in such a discussion, and that doing so would make it less likely for students to “feel bad” as a result.

This response is a change from her earlier answer to the same question of whether the racial or ethnic composition of her class would affect her answer, in which she simply stated, “I want to say no. But I’m not sure.” Clearly the experience of having a dark-skinned student in class and witnessing her experiences with race talk influenced Donna’s thinking about how the presentation of particular science content might be experienced by her students. Yet, by the end
of her student teaching, Donna still conceived of the pedagogical implications of race in
individual terms, saw anti-racist teaching solely in terms of shutting down individual race-talk
and the creation of a comfortable learning environment, and was still limited in terms of her
biology content knowledge in forcefully being able to address student misconceptions about skin
color.

**Donna’s Case Through a Critical Race Theory Lens**

**Racial realism.** There can be little doubt of Donna’s awareness of the existence and
relative permanence of racism in U.S. society. Her conceptions about race and the nature of
racism were shaped by her personal history that included a shift in familial ethnic identity, a
childhood in a semi-rural environment where she and her sister were among the few people of
color, and of course her own experiences with being stereotyped. Even so, Donna’s reliance on
individual explanations for systemic and institutional racism continued to render racism as
natural to her during her teacher education program.

Donna did not hold systemic explanations of racism as credible, but in her life had ample
evidence that racism still flourished. In all of the interview scenarios where teachers’ racism was
a possible explanation for their behavior, Donna ascribed “negative conceptions about race” to
the individual, and never to the influences of culture, institution, or wider society. In many ways,
Donna represented the individualistic orientation to student diversity described by Paine (1990),
and her use of her students Kezia and Maggie as examples reflects Paine’s finding that teachers
with this orientation “tend to consider diversity as something affecting individual students,” (p.
9). Donna was not yet at a point where she could describe the impact of racist behavior in a
classroom as impacting all of the students in a class through the reinforcement of practices and
patterns of systemic racism. Donna’s approach to any possible instance of individual racism was
to simply shut it down. Given her view of racism as an issue located within individuals, she viewed any mention of race—when not apparently objective or appropriate as a descriptor—as irrelevant and as a marker for the precipitation of racism. Such a stance may have been helpful and perhaps necessary for her personally, but it closed off the possibility of viewing racism as located anywhere other than in individuals, thus making systemic and institutional forms of racism appear as natural.

**Racial realism and Donna’s conceptual ecology.** Donna’s experiences as a parent and a substitute teacher were the likely sources of her evident skill in controlling behavior and discourse in her classroom, and underlying her practice appears to have been a conception of teaching as a mutual series of interactions that followed familiar scripts and patterns of behavior. This included the inquiry-response-evaluation discourse pattern well-known in the literature (Cazden, 2001), the use of “confirmation” inquiry labs and experiences (Windschitl, 2003, 2004), an uncritical use of teaching materials, and a tendency to explain answers to students rather than probe for understanding. Critically, it also included a concern for the socioemotional welfare of her students and a commitment to fairness.

Yet, she also possessed other conceptions in her conceptual ecology that were well-positioned to support her growth as a teacher. Certainly her understanding of the permanence of individual racism from personal experience ought to serve as a stepping stone to a deeper understanding of how racism operates systemically, just as her political actions outside of the classroom may one day serve to attend to issues of power and student voice within the classroom. It is difficult to avoid the conclusion that Donna’s conceptual ecology changed so little because there was no need for it to change. As useful as the concept of systemic racism may have been for Donna, there was nothing in her experience of learning to teach that caused her
enough dissatisfaction with her current conceptions about the pedagogical implications of race to make her abandon them for competing conceptions.

**The operation of Whiteness-as-property.** Harris (1993) opens her foundational article with the story of her grandmother who “passed” as White in Chicago in the 1930s in order to support her family. Establishing Whiteness as a form of status property in critical race theory draws upon the long legal history of viewing one’s reputation as a form of property. Harris (1993) describes “passing” as seeking the “shelter of an assumed whiteness as a means of extending protection at the margins of racial boundaries,” (p. 1779) and this appears to be an apt description of Donna’s de-racialization of her identity as she entered schools in authority roles, first as a substitute and later as a preservice teacher.

