

RETHINKING RACE AND  
ETHNICITY IN RESEARCH  
METHODS



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Editor



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## 10 QUANTIFYING RACE: ON METHODS FOR ANALYZING SOCIAL INEQUALITY

*Quincy Thomas Stewart and Abigail A. Sewell*

### **BACKGROUND**

Racial inequality is a social experience. Our interest in methodology centers on how to quantitatively model this concept. We each entered the academy with a love for mathematics and an aim to model patterns in the physical world. Though we both lost interest in the physical sciences early in undergraduate school, we similarly turned our attention to studying the social world, particularly social inequality. Our paths crossed when Abigail began graduate studies at Indiana University. At that time, we began an ongoing discussion about how to quantitatively model racial inequality. Our discussion centered on the question: “How can we model the complex, multi-level patterns that constitute the social experience of race and reveal the policy mechanisms needed to undermine racial inequality?”

Over the years, we have had countless spirited interactions in which we often agree, and sometimes disagree, on how to answer this question. We often agreed/disagreed on the extent that a study had great models with little policy relevance, clear policy relevance, and horrible models, and, rarely, both great models and clear insights on policy mechanisms. Each of our interactions, and disagreements, pushed us to a new peak in understanding how to quantitatively model the experience of race. This chapter represents our best mutual solution to date and it is a guide to our ongoing work. Our plan is to use—and build on—this solution to develop a body of research that may be used to guide policy aimed at eradicating racial inequality in the United States and beyond.

### **INTRODUCTION**

Scientific research on racial inequality is academically appealing because it has great promise. For some, it is the promise of eradicating racial disparities

in educational achievement that drives their research. For others, it is the promise of identifying the policy mechanisms for realizing racial equality more broadly. W. E. B. Du Bois (1899/1996) discussed the promise of his own research—and perhaps his personal hopes—in *The Philadelphia Negro*. He noted: “The final design of [this] work is to lay before the public such a body of information as may be a *safe guide* for all efforts toward the solution of the many Negro problems” (p. 1; emphasis added). Here, Du Bois invokes the promise of scientific research for advancing humankind and improving the deplorable relative conditions facing black Americans in particular. In the century since Du Bois’s publication, the promise of race research has continued to fuel the intellectual fires of countless social scientists.

Quantitative race research plays a critical role in realizing this promise as it is a means to conduct formal—and often generalizable—analyses of racial inequality. This research highlights the: (1) magnitude of racial disparities in an outcome; (2) variables that covary with the disparity; and (3) mechanisms responsible for the creation and/or maintenance of outcome disparities. The difficulty, though, is that racial inequality is a product of a host of variables simultaneously operating in various levels (e.g., structural, intrapsychic), social spaces (e.g., educational institutions), and in the gamut of individual/institutional encounters in a social system (Bonilla-Silva 1996; Reskin 2003; Stewart 2008a, 2008b; Zuberi 2001). This complexity creates endogeneity (i.e., dependence among variables), which undermines traditional quantitative methods’ ability to correctly identify the mechanisms that shape the experience—or interactive process—of racial inequality (Stewart 2008a). Our aim here is to review the arsenal of quantitative strategies available for analyzing racial inequality, discuss the benefits and drawbacks of each, and propose a plan for overcoming the deficiencies in each approach.

We begin with a brief review of race research and present a formal model of racial inequality. Then we review six quantitative methods and discuss how each addresses the complexity implicit in racial inequality. We conclude with a prescription for quantitative race research that centers on using multiple techniques.

## **RACE: THE ENVIRONMENT**

A host of factors shape the nature and magnitude of racial inequality. Some argue that socioeconomic (SES) disparities (e.g., education) are the primary mechanism behind racial differences in outcomes (e.g., health); others argue that discrimination plays the most important role (Cancio et al. 1996; Farkas & Vicknair 1996; Neal & Johnson 1996; Wilson 1978). We group these factors into three broad categories that capture the general tenor of the explanation. They are: (1) behavioral; (2) resource based; and (3) structural. We

do not endorse any one perspective as a best explanation. Rather, we use the categories as a frame to shed light on the implications—and oversights—of various approaches to studying racial inequality. This allows us to detail the appropriateness of a method for identifying the source of inequality when all of the theories may be operating.

### ***Three Broad Theories***

The first broad theory, entailing behavior, locates the source of group outcome disparities within individuals, specifically, in a set of traits that influence behavior. Outcome differences are viewed as a product of this set of behaviors occurring more (or less) in one race group than another. The behavior may be a preference for one group, statistical discrimination against a group, a disinvestment in education, etc. (Du Bois 1899/1996; McWhorter 2000; Ogbu 1974, 1978, 1983, 1987, 1990; Ogbu & Davis 2003). The driving feature of behavioral theory is that members of one racial group enact behaviors that are associated with an increase (or decrease) in an outcome for the underprivileged group. An important aspect of behavioral theories is the general assumption that the behavioral mechanism is largely modifiable. This leads to policy suggestions for inequality that center on modifying the behavior(s) of a specific group (Andreasen 1995; Durlak & Wells 1997, 1998; Eccles et al. 2002).

The second theory, resource based, locates the source of racial outcome inequalities in the distributions of a related, important resource. (See Cancio et al. [1996]; Darity [1982, 1998]; Farkas & Vicknair [1996]; Neal & Johnson [1996]; O'Neill [1990]; and Wilson [1978] for examples of this perspective in regard to wages.) The “important resource” varies based on outcomes from factors such as human and social capital (e.g., education, network connections) to access to important services (e.g., health insurance). The resources allow the actor entrée and/or access to higher outcomes than other similar actors without the resource. Thus, racial outcome disparities are viewed largely as a product of one group having more resources—or more of a set of resources—than another group. Policy suggestions for resource-based models center on changing the underlying distribution of the valued resource (e.g., increasing educational outcomes of a group) (Harvey 1973; Korpi & Palme 1998; Tyler 1997).

