

Signal Manipulation and the Causal Analysis of Racial Discrimination

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Abstract

Discussions of the causal status of race focus on the question of whether race itself can be experimentally manipulated. Yet many experiments testing for racial discrimination do not manipulate race, but rather a signal by which race influences an outcome. Such signal manipulations are easily formalized, though contexts of discrimination introduce significant philosophical complications. Whether a signal counts as a signal for race is not merely a causal question, but depends on sociological and normative issues regarding discrimination. The notion of signal manipulation enables one to take these issues into account while still using causal counterfactual tests to detect discrimination. The analysis provided here is compatible with social constructivism and helps differentiate between cases in which it is more or less fruitful to model race causally.

1 Introduction

Discrimination is, in part, a causal concept. The claim that an individual was discriminated against based on their race entails that their race made a difference to how they were treated. Yet there is currently a great deal of perplexity surrounding causal claims about demographic variables such as race. The problem arises within the methodology of causal inference, which evaluates causal claims using counterfactuals concerning the results of “manipulating” a purported cause for an individual, while keeping their other properties fixed. But it is doubtful whether there are hypothetical manipulations that change only a person’s race, while keeping all other factors fixed. This concern has been taken seriously by social scientists studying discrimination. The three dominant proposals addressing this have been 1) to claim that the relevant manipulation is not on race, but on the discriminator’s perception of race (Greiner and Rubin, 2011), 2) to claim that race is a cluster concept and that the relevant manipulations are on its components (Sen and Wasow, 2016), and 3) to deny that counterfactual causal methods are suitable for modeling discrimination (Kohler-Hausmann, 2018).

None of these approaches can account for the way that discrimination is empirically tested, even for simple experimental designs. Consider Bertrand

and Mullainathan (2004), who sent out resumes assigned either stereotypically black or white names and measured the difference in callback rates for otherwise similar candidates. Such experiments – called *audit studies* – provide a plausible test for a type of discrimination within certain contexts. Yet I will argue that the first two approaches introduce complications that make it harder to understand why the manipulations in the experiments play this role, while rebutting the third position that they cannot do so. While the following discussion will reveal there to be no shortage of thorny methodological questions related to causally understanding racial discrimination, the approaches listed problematize experiments that are not in fact problematic.

A great deal of confusion can be avoided by gaining a clearer understanding of the type of manipulation involved in Bertrand and Mullainathan’s experiment. The core idea is simple: although the experiment manipulates the name on the resume, this manipulation is informative only because the name is treated as a reliable signal for a person’s race. This is in some sense obvious – the purpose of the experiment is not to test for *name* discrimination, but *race* discrimination. But this feature of the experiment has not been discussed systematically, and is in fact non-trivial to reconcile with features of causal methodology. Notably, manipulations, when formally modeled as interventions on variables in a causal model, make a variable no longer depend on its causes other than the intervention. However, the value of name on the resume derives from its carrying information about race, and this informational link would be destroyed by such an intervention. We see that such manipulations, which I call *signal manipulations*, behave differently from standard manipulations, and thus call for their own analysis.

Here I present an analysis of how one tests for racial discrimination by manipulating signals for race. One might worry that my analysis commits one to a problematically realist view of race: If one were to assume that race is socially constructed, could one talk about race independently of its signals? I will argue that this worry is ill founded: the social constructedness of race does not entail that the relevant construct must reduce to its various manifestations. What this means for the causal status of race is a complicated question that I will only begin to evaluate here. I will suggest that whether it makes sense to causally model race varies based on the scenario and the particular normative or empirical context. My proposal will help explain why one can sensibly talk about race causally in some cases and why it is problematic in others. This will offer a way towards a deeper exploration of what makes race causally complicated, without throwing into doubt the ability to test for (at least certain kinds of) discrimination using well-designed experiments.