Donna’s experiences with racial stereotyping in her work as a substitute led her to shorten her name from a recognizably “Hispanic” surname to simply “Miss H.”, an action that she described as allowing her to avoid feeling stereotyped. Later when she married, she reported that she “dealt with it” by taking her husband’s surname. Though she spoke Spanish, being asked if she did was frustrating for her because it served to “separate” her from others. She was well-aware that some people’s limited exposure to diversity created racist behaviors, but nonetheless sought to avoid the consequences of their ignorance whenever possible.

A critical race theory view of Donna’s case highlights the advantages that the practice of passing offered her, as well as its costs. The benefits of passing included a relative freedom from engaging in issues of race in her daily life, as well as the freedom not to think about race that is part and parcel of the definition of White privilege (McIntosh, 1990). Though it is difficult to measure the psychological toll of racism that Donna avoided by minimizing her racial and ethnic identity, there is little question that experiencing discrimination is a stressor broadly impacting
health (Pascoe & Smart Richman, 2009). The price of this privilege was a “colorblind” view that left her less able to create the kind of safe environment she envisioned for all of her students, and shut down meaningful opportunities for her students to develop informed understandings about race and diversity in a biology class, as discussed further in the section on objectivity, color-blindness, and meritocracy below.

**The operation of Whiteness-as-property and Donna’s conceptual ecology.**

The organizing conceptions in Donna’s conceptual ecology that made Donna see herself as “a girl without a race” must obviously include both her conceptions about race and her self-conception in regard to her own identity. The critical race theory analysis above demonstrates that for Donna’s conception of race also includes its value as a quality-of-life resource. It appears as if she viewed Whiteness as a safe haven from racism. The high status afforded to all of these conceptions in her conceptual ecology was undoubtedly supported by affective considerations as well. The information she received in her teacher education classes about race was assimilated in her thinking through her lens of fairness, but was not convincing enough—or “warm” enough, in the language of the conceptual change theorists (Sinatra, 2005)—to change her mind about other aspects of the concept of race.

**Challenging claims of objectivity, color-blindness, and meritocracy.** As stated in the introductory section of this article, one of the guiding questions of this research asks what the concept of race explains to a given individual. For Donna, the answer to this question is that it explained very little, and that the only explanatory power held by the concept of race was as a focus for individual acts of discriminatory behavior. In her view, the only predictive power of race was in anticipation of prospective targets of such behavior.
As noted above, Donna found the use of descriptive race labels neither useful nor problematic, in large part because she saw them as containing little relevant information. By denying the salience of the experience of race in her students’ lives, both for her White and non-White students alike, Donna is enacting a philosophy of colorblindness. Crenshaw (2010) notes that such a view “reduces race to a symmetrical plain of skin color…such that equality is simply achieved by colorblindness, rather than acknowledging the asymmetries of race and the inequalities produced by treating all races as though they were the same,” (p. 1325). Critical race theory would have us point out the impact of such a stance of colorblindness not only on the (very few) students of color in Donna’s classes, but on the White students as well. In the one most likely class—high school biology—where students could have learned scientifically accurate information about the genetic basis of human differences, students instead received incorrect information that reinforced 19th century racial classifications. Students also learned that race was only something to be mentioned in a scientific context, such as in discussing susceptibility to sickle-cell anemia. This stance helps explain Donna’s uncritical use of a handout containing dated and essentialist racial descriptions. From her perspective, they were historical vestiges that no longer had any power to impact her students’ thinking.

Race was not discussed at all in classroom talk beyond the biology content of lessons, because Donna felt that keeping race-talk out of her classroom allowed her to maintain the safe environment she wished for her students. The unintended consequence of such a practice was that it lent support to a system of White supremacy.