The third and last broad theory, related to structure, locates the source of inequality within the spectrum of social relations in society. Structural theory asserts that while the distribution of resources and behaviors of agents are important—and in constant flux—the relationships between the agents conform to a larger *system* of racial inequality (Bonilla-Silva 1996; Oliver and Shapiro 1995; Omi and Winant 1994). Racial differences in an outcome, then, are viewed as products of an array of institutional arrangements (e.g.,

property tax and educational quality) and rules guiding behavior (e.g., social networks). These arrangements and rules produce a patterned set of relationships and resource distributions that constitute the system (i.e., structure) of racial inequality in the population. Structural theorists argue that the uneven effect of the institutional arrangements and rules across racial groups is the driving force behind racial inequality. Importantly, this theory subsumes that the ideology embedded in the institutional arrangements and rules that guide behavior are the true purveyors of injustice (Bonilla-Silva 2003). Hence, the policy suggestions center on changing the ideologies that create and maintain inequality via the racial structure.

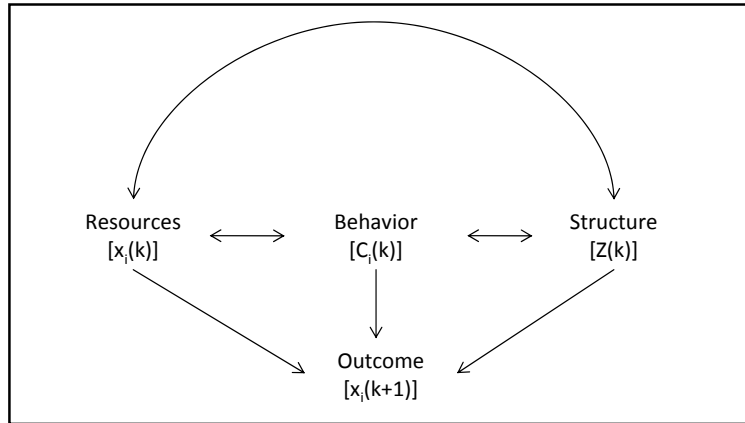
### ***The Formal Model***

The theories discussed above present quantitative social scientists with three unique mechanisms to model. An overlooked and, oftentimes, omitted important point in each of the theories is they are interconnected. For example, behavioral theorists often point out that behaviors are a result of systematic discrimination (Fryer & Torelli 2005; Ogbu & Davis 2003). Likewise, structural theorists often identify the summation of behaviors and resource distributions in a population as constituting the system of racial inequality (Bonilla-Silva 1996, 2003; Bonilla-Silva & Baiocchi 2001; Oliver and Shapiro 1995). Moreover, resource-based theorists often highlight the importance of behavior and institutional arrangements in creating the uneven distribution of resources (Bonilla-Silva 1996; Roscigno and Ainsworth-Darnell 1999; Wilson 1978). A depiction of this interconnected model of the three broad theories appears in Figure 10.1. All three of the theories, then, potentially contribute to an actor's outcome in time  $k+1$  and to outcome disparities among actors more broadly.

Indeed, the model of the three theories of inequality presents a considerable amount of complexity. Stewart (2008a, 2008b) suggests this is further complicated by race and racial inequality being an interactive process (Emirbayer 1997; Reskin 2003; Schwalbe et al. 2000; Tilly 1998; West & Fenstermaker 1995). Race, from this perspective, only has meaning in social interactions (i.e., mechanisms) where the concept is used to distinguish the experience of actors from diverse racial groups and facilitate racial inequality. Stewart writes:

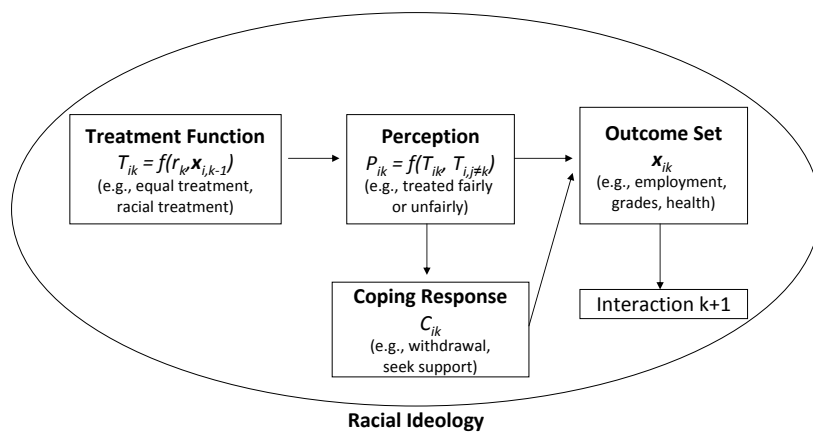
These mechanisms embody social processes that operate at various levels (e.g., organizational, interpersonal) and locations in society to allocate rewards based on actors' characteristics—including race. Each mechanism ... represents a social interaction space where an actor's characteristics are translated into some reward or opportunity, and where racial inequalities are created and maintained. (2008a:287)





**Fig. 10.1** General model of three broad theories of racial inequality operating in time period  $k$

Stewart (2008a, 2008b) formally characterizes this process as the accumulation of countless encounters of the form shown in Figure 10.2. During this generic interaction  $k$ , an actor enters with a set of characteristics  $\mathbf{x}_{i,k-1}$  and a racial identity  $r_k$ . She is then exposed to a treatment  $T_{ik}$  in the encounter, which may be based on her race (i.e., racial discrimination). After the treatment, the actor perceives the treatment  $P_{ik}$  and compares it with past encounters—and the treatment of similar others—to determine the quality of the treatment (i.e., fair/unfair). She then responds to this treatment. This response,  $C_{ik}$ , may take on several forms and depends on the perception of treatment by the actor. The



**Fig. 10.2** General interactive model of racial inequality: Interaction  $k$

interaction concludes with the actor receiving an outcome—or an update to her set of characteristics—which she carries into the next encounter.