Since I will touch on the issue of the social constructedness of race, it is worth highlighting how my strategy here diverges from the dominant ones in philosophical discussions of this topic. There is an ongoing discussion about whether race is in some sense real, even granting that it is not a biologically essential category (Haslanger, 2012; Mallon, 2017, 2018; Hochman, 2017; Kincaid, 2018; Msimang, 2019). The motivation for trying to understand race as real is naturalistic: race plays an important and seemingly ineliminable role in

successful social-scientific models (e.g. of inequalities). As Khalifa and Lauer (2021) point out, this literature considers the social scientific role of race in the abstract, without more nuanced analysis of the role on race within particular empirical models. The following discussion will reveal the fecundity of carefully analysing the issues that arise in such models. I emphasize, however, that my aim here is not to weigh in on the questions of whether and to what extent race is real, but rather to consider the extent to which such questions can be put to the side when evaluating causal models for detecting discrimination. While my discussion could fruitfully be extended to further engage with analyses of social constructions, here I offer a way to understand tests of discrimination in a way that does not sensitively depend on the conclusions of such an analysis.

2 Manipulability

The starting point of this discussion is a rather technical methodological issue: Although it is common to test and analyze causal claims in terms of whether one can influence the effect by manipulating the cause in a particular way, it is unclear if demographic variables such as race can be so manipulated (Holland, 1986; Glymour, 2007; Holland, 2008; VanderWeele and Robinson, 2014; Glymour and Glymour, 2014; Pearl, 2018). For readers interested in exploring race in all of its sociological and normative complexity, this technical focus might initially come as a disappointment. Nevertheless, there is a great deal to be learned from juxtaposing methodological questions about how to empirically detect racial discrimination with sociological/normative questions about what race is and what makes racial discrimination distinctively wrong. Two of the analyses we will consider (Sen and Wasow, 2016; Kohler-Hausmann, 2018) see the position that race is socially constructed as having direct implications for whether it can be manipulated. I believe that the connection between what race is and whether it is manipulable is not nearly as tight as suggested by these analyses. Clarifying these issues will require some background regarding what is at stake in debates over manipulability and why race is supposedly not manipulable. This section will provide this background.

I will use the terms “manipulation” and “intervention” interchangeably, though I note that the term “manipulation” often suggests a concrete change to a system, while the term “intervention” is preferable when discussing more abstract formal characterizations of such changes. *Ideal interventions* are a paradigm example of such a characterization. An ideal intervention on a variable sets that variable’s value in such a way that it depends only on the intervention, rather than on its other causes. Such interventions are useful for addressing the problem of “confounding” (Pearl, 2009, ch. 6). As a standard illustration: a strong correlation between smoking and cancer might indicate not that smoking causes cancer, but merely that those with a propensity to develop lung cancer are also more likely to smoke. To rule out this possibility, one can intervene to make test participants smoke whether or not they would otherwise. In a *randomized control trial* this would be accomplished by randomly assigning

subjects to either smoke or not smoke. Successful randomization ensures that whether a participant smokes is independent of any of their properties, including those that influence their propensity to get lung cancer.¹ Any remaining correlation between smoking and cancer under randomization thus reveals that smoking *causes* cancer.

Beyond their experimental utility, interventions have been central to the analysis of causation, since genuine causal relationships may be distinguished from merely probabilistic ones in terms of the former enabling one to predict the results of interventions (Woodward, 2003). Some philosophers might dismiss interventions as being of “merely” methodological significance, and thus of little relevance for understanding what causation is. Such philosophers would readily accept the existence of causes that cannot be manipulated as evidence that the set of causes in the world is wider than the set of variables that one can intervene upon and thus might dismiss what follows as being of interest only to those adopting a controversial “interventionist” view of causation. As a preliminary response, it is crucial to clarify that the concept of an intervention applies even in cases where human agents cannot intervene for practical or ethical reasons. Although the ethics research board won’t permit interventions to make people smoke, it is clear enough what such an experiment would look like. The Federal Reserve would not randomly intervene upon the economy, but clever researchers will seek naturally occurring “instrumental” variables that play the same evidential role as interventions (Angrist et al., 1996). What matters in principle is how variables *would* respond to interventions, rather than whether such interventions are feasible.