The notion that student ideas (and “misconceptions”) are obstacles to teaching, rather than resources (Larkin, 2012a), explain Donna’s minimal consideration of the impact that students’ prior conceptions had on learning. In her primarily transmissionist view of teaching,
student ideas were like a surface being painted over, rather than the raw material of her work. Objectivity, in Donna’s conceptual ecology, meant a level playing field, and if students came into her class ready to learn the lessons in the script of the day, that seemed much more fair than trying to measure the wide variety of existing understandings among her students and build upon them.

Summary of Donna’s Case

Donna’s case represents an example of someone who thinks of teaching as fairly straightforward and technical, and of learning to teach as the mastery of the managerial tasks and pedagogical skills of teaching—in which race plays no part. Even more so than Jethro, Donna’s case highlights the connection between a denial of the salience of race in teaching and a lack of understanding of the role of student ideas in learning. The space this occupies in her conceptual ecology was quite small. For Donna, shutting down race talk unrelated to science is an act of protection for both herself and other people of color, because little good can come of it. At the same time, her lack of knowledge about the physiological and genetic basis for characteristics associated with race designations led her to unproblematically accept assertions about race that possessed the veneer of science (Fields & Fields, 2012).

A final lesson to be drawn from Donna’s case stems from her desire to create a classroom environment that was safe and comfortable for all students. The existence of a single student of color in the class prompted her to reflect on what that student’s experiences would be during a lesson on the physiology of skin, and such a finding seems promising, as it indicates that Donna is beginning to view student learning as it occurs through that individual’s perceptions of the world, rather than simply as information transmitted from teacher to student.

Discussion
Looking across both cases raises a number of issues concerning individuals’ ideas about race and the pedagogical implications of race during the process of learning to teach. Both participants constructed racism as an individual, rather than an institutional, structural, or societal issue, and both retained an individualistic approach to student diversity (Paine, 1990). However, some small changes in participants’ understanding of race and pedagogy did occur during their time in the study. For example, Jethro’s acknowledgment that race might serve as an indicator of the prior conceptions students might bring to the task of learning science, and Donna’s increasing awareness that race talk had the potential to threaten students’ feelings of safety in the classroom. In a more comprehensive sense, the participants’ ideas about race and the pedagogical implications of race changed very little over the course of this study, undergoing only minor shifts presumably as a result of their teacher education program experiences. However, it does not appear that any of the participants were better prepared to address racial achievement gaps by engaging in teaching practices consistent with the literature on teaching for diversity (e.g., Ladson-Billings, 1999; Villegas & Lucas, 2002b; Zeichner, 1996).

It is important to restate that here we have only examined participants’ understandings and reasoning about race and the pedagogical implications of race. In other aspects of learning to teach, it appeared that Jethro and Donna learned a great deal. Their lesson planning and classroom management skills improved over the course of the year, as did their overall demeanor as professional educators. To a casual observer who saw Jethro “melt down” in front of his sixth-graders in October, the well-organized and confident physics teacher doing electrostatics demonstrations in May seemed almost a wholly different person. Nonetheless it remains disturbing that so little growth occurred concerning participants’ understanding of issues of race and its pedagogical implications.
In one sense, the fact that neither of the participants saw the concept of race as having any explanatory power can be considered somewhat encouraging. After all, neither of them espoused essentialist folk beliefs about race, and both seemed to recognize that race was much more of a social than biological phenomenon. On the other hand, their ideas about race left them to struggle with the reality that race still mattered in apparently important ways. It may not be unreasonable to suggest that their view of race as a marker for problems might actually have been part of the larger issue of seeing student difference as a marker for problems. Race may simply be a difference that is harder to handle because of its historical significance and continued salience. This study suggests that the difficulty of incorporating an understanding of difference and leveraging it into one’s practice to support student learning is easily underestimated by those who seek to impart modern understandings about race to others.