Although Stewart's (2008a, 2008b) model depicts the potential process through which race becomes racial inequality, several mechanisms are not discussed. Specifically, where do the aforementioned behavior, resources, and structure fit into this theoretical model? Albeit overlooked, the general nature of these variables highlights where they fit. First, behavior corresponds with the coping responses of actors  $C_{ik}$ . This space identifies the influence of an individual's agency on her own outcomes and to the larger structure (i.e., the system of relations). Second, resources span the treatment, perception, and coping response mechanisms. An actor's resources will govern her treatment, her perceptions of that treatment, and the actions she takes as a consequence of the treatment/perception. Structure, the final—and most complex—variable, enters the model via the treatment mechanism. This space captures the systematic disparate treatment of actors on the basis of their race, which compounds across encounters to become differences in characteristics. It is this systematic disparate treatment of actors that constitutes the racial structure. Hence, Bonilla-Silva (2003) defines the "racial structure as the *totality of social relations and practices that reinforce white privilege*" (9; emphasis in the original).

### Summary

The discussion above suggests that resources, behaviors, and structure operate to create inequality in countless social encounters across the course of social actors' lives. We have formalized this model in Equation 1.

$$x_{ik} = f[T_{i,k-1}, P_{i,k-1}, C_{i,k-1}] \quad (1)$$

where

$$\begin{aligned} T_{i,k-1} &= h[r_i, \mathbf{x}_{i,k-1}(x_{i,k-2}), (Z_{k-1})] \\ P_{i,k-1} &= g[\mathbf{x}_{i,k-1}, T_{i,d < k-2}(Z_{k-2}), T_{j \neq i, k-2}(Z_{k-2})] \\ C_{i,k-1} &= z[\mathbf{x}_{i,k-1}, P_{i,k-1}, T_{i,k-1}(Z_k)] \end{aligned}$$

The terms in Equation 1 are synonymous to those used above—and the terms  $f$ ,  $h$ ,  $g$ , and  $z$  preceding the parentheses refer to functions. Here, the outcomes in the current encounter [ $x_{ik}$ ] (i.e., resources) are a function of the treatment [ $T_{i,k-1}$ ], perceptions [ $P_{i,k-1}$ ] and coping responses [ $C_{i,k-1}$ ] of all earlier encounters—but only directly tied to the parameters seen in the previous encounter. As indicated earlier, the treatment in the preceding encounter is a function of race [ $r_i$ ], resources [ $\mathbf{x}_{i,k-1}$ ] and structure [ $Z_{k-1}$ ] in that encounter. Perception of treatment [ $P_{i,k-1}$ ] is a function of one's resources as well as one's own treatment in previous encounters [ $T_{i,d < k-2}$ , where  $d$  is interaction number] and the

treatment of others [ $T_{j\neq i,k-2}$ ]<sup>1</sup>—both of which are tied to the structure of previous encounters [ $Z_{k-2}$ ]. Finally, the current outcomes are also tied to the coping responses [ $C_{i,k-1}$ ] used by the actor in the previous encounter. These responses are a direct result of the resources [ $x_{i,k-1}$ ], perception [ $P_{i,k-1}$ ], and treatment [ $T_{i,k-1}$ ] experienced in the same interaction.

This model of racial inequality is quite complex. Each of the respective variables becomes nested in others such that an early difference in behavior influences the resources of ensuing encounters (Stewart 2008a). Alternatively, an initial difference in structure may nest itself in behavioral differences. This process complicates our ability to single out any one variable as the primary culprit behind racial inequality. So, how do we model this complexity? We now turn to our review—and critique—of six quantitative methods.

## RACE RESEARCH: THE STRATEGIES

There are several ways one may model the general system of racial inequality outlined above. We review six methods ranging from static models of cross-sectional data to dynamic methods that use artificially simulated data. They are: (1) traditional survey; (2) comparative analysis; (3) natural experiment; (4) multilevel analysis; (5) formal experiment; and (6) computational. Each method has a host of submethods (e.g., traditional survey includes both ordinary least squares and logistic regression models). Although some readers may be interested in the specifics of these submethods for a particular research question, we only review the larger method to shed light on the benefits and drawbacks for studying the system of racial inequality.

### *Traditional Survey*

The traditional survey method—or variable analysis—uses individual-level data derived from social and/or demographic surveys (e.g., General Social Survey, U.S. Census data) to assess the nature and magnitude of racial inequities in an outcome (Blumer 1969/1998; Stewart 2008a, 2008b). Traditional surveys collect data on race group membership (i.e., racial identification) as well as a host of other variables such as income and education. These data sets are generally large (i.e.,  $N > 1000$ ) and collected using random sampling techniques. Researchers use these data to generate unbiased estimates of the nature and magnitude racial differences in a specific outcome at the time of the survey.