Still, why think that the set of causes should be at all delimited by the set of manipulable variables? The position I adopt here is not that there cannot be non-manipulable causes (I remain agnostic on this point), but rather that certain types of non-manipulability threaten the intelligibility of viewing the variable in question as a cause. Taking a step back, questions about whether some relationship is causal only make sense relative to an implied contrast regarding what it would be for it *not* to be causal. In the well-understood case of the randomized trial, we are interested in whether someone’s taking a drug brought about their recovery, or, instead, whether learning that someone took a drug is *merely evidence* that they are the type of person who would have recovered even without the drug. The key to randomization is that because, in the limit, the treatment and control groups – e.g. the groups that received the drug as opposed to the placebo – differ only in their treatment status, one can take the outcome in the control group as reflecting the outcome that the members of the treatment group would have had (on average) had they received the control (and vice versa). This works only because it is possible to vary one property, while keeping the distribution of all other properties the same across the groups,

¹For a randomization to be “successful”, participants must comply with their randomly assigned treatment. Additionally, randomization only ensures the similarity of the treatment and control groups in the limit – in finite samples these groups may differ due to chance. These qualifications will not impact the following discussion.

and this possibility underlies interventions more generally.² At the extreme, imagine that it were impossible to vary whether an individual was in one group or another without varying all properties of the individuals across the groups. It would arguably no longer make sense to ask whether the group an individual is in is causally or evidentially relevant to a particular outcome. Had she been in the other group, she would have been an entirely different individual. In such a case, the impossibility of characterizing an intervention on group status is not just a pragmatic limitation, but rather reflects that a standard basis for conceptually differentiating causal from non-causal relationships is inapplicable.

Discussions of whether demographic variables are manipulable are sometimes posed as metaphysical questions about whether it is possible to change someone's race or gender compatibly with their being the same person. But the real issue is not metaphysical identity, but rather whether the variable in question can be manipulated independently of other variables characterizing an individual (Weinberger, 2015). If it made sense to talk about intervening upon a person's race independent of their other properties, this would be sufficient for differentiating causal from merely evidential relevance, and the question of whether the person would remain the same individual would be of no further relevance to whether race is a cause. Of course, it remains far from clear that it does make sense to talk about changing race in this way. This is why the question arises as to whether and how one can experimentally test for its purported effects. Nevertheless, the discussion has already yielded an insight that will be crucial for evaluating proposals for causally understanding race. Namely, whether it makes sense to reason about race causally boils down to whether it is possible to reason about variation in race independently of variation in an individual's other properties.

In the context of empirically modeling racial discrimination there is often little need to answer unrestricted questions about how a person would have been different had they been of a different race. It would already be progress if we could clarify what it would mean for race to influence how a person is treated in particular discriminatory contexts. Even given a simplistic view of race, however, it is non-trivial to clarify how the effects of race are measured in a particular context. Marcellesi (2013) imagines a fictional experiment in which one intervenes on a fetus' genes in utero to change the future child's race (understood biologically). Even supposing that such an intervention made sense, it would still not be the intervention of interest in standard contexts of discrimination. If one wants to know whether a job candidate who was denied a position last week was discriminated against, one is presumably *not* asking whether she would have gotten the position had she spent her whole life as a person of a different race. Plausibly, such an intervention would change many facts about her life trajectory, making it unlikely that she would even end up applying for the job. We see that even if one is willing to conceptualize race in a limited way such that it can be manipulated, one needs to further show

²More precisely, while an intervention varying some property X will lead to variation in X 's effects across the groups, all such variation must be *via* X . This requires that the intervention does not *directly* change all the properties of the groups (see Woodward, 2003, § 3.1.3.)

that the envisioned manipulation is relevant for establishing a certain type of discrimination.

In many contexts where a variable is said to be “non-manipulable” the issue is not that there is no intervention one could perform on it, but rather that there are too many distinct interventions. This might not be an issue when the intervened-upon variable can be characterized such in a way that its influence on its effects is invariant across different versions of the intervention. But many variables are not like this (Spirtes and Scheines, 2004). Regarding race, one can imagine a range of experiments testing the effects of race in a particular context, including interventions changing an individual’s external appearance, interventions changing how that individual is viewed by others in a context, and perhaps even interventions on whether the individual lives in a society with racial disparities – to name just a few possibilities. Each of these corresponds to a different experiment with different effects, and consequently one cannot talk about intervening on race without clarifying which particular intervention one has in mind. This problem suggests its own solution (Woodward, 2003, p. 116-117): experimenters should limit themselves to only talking about race in the context of particular interventions on race, and to avoid discussing race without specifying particular interventions.