An example of this may be seen in Jethro’s emerging conceptions about culture, which we traced back to discussions in his program about the “culture of poverty” from the Ruby Payne (2005) readings in his Change Strategies in Urban Education class. Jethro spoke of culture as Payne does, as though it were either an inherent characteristic of a person or the collective characteristics of a group. He found it plausible that drawing upon these characteristics to inform his teaching would be a productive strategy, but admitted being at a loss on how to do it. Yet the concept of culture came to hold promise as a resource for maintaining student engagement, a task still central to his teaching practice. Interestingly, Jethro did not yet invoke “culture” to explain student failure within school structures, an argument commonly voiced by prospective teachers (Haberman, 2007; Ladson-Billings, 2006), but it seems likely that he was not yet at a point in his learning progression about race and pedagogy for that idea to emerge.

Conclusion and Implications
This study sought to explore two preservice teachers’ conceptions about race and their pedagogical implications during their classroom teaching placements, as well as to understand the nature and sources of change in those conceptions. We began with the question: to a given individual, what does the concept of race explain? Perhaps most notably, for both study participants, the answer to this question was that race itself had very little explanatory power, except as a marker for individual racism and its effects. In this way, race in a given situation was seen as marker of a potential conflict or problem.

Previously, critical race theory has been used to analyze institutional racism in U.S. education, demonstrating the hidden ways in which interrelated systems of domination have normalized racism, treated race as alienable, and continue to structure contemporary policies and practices in schooling. In this article, we stretched this framework to consider how the social construction of race is a part of an individual’s conceptual ecology and thus how the operation of privilege and power is associated with cognition. Critical race theory was particularly helpful in understanding how Whiteness and colorblind ideologies affect the ways preservice teachers conceptualize race in their practice and in their work with their colleagues, students, and their students’ families.

The participants’ conceptions changed on a very small scale, and in ways that were likely overlooked in earlier studies (such as the TELT) because the conceptual change did not result in wholesale changes to beliefs or practice. It is fair to say that as a result of their fieldwork experiences, each participant was able to view race as one aspect of the larger set of student resources being brought to the task of learning—yet, learning how to leverage those resources to further student learning remained beyond their grasp. In this study, “race” as understood by the participants was inextricably linked to racism, and the possibility of racism to exist without
purposeful, individual malice proved difficult to comprehend. Each participant initially feared that explicit references to race or racialized concepts would instigate possible cross-racial conflict, but in their daily experiences, as they made connections between their ideas about race and their individual students, the nature of the “problems” that race could portend became less threatening. It is also important to note that the participants’ limited reservoir of historical knowledge from which to draw about the pervasive influence of racism in U.S institutions like schools, or the consequences of continuing racial oppression on individual lives, surely contributed to their choice to suppress racially-tinged scientific topics—even as teachable moments to connect classroom science to “real life” presented themselves. It is doubtful that either participant would have felt capable of encouraging or sustaining—let alone initiating—any conversation that effectively dealt with the depth and nuance of race and racism, or their complicated historical relationship to the discipline and study of science.

It was possible in this study to examine the participants’ changing conceptual ecologies during their process of learning to teach. Jethro all but dismissed efforts to draw attention to issues of race in his teacher education program because he simply did not see a connection between physics and his conception of race as historical “heritage.” Instead he focused more on the geographical and generational differences he perceived between himself and his students in order to construct explanations for his difficulties. Donna’s own experiences on the receiving end of racism led her to shut down race talk altogether to minimize the potential damage it could cause, even though doing so allowed problematic misinformation about race to slip into her teaching.