The traditional survey modeling process is done in two (or more) steps. First, the racial difference in an outcome variable is estimated in a bivariate model. Specifically,

$$y_i = f[r_i] \quad (2)$$

where  $y_i$  is the outcome for person  $i$ , and  $r_i$  is the race of person  $i$ . This model highlights the nature and magnitude of observed—or “real”—racial differences in the outcome of interest. Researchers then control for theoretically relevant variables that may be correlated with this real difference. For example, an analysis of income disparities typically controls for education, experience, and occupation (Cancio et al. 1996; Darity 1982, 1998; Kilbourne et al. 1994; O’Neill 1990). Similarly, an analysis of disparities in negative health outcomes often includes variables for smoking behavior, body mass index, and physical activity (Adler & Rehkopf 2008; Bell et al. 2004; Dressler et al. 2005; Lantz et al. 1998; Schoenborn et al. 2004; Williams & Jackson 2005). Hence, one controls for variables that are theoretically tied to the outcome variable in a fundamental way. This second step is seen in the multivariate model

$$y_i = f[r_i, \mathbf{x}_i^*], \quad \text{where } \mathbf{x}_i = y_i \cup \mathbf{x}_i^* \quad (3)$$

where  $y_i$  is the outcome of interest for person  $i$ ,  $r_i$  is the race of person  $i$ , and  $\mathbf{x}_i^*$  refers to the vector of theoretically relevant variables for person  $i$  that are used in the analysis. This multivariate model provides an estimate of the average racial difference between persons with similar characteristics [i.e.,  $\mathbf{x}_i^* \approx \mathbf{x}_j^*$ ]. If the addition of variables to the model reduces (i.e., explains) the race effect to insignificance, scholars interpret the variables as being responsible for the observed racial disparity in the outcome (Darity 1982; Reskin 2003; Stewart 2008a; Zuberi 2001). When the race effect is not explained away, scholars interpret the result as evidence of either continued racial discrimination in the social arena or an omitted variable.

Although the traditional survey method is elegant, cost effective, and easy to apply, the method is severely limited by the nature of the data. Specifically, the method draws on cross-sectional data, where each unit of analysis has only one data point within a time continuum. This creates an epistemological gap as the theoretical models of interest are dynamic (i.e., causal), but the empirics used to examine theory strictly rely on correlation. This gap is best seen in the difference between the dynamic, theoretical model depicted in Equation 1 and the static, empirical model shown in Equation 3. This gap necessitates a “leap of faith” by scholars in which one presumes that the static, cross-sectional model accurately depicts the complex, dynamic relationship between the same variables in the real world (Zuberi 2001).

### ***Comparative Analysis***

Comparative analysis explicitly focuses on group similarities and differences to shed light on the social mechanisms that influence racial inequality (Martin 2009; Ogbu 1983, 1987, 1990; Waters 1999). Specifically, this

method looks at two or more groups with the same racial classification that vary on a specific characteristic (e.g., immigration status). For example, Dodoo (1997) compares the earnings of African Americans with those of black West Indian and African immigrants, while Stewart and Dixon (2010) compare the wage outcomes of four native-born racial groups with their foreign-born counterparts. Comparative analysis attempts to shed additional light on the mechanisms behind racial inequality by analyzing two phenotypically (i.e., racially) similar groups and modeling how a criterion variable (e.g., immigration status) is correlated with differences in outcomes across the two groups.

Comparative analysis is done in two (or more) steps. First, one estimates the raw outcome disparity between two phenotypically similar groups. Equation 4 shows this basic model where nativity of the respondent,  $n_i$ , is the characteristic that differentiates the two groups.

$$y_i = f[n_i] \quad (4)$$

This model provides an estimate of the average difference between persons of the same race group, but different nativity groups (i.e., native-born/foreign-born disparity). Perhaps the most popular statistic among comparative analyses comes from this basic model, which shows that foreign-born Blacks earn significantly more than native-born Blacks (Dodoo 1997; Sowell 1978, 1983; Stewart & Dixon 2010)—a relationship researchers have found also applies to Whites (Stewart & Dixon 2010).

The second step is to incorporate theoretically relevant variables and is functionally written

$$y_i = f[n_i, \mathbf{x}_i^*], \quad \text{where } \mathbf{x}_i = y_i \cup \mathbf{x}_i^* \quad (5)$$

where the variables are synonymous to those used above. Scholars interpret any significant residual nativity—or other—effect in this model as a sign that the factor differentiating the groups (e.g., birthplace) produces or mediates the group outcome disparities and, in kind, racial inequality more broadly.

The benefit of comparative analysis is that by analyzing two phenotypically similar groups that are different in regard to a broad characteristic (e.g., African ancestry with different migration history), one can shed light on the broad social mechanisms that are tied to the criterion variable (e.g., migrant selection). Comparative analysis, though, suffers from the same issues as the traditional survey method: The empirical estimates are simply correlations. Researchers have to make a leap of faith as to how differences in treatment, coping responses, resources, and the like covary with the criterion variable *and* as to whether and how observed relationships capture the deeper dynamic process of racial inequality (Stewart 2008b). An example of this leap is research where scholars presume that the higher SES outcomes of West Indian Blacks is attributable to more motivation and culture and that the poor

outcomes of native-born Blacks is attributable to laziness and ineptitude (McWhorter 2000; Sowell 1978, 1983). This problem speaks to the critical issue of research design and theoretical development for comparative analyses (Bashi & McDaniel 1997). The phenotypically similar social groups should not be able to be distinguished by other mechanisms or sources of bias beyond the criterion variable (e.g., language or nativity). When this condition is not satisfied, the results of comparative analysis are biased and the conclusions are off the mark.

### ***Natural Experiments***

The natural experiment method draws on naturally occurring data to shed light on the social mechanisms that drive racial inequality. These data must capture a change in one or more of the mechanisms theorized to impact racial inequality. Typically, social scientists draw on spatiotemporal variation (i.e., change) in a social policy or an environment as a means to examine these mechanisms (Marini & Singer 1988; Stewart 2009). This variation in a social mechanism (e.g., policy) creates a large-scale, “quasi” case-control design that one can use to study the effect of a social or environmental manipulation on a given outcome.