Although this disambiguation strategy is useful for generating manipulable variables, it should be viewed only as the first step towards understanding race and racial discrimination causally. Beyond specifying a manipulable race-related variable, one must defend that the relevant intervention is a suitable one for testing for racial discrimination. This is non-trivial, as we will presently see when we look at existing proposals in the literature for modeling (or rejecting) the manipulability of race. One basis for evaluating these proposals will be in terms of their ability to account for audit studies in which the experimenter varies a cue related to a person’s race to see how doing so impacts whether they are hired. Notably, Bertrand and Mullainathan (2004) sent out resumes randomly assigned names that are perceived as stereotypically white or black to see whether this impacted the fictional applicant’s chance of receiving a callback (it did). Although this experiment only considers a particular type of employment discrimination in a limited context – e.g. one in which there is no in-person interaction – I take it to be a fairly clean cut test of racial discrimination. One would therefore hope that existing proposals for the manipulability of race could easily account for the relevant manipulation.

While the proposals to be discussed concern race, the issue of non-manipulability arises also for other demographic variables, such as gender and age (Fosse and Winship, 2019). Here I will focus on race, though in later discussions of socially constructed variables, an occasional example involving gender will help. Moreover, even with respect to race I will only consider certain types of purported effects. Specifically, I’ll emphasize types of discrimination that involve agents or institutions “detecting” the races of individuals. This is what is at issue in many standard queries about employment discrimination and discrimination by police. We will see that not all discrimination is like this. Some

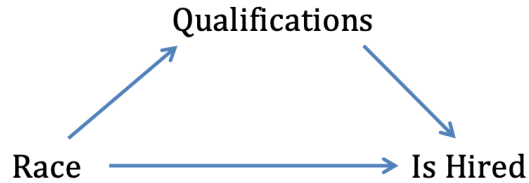


Figure 1: Discrimination DAG

discrimination (e.g. redlining)³ relies on indirect proxies for race (Prince and Schwarcz, 2019), and broader patterns of discrimination do not simply reduce to the actions of agents or institutions. These issues are pressing, and are more complicated than those considered here. This paper is motivated by my view that existing proposals cannot even account for simple tests of discrimination and that a better one is a prerequisite for clarifying more complicated scenarios.

3 Problems with Existing Solutions

3.1 Greiner and Rubin: Race as Perception of Race

Greiner and Rubin (2011) propose that instead of treating race itself as a cause, experiments on discrimination should be understood as manipulating the discriminator’s perception of race. This proposal clearly gets something right. In audit experiments, one is interested in whether the candidate would have been called back had the employer *thought* they were of a different race, not whether they had *been* a different race. And it is a virtue of the proposal that it locates discrimination not in some allegedly intrinsic feature of the individual, but rather in how others respond to that individual. The limitation of the proposal is the extent to which it links the intelligibility of discrimination claims to specifications of who is making the potentially discriminatory decision and of “the moment the decider first perceives a unit’s race” (Greiner and Rubin, 2011, p. 775). It therefore cannot account for cases in which these details are not relevant. In an audit study measuring callbacks, we simply do not need to know how many people were on the hiring committee to judge whether discrimination is occurring. Given a compelling argument that the names differ in the information they provide about race (and not about other features), a difference in callback rates would provide evidence of racial discrimination.

Further questions arise if one takes the proposal as offering the variable *perception of race* as a replacement for *race*. Consider the plausible if simplistic model for audit studies in figure 1. The model posits a person’s race as

³“Redlining” refers to financial institutions treating zip codes predominantly containing minorities differently from zip codes that do not, thereby discriminating against minorities without explicitly taking minority-status into account at the decision-making level.

potentially influencing whether a candidate is hired via two paths (sets of connected causal arrows). First, prior discrimination may have led the candidate to be denied opportunities to develop job-relevant qualifications, resulting in the candidate being denied the job due to lacking these qualifications. This is represented by the indirect path from *race* to *qualifications* to *is hired*. Second, the candidate may be not hired due to the employer identifying their race. This is represented by a direct path in the model, but we could just as easily have included an indirect path through a variable for the name on the application. Pearl (2001) presents this model to illustrate that when evaluating discrimination, what matters is not whether race has *any* effect on being hired, but rather whether it influences being hired by the direct path (i.e. holding qualifications fixed). Note that in this model, one cannot just replace the variable *race* with *perception of race*. Although perception of race can plausibly describe what is happening along the direct path, the current hirer’s perception of the candidate’s race has nothing to do with why the candidate has her current qualifications. Although the issue here traces in part to the simplicity of the model, the lesson generalizes. One cannot simply replace race with some particular operationalization of race and assume that one’s models will still be coherent. Even in relatively simple experiments, it will be important to keep track of both race as well as the way that it influences a particular outcome.