To build upon the earlier metaphor suggested above, it is as if Jethro’s and Donna’s notions about race are moored by three ropes. The first rope is anchored to the view of race as a
marker for conflict from which teaching must be exempt. Jethro sees race through the lens of the racial conflicts of his youth, while Donna draws upon the conflict from her own experiences with race. Both viewed race itself as the source of racism, and denying race any salience in the classroom was a way to minimize potential conflict. The second rope represents the individualistic orientation to racism held by both participants, as opposed to one that would acknowledge systemic or institutional forces on individuals’ control over their own fates. The third rope is the idea that science as a system of knowing is universal and exists independently of the learner, and this idea was expressed both in content and pedagogy. For Jethro, learning science ought not to depend on race in any meaningful way, and including discussions of race in science class is simply not practical. For Donna, this meant not questioning problematic constructs of race because of the aura of scientific authenticity surrounding them in her classroom context. For there to be genuine movement in Donna’s or Jethro’s conceptions about the pedagogical implications of race in their teaching, there would need to be much more slack in each of these ropes, and real conceptual change—what Sinatra and Pintrich (2003) would term “intentional conceptual change”—would entail untying them altogether and attaching them to different ideas elsewhere.

In both cases, we claim that the most likely pathway toward ensuring that candidates ultimately develop a robust understanding of race, racism, and the pedagogical implications of race is one in which each participant develops a better understanding of the role of student ideas in learning. It stands to reason that teachers who seek robust and deep evidence of learning among students will find it difficult to ignore the role of race and racism in the shaping of their students’ thinking.

One role of teacher educators, then, will be to help prospective teachers to build
explanatory models for race that draw upon historical, systemic, and institutional racism that have broader explanatory power and help them make sense of the prior knowledge that their students bring to the task of learning. At the same time, critical race theory questions the reliance on the current structures of formal teacher learning to address inequities in schooling and society. If learning the pedagogical implications of race takes long-term and sustained attention in diverse environments, it seems that teacher education policies that accept and support a much longer view of teacher learning across the professional continuum (Feiman-Nemser, 2001) will be a necessary first step at the very least.

Of course, as case studies, the findings described here may have limited generalizability to other preservice teachers, especially given the differences that exist in different types of teacher preparation programs, not to mention the individualistic differences among the teachers themselves. It is also possible that the methodology of the study did not adequately ascertain individuals’ conceptions about race, or more plausibly, were not able to overcome the sometimes powerful social incentives to not speak about the topic of race. One final major limitation of this study is that it was descriptive in nature, and there was no intervention designed specifically to foster intentional conceptual change on the part of the participants (beyond the intervention of the teacher education program, obviously). In a sense, this study may serve as a baseline for future research projects where there are clear, well-defined efforts to help teachers develop a robust understanding of the pedagogical implications of race and other forms of difference.

However, it is also evident that more research must be done on the unconscious processes and conscious motivations that frame so many teachers’ pedagogical patterns within the larger context of societal oppression and pervasive structural problems like racism, linguistic discrimination, patriarchy, and heterosexism in the United States. In the preparation of teachers
for the diversity of modern classrooms, we can learn from analyses rooted in critical race theory in order to design individual, institutional, and systemic interventions that continue to diminish the predictive power of race on student achievement.
Endnotes

i To be clear, this is not a study about how a prospective secondary science teacher develops a culturally relevant pedagogy (e.g. Johnson, 2011; Patchen & Cox-Petersen, 2008). Nor is it an intervention study in which an effort was made to influence the participants toward a particular outcome. Rather, this research is more appropriately framed as an investigation that is both anthropological and phenomenological in nature, though strictly it is not ethnography either.

ii Other facets of critical race theory, such as interest convergence, the critique of liberalism in regard to the slow pace of social change, and the role of counter-storytelling, are better suited for systemic critiques and are not used in this analysis.

iii All names of individuals, programs, and institutions in this research article are pseudonyms. Participants were given the opportunity to choose their own pseudonym, but only “Jethro Tull” did so.

iv It is also the case that each participant entered their teacher education program from a prior career in a scientific field, and a brief account of this work experience, along with their educational background, is included in each case. Prior work by Windschitl (2003) has demonstrated a connection between experiences with authentic science research and science teacher candidates’ approaches to inquiry teaching, but a more detailed examination of this connection was beyond the scope of this study.