The data for natural experiments consist of individual-level survey data as well as aggregate survey and/or administrative data where the units of analysis may be cities, counties, or states. The data must provide information on the spatiotemporal variation in a mechanism (e.g., social policy) and on individual/group outcomes prior to and after the time of implementation in the respective spatiotemporal spaces. One compares group outcomes before and after a period of change to make an inference about the importance of the mechanism (i.e., the quasi-manipulation) for racial inequality. If changes in group outcome disparities occur after the quasi-manipulation—compared to the control areas—then one may infer that the mechanism (e.g., environmental change) is a determinant of racial inequality.

The natural experiment begins with a simple model of group disparities in outcomes across time  $k$  and space  $l$ .

$$y_{ikl} = f[r_i, k_i, l_i] \quad (6)$$

Equation 6 indicates that the outcome  $y_{ikl}$  of person  $i$  at time  $k$  and place  $l$  is a function of the race  $r_i$  of individual  $i$  and the respective time  $k_i$  and place  $l_i$  of the respondent. This simple model gives an idea of how group disparities vary across time and space. After estimating the simple model, we build on it by adding controls for the quasi manipulation variable  $T_{kl}$ —this is the change of social policy that mirrors the treatment function discussed in Figure 10.2. We write this as

$$y_{ikl} = f[\mathbf{T}_{kl}, r_i, k_i, l_i] \quad (7)$$

where  $\mathbf{T}_{kl}$  is a dummy—or continuous—variable that measures the spatiotemporal variation in social policy or environment. One should insert an interaction variable in this model to assess the extent to which the manipulation is related to the racial disparities in the outcome variable (e.g., modeling the  $r_i$  coefficient at level-1 as a function of  $\mathbf{T}_{kl}$  at level-2). This model provides an estimate of how group disparities in an outcome covary with changes in a social policy or environment. As a last step, one estimates a full model that includes other individual  $\mathbf{x}_{ik}^*$  and spatiotemporal  $\mathbf{X}_{kl}$  variables that are theoretically tied to the outcome.

$$y_{ikl} = f[\mathbf{T}_{kl}, r_i, k_i, l_i, \mathbf{x}_{ik}^*, \mathbf{X}_{kl}] \quad \text{where } \mathbf{x}_{ik} = y_{ik} \cup \mathbf{x}_{ik}^* \quad (8)$$

Equation 8 allows one to assess the extent to which racial outcome disparities are tied to the quasi manipulation  $\mathbf{T}_{kl}$  among similar persons who live in comparable social environments.

Natural experiments draw on repeated cross-sections of both observational and survey data to capture more of the complexity spelled out in Equation 1. This allows one to assess the direction of causality between a social policy/environment and racial disparities in a specific outcome. When the method is applied correctly, the natural variation neatly approximates a real social space with an experimental manipulation—as opposed to the contrived (i.e., quasi-) space that is discussed in the traditional survey and comparative analytic methods (see Bansak & Raphael [2001], Chay [1998], and Chay and Greenstone [2003] for examples of natural experiments). This allows one to more effectively test a hypothesis instead of statistically *speculating* on how manipulating one variable (e.g., education) may affect racial disparities in another outcome variable (e.g., income).

Although natural experiments are extremely useful, they are not without criticism. The primary criticism is that the quasi-manipulation may not truly capture the theoretical mechanism in question. In a perfect world, a quasi-manipulation emerges directly from a scholar's theory of racial inequality in a specific outcome. This would allow one to measure the influence of this manipulation on racial inequality. More commonly, the quasi-manipulation is muddied by the real world where natural variation is one dimension of a larger social policy or, in most cases, does not exist at all. This limits the applicability of the method to areas where one can find natural social/environmental variations that are theoretically meaningful to racial inequality.

A second criticism is that using repeated cross-sectional surveys overlooks how the quasi-manipulation affects specific respondents. These pooled samples of theoretically identical people potentially overlook: (1) person-specific variation in the relationship between the quasi-manipulation and other respondent characteristics (i.e., endogeneity); (2) person-specific

variation in the coping response of respondents to the quasi-manipulation that may alter the first oversight; and (3) temporal variation in other environmental factors that may be tied to racial disparities in the outcome variable. Thus, the natural experiment method does not fully capture Stewart's (2008a, 2008b) "interactive process" of racial inequality. While natural experiments provide novel insights on how a policy/environment is tied to racial inequality, they still overlook the gamut of interactions that comprise the system of inequality.

### ***Multilevel Analysis***

Multilevel analysis is quite similar to the natural experimental method. The method draws on repeated data for a key unit of analysis to infer the mechanisms of racial inequality. The key unit can vary considerably based on one's research question and data availability. For example, the key unit in longitudinal studies where the focus is on the forces driving changes in personal characteristics [ $\mathbf{x}_{ik}$ ] is the individual (Block & Robins 1993; Karter et al. 2002; Lantz et al. 2001; Muthén & Muthén 2000). The researcher in this example would use longitudinal data for a group of respondents over a finite period of time (e.g., a panel study of income dynamics). In contrast, the key unit for hierarchical studies is a macro-unit that represents a theoretically important social or spatial dimension (e.g., neighborhoods). The investigator in this example would use survey data that contains information on individuals within the macro-units (e.g., race) and on the characteristics of the respective macro-unit (Grodsky & Pager 2001; Horton & Sykes 2008; McCall 2001; Stewart & Dixon 2010; Sykes 2003). These two examples represent ideal types of multilevel models. The estimation is synonymous across the different types. For brevity, we will only discuss the longitudinal model as it has a stronger causal claim.