In the model just considered, one could compellingly argue that even the influence via the the indirect path is mediated via the perceptions of discriminators other than the employer. Accordingly, in rejecting the proposal to reduce race to perception of race, I am not committing myself to the claim that there is a notion of race that is independent of the way individuals are perceived by a society (nor am I committed its denial). My target is rather the position that one can address issues of the manipulability of race by talking instead about interventions on particular discriminator’s perceptions of race. In my positive proposal, I will defend the usefulness of modeling race independently of particular avenues by which it is detected.

3.2 Sen and Wasow: Race as a Bundle of Sticks

Sen and Wasow (2016) propose that instead of attempting to define a single race variable that can be manipulated, race should instead be defined as a cluster property consisting of an aggregate set of elements, some of which can be manipulated in particular experiments. The guiding analogy is that race is a “bundle of sticks”, where race corresponds to the whole bundle and the sticks correspond to its aggregate elements. As is evident from their choice of metaphor, their account is not designed to say anything about the relationship between the sticks and the bundle, or to provide a basis for theorizing which elements should count as being in the bundle at all. They do suggest that some elements of the bundle are more mutable than others, and thus more manipulable (507). Yet clearly the aim of the account is not to provide a unified framework for thinking about the relationship between the different elements of race, but rather to emphasize that race consists of many elements and that only

a subset of elements will be under consideration in any particular study.

Sen and Wasow present their account as clarifying how the effects of race are tested in a range of experiments, including the audit experiments emphasized here. They go beyond Greiner and Rubin by distinguishing between race and its elements, but have little to say about how these relate to one another. This is an issue, because it leaves them unable to specify why particular manipulations are relevant for testing the effects of race. For instance, their account analyzes audit studies by saying that the manipulated cue is a part of race – a “stick” in the race bundle. But saying that the name on the resume is a part of race that can be manipulated does not explain why the name is manipulated in the way that it is. It is crucial to Bertrand and Mullainathan’s experiment that the name is not altered arbitrarily, but rather in such a way as to vary the racially relevant information that is being transmitted to the hirer. This feature of the experiment is better characterized by treating the name as a *proxy* for race rather than a part of race, as I will illustrate with my positive account. While Sen and Wasow do in fact use the word “proxy” in describing audit studies, proxies are not *parts* of the entities they represent, but distinct from them.

I suspect that the appeal of Sen and Wasow’s position derives from an underlying assumption that since race is a social construct, one cannot legitimately model it as independent of its social manifestations. My suggestion that the manipulated variables are not parts of race but rather proxies would thus be rejected as relying on a contentious claim that race has an existence independent of its proxies. In section 5, however, I will argue that this underlying assumption is wrong. The social constructedness of race is compatible with modeling race independently of its proxies.

3.3 Kohler-Hausmann: Abandon the Causal Approach

According to Sen and Wasow, the purported non-manipulability of race results from misunderstanding it as biologically essential, and switching to a social constructivist view clarifies how its parts can be manipulated. In contrast, Kohler-Hausmann (2018) argues that counterfactual causal tests for discrimination are *incompatible* with understanding race as socially constructed. On her view, because race is constituted by a complex set of social relationships, localized counterfactual tests are unsuitable for detecting racial discrimination in experimental contexts. Kohler-Hausmann’s discussion contains a wealth of insights that will be central to the subsequent discussion. In this section, however, my aim is to rebut her claim that the counterfactual approach presupposes the biological reality of race.