v Protocols for chemistry and earth science were also developed and used in the larger study, but are excluded from discussion here given the certification areas of the participants in the present study.
This figure is reproduced with permission from McGraw-Hill. The graph suggests that four genes are involved in the production of skin color. In fact, genomic research on skin pigmentation has identified at least 24 genes in humans with identifiable single nucleotide polymorphisms that are responsible for variations in skin pigmentation (Myles, Somel, Tang, Kelso, & Stoneking, 2007), and 60 of the 127 genes recognized as pigmentation genes in mice DNA have human counterparts (Bennett, 2003; Jablonski, 2004).


It became clear during pilot interviews—in which the “floodlight” question had been placed at the end of the interview—that interviewees tended to become flustered and uncertain during these questions, thus ending the interviews on a discordant note. Subsequently, the order of questions was rearranged so as not to conclude the interview immediately afterward. Instead, the question about teaching students to read measurement scales was moved to the end; as most respondents answered confidently, each conversation ended much more amicably.

Donna was by far the most activist preservice teacher of the 14 individuals in the larger study. She was successful in her efforts to pass a “backyard chicken” ordinance in her municipality, and she was a steady advocate with a group of farmers who wished to make the selling of unpasteurized milk legal in the state.

Though information about an applicant’s “race/ethnic description” is one of the categories of information required on applications for a Social Security Number change, the only participant information coded in Social Security Numbers is geographical location, and even that practice is likely to be discontinued in the near future (Puckett, 2009). Race/ethnicity information is not recorded for the millions of individuals each year issued a Social Security Number at birth.
xi To be clear, this depiction of three racial groups and their differences is no longer supported, and is considered to be a artifact of early 19th century beliefs in three separate species of human beings (AAA Executive Board, 1998).

xii Similar ideas were echoed in her approach to teaching topics in evolutionary biology, in that she wanted students to learn the content while still being able “to believe what they want to believe, [and] not be forced to take sides.” (Donna interview, December 2008)

xiii Note also that Donna appears to take for granted that a group of African American students in her class would present similarly in terms of skin pigmentation, an assumption that is not supported by empirical research (Jablonski, 2006). Such a view may actually reflect her reported limited exposure to interactions with African Americans growing up, and therefore fewer opportunities to experience what Allport (1979) calls “the effect of contact.”

xiv Though it must be noted that many of Donna’s classroom materials, including this handout, had been used for many years by her cooperating teacher as well.

 xv Payne’s work remains popular in teacher education and professional development efforts despite increasing criticism of the deficit-laden and essentializing nature of her “culture of poverty” construct (Gorski, 2006; Sato & Lensmire, 2009).
References


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Index of Tables and Figures

Figure 1. Biology interview question for probing participants’ thinking about the intersection of race and pedagogy.

Figure 2. Physics interview question for probing participants’ thinking about the intersection of race and pedagogy.

Table 1. Participant demographic information & fieldwork experiences
Table 2. Timeline of participant experiences and data collection
Table 1.

**Participant Demographic Information and Fieldwork Experiences**

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<tr>
<th>Name</th>
<th>University-based Teacher education program</th>
<th>Post-baccalaureate certification area</th>
<th>Age Range</th>
<th>Self-described race/ethnicity &amp; gender</th>
<th>Prior scientific work experience</th>
<th>Practicum field experience</th>
<th>Student teaching field experience</th>
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<td>Donna</td>
<td>Central State College</td>
<td>Biology</td>
<td>25-29</td>
<td>Filipino/White female</td>
<td>Biological supply company</td>
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<td>Suburban high school</td>
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<td>Jethro</td>
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<td>Physics, Computer Science</td>
<td>50-54</td>
<td>White male</td>
<td>Electrical Engineer</td>
<td>Urban middle school</td>
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Table 2

Timeline of Participant Experiences and Data Collection

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<td>Interview 3</td>
<td>Questionnaire 2</td>
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