For longitudinal models, one begins with a simple model that highlights time variation in race group outcomes and is written

$$y_{ik} = f[k] \quad \text{where } k = h[r_i] \quad (9)$$

where the time-specific individual outcome  $y_{ik}$  is a function of time  $k$ , and each time point  $k$  (Level-1) is a function of the race  $r_i$  of the respondent (Level-2)—such that multiple observations are nested in individuals. This model highlights how race is related to the emergence/change in the time varying outcome of interest.

We build on this by incorporating time-varying Level-1 characteristics  $\mathbf{x}_{ik}^*$ , which are nested in respondents and modeled as a function of race, as well as the time-invariant Level-2 characteristics  $\mathbf{X}_i$  [Equation 10].

$$y_{ik} = f[k, \mathbf{x}_{ik}^*] \quad \text{where } k = h[r_i, \mathbf{X}_i] \text{ and } \mathbf{x}_{ik}^* = g[r_i, \mathbf{X}_i] \quad (10)$$



The estimation of this function reveals the extent that the observed pattern (e.g., emergence, change) of racial outcome disparities persist among persons with similar time-varying and time-invariant characteristics.

The strength of multilevel models is the fluid estimation of racial inequality. For example, one can model how racial disparities in college persistence emerge among a cohort of incoming college students using a longitudinal method and the factors that temporally precede this event. Alternatively, one can assess racial disparities in educational achievement across schools and assess the extent to which they are related to school composition. The flexibility of the methods allows one to infer either temporal (i.e., longitudinal) or ecological (i.e., hierarchical) causality.

Multilevel modeling has two limitations. First, the method overlooks the treatment, perceptions, and adaptive coping responses that contribute to the social experience—and reality—of racial inequality. Though longitudinal models can capture the emergence or change in racial inequality among a sample of panel respondents, it does not reveal how a respondent's treatment, perceptions, and responses may have altered the racial inequality. In other words, multilevel methods simplify the interactive process that influences a respondent's outcome trajectory in a longitudinal model and overlook the endogeneity introduced by this process—this is seen in comparing Equation 1 to Equation 10 (Stewart 2008a).

The second limitation centers on the conceptual measurement of variables and related interpretation. Although accurate conceptual measurement is important in all research, it poses new issues in multilevel work. Vague measures, such as residential segregation or poverty rates, are often used to measure a theoretically important concept in the second level of a model. The issue becomes acute when the vague measure offers no practical policy insights. For example, a significant correlation between residential segregation and health disparities may be interpreted as either: (1) living around black people is bad for one's health; or (2) residential segregation represents the larger structural phenomenon of race which has an impact on health outcomes (Collins & Williams 1999; Williams & Collins 2001). Unfortunately, the multilevel method often does not allow one to discern which practical explanation rings true.

### ***Formal Experiments***

Formal experiments are the product of contrived social situations that are designed to infer the mechanisms behind racial inequality. They may take the form of: (1) lab-studies with respondents interacting with authority figures or "confederates" (Richeson & Trawalter 2008; Steele 2003); (2) audit studies where confederates participate in a discrete social interaction with

unknowing respondents (Bendick et al. 1999; Bendick et al. 1994; Bendick et al. 1991; Fix et al. 1993; Heckman & Siegelman 1993; Pager 2003; Saltman 1979; Yinger 1993); and (3) vignette studies where respondents rate/gauge a series of faux materials such as resumes or medical records (Loring & Powell 1988; Perneger et al. 1995). Each formal experiment is designed to approximate a social space in the everyday world. The intent of the method is to examine how stimuli (i.e., manipulations) in a controlled environment elicit various responses (Walker 2011; Walker & Willer 2007; Willer & Walker 2007). The focus of the race researcher is how race influences the response of actors to a stimuli *and* how this may influence the dynamics of race in the real world.

The formal experimental model is written

$$y_i = f[T_i, C_i] \quad \text{where } T_i = h[r_i, x_i] \text{ and } C_i = g[x_i, T_i, P_i] \quad (11)$$

where  $y_i$  is the experimental outcome for respondent  $i$ . This outcome is a function of the stimuli  $T_i$  and the response to the stimuli  $C_i$ . The stimuli is a function of race  $r_i$  and other respondent characteristics  $x_i$ , while the coping response is a function of respondent characteristics, the stimuli, and the perception  $P_i$  of the stimuli by respondent  $i$ .

Certainly, formal experiments offer great insights into how social actors experience a finite interaction (Walker 2011). Researchers can vary the form of the interaction, the treatment, and the resources available to respondents. One can assess how a specific manipulation is tied to a specific coping response and outcome. The issue with formal experiments is generalizability. They typically use convenience samples—mostly college students—to examine a social interaction. These samples limit generalizations to the social spaces from which the sample is drawn. Audit studies and vignettes provide more representative alternatives to lab studies as they are conducted outside of the laboratory environment. These type of experiments draw on real-life social interactions (e.g., review of resume) to evaluate how people respond to a stimuli “in the wild.” However, they are also limited because they focus on a finite interaction in what is usually a convenient social location for the researcher.

### ***Computational Approaches***

The computational (i.e., agent-based) approach to studying racial inequality is considered the latest quantitative method being used in the area. Schelling (1971), however, used it in a pioneering study of residential segregation over thirty years ago. Schelling randomly populated a checkerboard with black and white checkers. He then selected checkers at random and moved them using a simple rule: If your neighborhood (i.e., the blocks surrounding the checker) has at least 50% of checkers of your color then stay; otherwise, move to the

nearest open square that satisfies this preference. Schelling showed that perfect residentially segregated communities can result (i.e., emerge) from agents independently using a simple preference rule for living in a neighborhood where one-third of the population is of the same racial group. The micro-level preferences for mixed neighborhoods created a macro-condition of segregated communities.