To illustrate her thesis that counterfactual approaches are inappropriate for evaluating socially constructed categories, Kohler-Hausmann describes a hypothetical society stratified into two groups: Royals and Non-Royals. Royals are identified by their wearing purple capes and carrying sticks, and are considered so above Non-Royals that the latter are expected to step off the sidewalk when a Royal approaches. An anthropologist observing this society would miss the significance of the Royal/Non-Royal distinction if they myopically focused on

the effects of capes on sidewalk behavior. The counterfactual “If I changed an isolated trait about a person (cape, stick) and nothing else changed about that person, would other pedestrians have remained on the sidewalk?” (p. 1180) locates the disparate treatment in the behavior of individuals, while it is better understood as a reflecting the social stratification of the society. Put differently, the answer to the question “why did the Non-Royal step into the road” is not, “because she encountered a cape-wearer”, but “because she encountered a Royal” (cf. Dembroff et al., 2020). Being a Royal does not reduce to the features used to identify Royals, but is a fact about the status attributed to different groups within a society. Similarly, race is a social category, and Kohler-Hausmann sees the counterfactual approach as a misguided attempt to reduce it to superficial features such as skin color.

In modeling discrimination, the anthropologist’s lens is not the only one that matters. Intervening to give a Non-Royal a cape and stick and seeing if other Non-Royals defer to them would not tell the researcher why Royals are privileged within the society. But it is a perfectly good test of whether Non-Royals are being discriminated against in the particular context. Such a test would not resolve the question of whether such discrimination is bad or what makes it so, and thus would be of limited use to a lawmaker deciding whether to design legal protections against it. But it would nevertheless be a vital test to conduct if one was uncertain whether Royals and Non-Royals were being treated differently on sidewalks. Contra Kohler-Hausmann, a category’s being socially constructed does not mean that counterfactual tests are ill-suited for testing for discrimination based on that category.

Throughout, Kohler-Hausmann conflates the issues of whether causal counterfactuals provide an analysis of what discrimination is and why it is bad with the issue of whether such counterfactuals are relevant to *detecting* discrimination, which is what she claims to be addressing. Before elaborating upon this criticism, I should emphasize that there are cases in which counterfactual tests are used to address the former issues, and for those her objections hit their mark. Dembroff, Kohler-Hausmann, and Sugarman (2020) discuss a lawsuit pertaining not to race but sex, and in particular whether protections based on sex also protect individuals based on sexual orientation. In particular, if a male employee is fired for being married to a man, do we say either that A) he was discriminated against based on sex, because had he been a woman married to a man he would not have been fired or that B) he was not discriminated against based on sex, but on sexual orientation, since had he been a woman in a homosexual marriage he still would be fired. Each option appeals to a different counterfactual, and which counterfactual to choose cannot be resolved by appeal to value-free facts about the individual, but rather to social questions about whether sexual orientation is part of the social category of sex, as well as normative questions about why sex merits legal protections against discrimination.

Kohler-Hausmann emphasizes that the counterfactual approach sheds little light on what race is or what makes discrimination based on race – as opposed to, e.g., having freckles – sufficiently bad to merit special constitutional protections. The answer to these questions is found not in facts about individuals,

but requires reference to broader social and historical patterns of discrimination. Nevertheless, it does not follow that *given* assumptions about which categories are protected, one cannot use counterfactual tests for detecting discrimination. And it is not clear how one could do without such tests. An individual's claim to have been racially discriminated against would be undermined if they would have been treated similarly even had they been of a different race.

4 Signal Manipulation

In testing whether Non-Royals defer to Royals, one does not manipulate whether someone is a Royal, but whether someone has a cape and stick. This test only works, however, if the cape and stick are *reliable signals* for royalty. If the Non-Royal were not fooled into identifying the caped individual as Royal, she would not defer to her. That said, if the disguise *is* convincing, the test does establish an effect of royalty in this localized context. This effect is just one node in the nexus by which the society reinforces its social structure. Yet even this localized example has structure that eludes existing approaches to manipulability. The test described requires that one attends to both the Royal status and its signal, as well as their systematic relationship. Greiner and Rubin focus only on the signal. Sen and Wasow cannot account for the systematic relationship. Kohler-Hausmann recognizes the complexity and non-manipulability of status, but denies that the effects of status are tested via the manipulation of signals.

The robe and stick are reliable signals for royalty insofar as they counterfactually track one's royalty status. Outside of the experiment, they correspond to what one would have if and only if one were a Royal. Similarly, in Bertrand and Mullainathan (2004), the name on the resume is only significant insofar as it reliably tracks the applicant's race. The study involves holding the individual's qualifications and non-racially-identifying factors fixed while changing the signal by which information about their race is transmitted.