The computational approach is designed to reveal how several of independent agents may interact to create a larger social phenomenon (Epstein & Axtell 1996; Hanneman et al. 1995; Leik & Meeker 1995; Moss & Edmonds 2002). Macy and Willer (2002:144) precisely describe the aim of the approach noting: “[We] may be able to understand [the] dynamics [of human groups] much better by trying to model them, not at the global level but instead as emergent properties of local interaction among adaptive agents who influence one another in response to the influence they receive.” The computational approach, then, is a means to examine how the finite behaviors of artificial agents in repeated social interactions coincide *and* compound to create a larger social phenomenon such as racial inequality (Cederman 2005; Epstein & Axtell 1996; Hanneman 1995; Stewart 2010).

Indeed, each analysis that uses computational approach model is distinct. The two things that connect the models are: (1) Agents interact with other agents on the basis of a set of rules; and (2) They use bounded rationality in their decision making (i.e., they do not have complete information). Each agent is running a simple, logical model in each interaction. Equation 12 details the generic model used by agents in the computational approach.

$$y_{i,k+1} = f[T_{ik}, P_{ik}, C_{ik}] \text{ where } T_{ik} = h[r_i, x_{ik}], P_{ik} = g[x_{ik}, T_{ik}, T_{i,d \neq k}, T_{j \neq i, k-1}] \text{ and } C_{ik} = z[x_{ik}, T_{ik}, P_{ik}] \quad (12)$$

An agent’s outcome in an encounter  $y_{i,k+1}$  is a function of the treatment  $T_{ik}$ , perceptions  $P_{ik}$ , and coping responses  $C_{ik}$  of the current encounter. The treatment, perceptions, and coping responses covary with each other (i.e., they are endogenous), and are also a function of agent characteristics (e.g., race, previous outcomes). Using Schelling’s segregation model as a frame, one can walk through the functional model where an agent is treated by being placed in a neighborhood. The agent perceives the composition of this neighborhood—in this case, the comparison is to a preference set—and makes an adaptive coping response (i.e., moves) if the racial composition of the neighborhood is not to his or her liking. Altogether, the model allows one to formally imagine the natural consequence of countless micro-behaviors.

Although the computational approach best captures the complexity implicit in racial inequality, it has a huge limitation. Namely, it is based on artificial data. One can examine how various theories may dynamically intersect at the level of individual to produce the larger system of racial inequality, but the

analysis is all based on data that is contrived. Epstein (2008) responds to this criticism:

Anyone who ventures a projection, or imagines how a social dynamic—an epidemic, war, or migration—would unfold is running some model. But typically, it is an implicit [theoretical] model in which the assumptions are hidden, their internal consistency is untested, their logical consequences are unknown, and their relation to data is unknown. ... The choice, then, is not whether to build models; it's whether to build explicit [agent-based] ones. In explicit models, assumptions are laid out in detail, so we can study exactly what they entail. (pp. 1.3–1.5)

The utility of the computational approach is that one can examine the merits of theory and assess the natural consequence of micro-level behaviors observed in a laboratory setting or in qualitative research. These concrete benefits, however, do not change the fact that the computational approach is still a dynamic *artificial* model of the system of racial inequality.

### **COUNTING RACE: THE MASTER PLAN**

The quantitative analysis of race and racial inequality presents researchers with an array of dilemmas. “How do we measure race? Can survey data capture the dynamic, interactive process? Are we able to replicate experiments in the real world? Does my residual race effect measure discrimination? How can I model structure?” No technique will sufficiently address all of these and many other dilemmas (i.e., questions). Every method has at least one major limitation that prevents an analyst from strictly confirming/refuting a theory on the emergence, experience and maintenance of race and racial inequality (see Table 10.1). The question remains: How should we conduct policy relevant quantitative race research given the limitations of each method?

There are two solutions to the dilemma. The first solution is to continue the status quo. One can conduct research and mention the limitations in the Methods and Discussion sections of an article. For many, this will be the preferred solution. There are no real costs to this solution other than the addition of text that lists the caveats of the analysis. One may also add qualifying language to the interpretations of the results to better frame the contribution of the study to the literature. The pitfall is this solution does not advance our understanding of the system of race and racial inequality. A researcher must still speculate about the policy relevance of a significant residual correlation between two variables. Or, one must infer what a finite interaction in a laboratory experiment would look like in the real world when it's taking place in millions of interactions in various social realms everyday. The inability to

**Table 10.1** Summary of Quantitative Methods for Race Research

<i>Method</i>	<i>Benefits</i>	<i>Limitations</i>
Traditional survey	Easy to apply, elegant design, cost effective	Static data (i.e., not dynamic), causality inferred
Comparative analysis	Easy to apply, elegant design, identification of broad mechanism, cost effective	Static data (i.e., not dynamic), causality inferred, requires good criterion variable
Natural experiment	Elegant design, identification of policy mechanism (i.e., quasi-manipulation), causal model	Overlooks micro-level response to manipulation, requires good instrument (i.e., quasi-manipulation), inflexible manipulation
Multilevel analysis	Flexibility in model specification, incorporates time (i.e., longitudinal) or space (e.g., geography, social), models growth/emergence	Overlooks micro-level processes (e.g., treatment, response), requires good conceptual measurement at each level, causality inferred (geographic models)
Formal experiment	Models micro-level interaction, causal model, flexible manipulations	Small sample size, limited generalizability, mechanisms and manipulations are often contrived (i.e., not real), high costs
Computational	Dynamic data, simultaneously models micro-level interaction and system, causal model, flexible manipulations, large sample size	Contrived data, limited generalizability, difficult to apply

shed light on more than one aspect of the dynamics of race and racial inequality makes this solution undesirable.