Schematically, we can describe a signal-based manipulation with three variables, C for the category (e.g. race), S for the signal, and Y for the outcome (i.e. the effect). S reliably tracks C , and this relationship obviously calls for further elaboration. From the modeling perspective, the most crucial feature of this relationship is that one can specify how S would counterfactually vary given different values of C . A signal-based manipulation involves manipulating S . But unlike with ideal interventions, one does not do so to render it fully independent of its prior causes. Rather, one manipulates it to make it vary in the way it would were C to have one value as opposed to another. So if C has two values, c and c' , which are reliably tracked by the values s and s' , respectively, then signal-based manipulations for the influence of C on Y would correspond to the result of manipulating S from s to s' .

In Bertrand and Mullainathan (2004), C is race (black or white), S is the name, where certain names are treated as reliable signals of race, and Y is whether the applicant gets a callback. To test for whether a black candidate was discriminated against, one changes the name from that which the candidate

would (and does) have as a result of being black to a name they plausibly would have were they white. If this change in the name leads to a change in the probability of getting a callback, this is taken to show that *race* influences callback. In this manner, one tests for the effect of C on Y by manipulating S .

As a practical matter, whether a name in fact tracks race is not tested by the experiment itself, but is part of the experimental design. Bertrand and Mullainathan (p. 995) chose the names based on the combination of data regarding the racial distribution of names on birth certificates with a survey they conducted to determine how respondents racially identify the names. This survey revealed that certain disproportionately African-American names – they give Maurice and Jerome as examples – are not perceived as such by respondents, and such names were therefore not used in the experiment.

The following sections will further consider the extent to which the category-signal relationship should be understood causally. For the rest of this section, I will further explore the signal-manipulation proposal by imagining that C is an ordinary cause of S and that this accounts for the counterfactual dependence of the latter on the former. This resulting causal model contains the path $C \rightarrow S \rightarrow Y$. In such a model, one could determine the effect of C on Y via a signal manipulation of S . The ability to do so is at the center of *causal mediation techniques* (Pearl, 2001; Imai et al., 2010), which measure the way that an effect variable would respond to a change in a cause variable, were that change to be transmitted via some causal paths but not others (Weinberger, 2019). For models with multiple paths between the cause and effect, the definitions for the various effects along the different paths (e.g. direct and indirect effects) can become somewhat involved. For our purposes, the key facts are that A) in the case where the *only* path between C and Y is via S , the total effect of C on Y will just be its indirect effect via S , and B) indirect effects are measured by signal manipulations of the mediators. This suffices to show that the effect of C on Y can be established via a signal manipulation.

Recall that ideal interventions disrupt the relationship between the intervened-upon variable and its causes other than the intervention. If one manipulated the signal in this way, it would no longer function as a signal. Signals convey information – typically about their causes or effects of their causes – and ideal interventions break the causal connections by which this information is transmitted. An intervention that assigns a person a name independent of any other fact about them will, by design, render the name informationally independent of that person’s race. Signal manipulations do not work like this. In selecting the contrastive values to which one intervenes to set the signal, one assigns the values that would obtain given different instantiations of category C . In this sense, the signal behaves as if it were tracking C . Nevertheless, it is not tracking C (within the experiment), since its variation is not due to variation in C . Although one changes the name on the resume from a black-sounding to a white-sounding name, the applicant remains black.

Thinking about certain tests of discrimination as testing the “effect” of race on some outcome via manipulating racial signals has several virtues. Most obviously, it captures the fact that the manipulation is not on race itself, but

rather on a variable by which race influences an outcome. Nevertheless, the effect of interest is not that of the manipulated variable, but rather of race. This is reflected in the modeling insofar as one manipulates the signal in a way as to mimic counterfactual changes in the value of C . More subtly, the fact that the signal only matters as a proxy for the category is reflected in the fact that the same effect could in principle be measured by manipulating distinct signals. Consider again the model from figure 1, in which race influences being hired via qualifications and via a direct path. Assuming that whether the employer discriminated depends on whether there is an influence via the direct path, it does not matter precisely which signal is manipulated, provided that one manipulates a set of variables that are sufficient to account for the influence via the path (i.e. if one were to include those variables in the model, there would be no remaining direct path). This reflects the idea that it simply shouldn't matter precisely when a particular hirer perceived the applicant's race or whether there was one or multiple hirers. What matters is whether race made a difference for employment not going through qualifications, not the precise avenue of influence.