A second solution is to conduct research that uses more than one quantitative method. This solution draws on the allegory of the blind men and the elephant. Each of the blind men in the allegory touches one part of the

elephant to infer what the elephant looks/feels like. The consequence of this event is that each blind man has a different description of the elephant. This leads to a conflict as to which description is correct.

As in the allegory, a scientist (or group of scientists) who conducts quantitative race research using one method illuminates one aspect of the system of racial inequality. Another, using a different method, sheds light on another dimension of racial inequality. This is further complicated by research being conducted using one social domain, sample, and/or general specification. The conclusion of these separate scientific investigations using different methods is often disagreement—specifically, a heightened conflict about the social experience of racial inequality and the policy solutions.

We can, however, solve this dilemma by taking a lesson from the blind men and the elephant allegory. The blind men were limited to inferences based on touching one aspect of the elephant. As scientists, we are free to study the experience of racial inequality using an array of quantitative methods; we are only limited by our training and imagination! We can advance our understanding of race and racial inequality by using complimentary quantitative methods (i.e., one method overcomes the limitations of the other)—as well as qualitative methods that better capture the immeasurable human experience (e.g., emotion, spirituality). These types of analyses will provide insights into how the concept of race becomes racial inequality across the course of social interaction and better reveal the social experience of race.

Perhaps the best example of this second solution is seen in group processes research. Social scientists in this tradition use an array of methods to reveal the mechanisms behind a particular outcome (e.g., the emergence of status value for a characteristic) (Berger et al. 1972; Cohen 1982; Ridgeway 1991). These scholars use formal experiments, computer simulations, and traditional surveys as well as qualitative methods to ascertain the fundamental mechanisms of a particular social process (Cohen & Lotan 1995; Ridgeway 1997; Ridgeway & Balkwell 1997; Ridgeway et al. 1998; Ridgeway & Johnson 1990; Robinson & Smith-Lovin 2001; Smith-Lovin & Brody 1989; Umberson & Hughes 1987). No one researcher performs all the methods. Rather, they collaborate with methodologically divergent colleagues to assess the different aspects of the system of interest. In race research, this strategy would provide a more nuanced understanding of the social and policy mechanisms that create and maintain racial inequality.

Indeed, triangulation in quantitative race research would be most effective at capturing the multiple mechanisms that create and maintain racial inequality—at once a social identity, an institutional force, and a network structure. One example of the triangulation approach in race research is a disparate outcomes study that employs traditional survey research, multilevel models, and computational methods. Sewell (Forthcoming) is using this approach to analyze racial discrimination as a fundamental cause—or multi-pathway

mechanism—of health disparities. In the analysis, she connects a longitudinal survey of youth who are nested in neighborhoods with: (1) data from a community survey of adults living in the neighborhoods; and (2) systematic observations of the institutional and environmental features of the neighborhoods.

Sewell uses traditional survey methods and multilevel analysis to model the emergence of health disparities, and, subsequently, the individual- and community-level characteristics that are related to this emergence. The limitation of this initial analysis is that it ignores the micro-level processes (i.e., agency of actors) that influence the relationship between the variables of interest. To overcome this limitation, she uses the computational approach to estimate how human agency (i.e., selection effects) and health behaviors may bias the results. Thus, Sewell uses triangulation to reveal the nuanced mechanisms that shape the experience of race and racial inequality.

### CONCLUDING THOUGHTS

In his early article entitled “The Study of the Negro Problems,” Du Bois (1898:2) defined a social problem as “the failure of an organized social group to realize its groups ideals, through the inability to adapt a certain desired line of action to given conditions of life.” Du Bois viewed the exclusion of Blacks from fully participating in the national life of the United States as a pressing social problem. In the course of his career, Du Bois aimed to use social scientific research to reveal the sources of the race problem so they could be used as guides for policy aimed at eradicating racial inequality.

The continued significant racial disparities in earnings, educational achievement, health outcomes, and countless other measures of social and physical well-being represent a modern social problem (Conley 1999; Grodsky & Pager 2001; Hayward & Heron 1999; McCall 2001; Oliver & Shapiro 1995; Stewart 2009; Stewart & Dixon 2010; Williams & Collins 2001). Though minority groups are no longer excluded from the gamut of social realms through legal means, significant disparities in well-being are signs that the complex system of racial inequality still exists. Our task as social scientists is to shed new light on the mechanisms used to maintain this system. For quantitative social scientists, this means using formal, mathematical techniques to measure the extent to which a social policy, network, or other pattern of social interaction influences the experience of racial inequality in a particular social dimension.

Quantitative race researchers must produce empirically sound estimates of the nature and magnitude of racial inequality and assess the varying degrees to which specific mechanisms act to create and maintain racial outcome disparities. The dilemma is that our methods, when used singularly, undermine our ability to clearly identify the range of mechanisms behind race and racial

inequality. We can overcome the limitations in one method by supplementing our analyses with complimentary methods. Data limitations may prevent scholars who study less-developed regions or novel outcomes from using an array of methods. One may have to build the infrastructure to perform complimentary quantitative analyses of racial inequality in a particular environment. The benefit of the complimentary analyses, though, is the ability to circumvent the limitations of single method and shed new light on the social machinery (i.e., mechanisms) that constitutes the system of race and racial inequality. By revealing these mechanisms, quantitative social scientists set the stage for realizing the larger universal ideals of fairness, equality, and justice for all. And then we may begin to see the promise of race research in the United States and beyond.

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