Even in experiments in which the signal is not directly manipulated, the concept of a signal manipulation may be relevant. Consider the experimental design of Grogger and Ridgeway (2006), which compared the racial disparity in police traffic stops during day and during the night. The underlying assumption was that during the night it would not be possible for police to identify the driver's race prior to stopping them, and thus the nighttime stop rates could be used as a benchmark for what the disparity would be in the absence of discrimination. If the disparity were higher during the day, this would be evidence that race was being taken into account in decisions about which cars to stop. Here there is no manipulation to make drivers appear to be of a different race. One would be hard pressed to localize the variable being manipulated. But the case is easily accounted for in terms of signal manipulation. If the assumption underlying the design is correct, then the signals about drivers' race are transmitted during the day, but not at night. The experiment works by manipulating whether the signal is transmitted.

We see that modeling the interventions as signal manipulations seems to provide a fruitful way for thinking about how audit studies test for racial discrimination. Yet the relationship between race and its signals has yet to be properly explicated. Talk of the signal "reliably tracking" the category has a causal ring to it. But without specifying what the race variable designates we cannot say if it is manipulable, and we have thus replaced the question of whether race is a cause of an outcome with that of whether race is a cause of its signals. This might not initially seem like progress. The reason that it is that there is a story to be told about why certain variables are only manipulable via their signals. Telling this story will bring into focus the genuine reasons why interventions on race are problematic.

5 Race and Manipulability: A New Lens

Earlier I noted a common – if implicit – assumption that since race is just a social construct, causal descriptions of it must reduce it to its social manifestations. This is what makes it sound plausible to say that race *just is* perception of race, or that it is nothing more than a bundle of sticks. But the underlying assumption is false. That race is a social construct does not imply that it reduces to its social manifestations. Seeing why is crucial for understanding the ways in which it does and does not behave like a cause.

Consider the question of whether a work of art was bought for a high price because it was authentic (as opposed to a forgery). The fact that original paintings are considered so much more valuable than near-indistinguishable forgeries is a societal fact about how art is valued. In this sense, the value of the authenticity of a work of art is a social construct. There is little doubt about whether authenticity influences price and there are strong institutional mechanisms for ensuring the reliability of signals about a work’s authenticity. Yet, if there were any doubt about the effects of authenticity on price, it would be impossible to test this by intervening to transform a forgery into the real thing. Rather one would have to manipulate the signals for authenticity and see the effect on price. But this does not mean that authenticity reduces to these signals. Although the value of authenticity is a social construct, *within* the socially-constructed theory of value what matters ultimately is not whether people believe an artwork is authentic, but whether it *is* so.

With this in mind, let’s revisit the suggestion that race should be understood as perception of race. This suggestion is potentially ambiguous. On the one hand, it might just indicate that race is not an intrinsic feature of an individual, but depends on how one is perceived within a society. Alternatively, it might suggest that all that matters is whether a person is perceived as being of a certain race, whether or not they are of that race. This second interpretation is much less plausible, and one should not take it as following from the first. If a white candidate were denied a job because the employer mistakenly believed they were black, we would not say that they were discriminated against based on race. This is so even though their perceived race might match that of a black candidate who was discriminated against based on an accurate perception of their race. This feature of linguistic practice makes sense within a society in which people’s perceptions of race fairly reliably track the way that an individual is categorized within the society, and where the ability to detect race in this manner is an important component of how discrimination functions within that society. The point is not that individuals are never mistreated based on false racial identifications, but rather that these aberrant cases are not really what is at issue when studying (or designing legal protections to counteract) the phenomenon of people who are discriminated against based on accurate perceptions of their socially-constructed race.⁴

⁴The idea that socially-mediated causal relations implicitly ignore certain aberrant cases is evident in an example by Prescott-Couch (2017). Georgina is a student who is stigmatized for having a large birthmark and as a result of the stigmatization is distressed. Intuitively, the

There is an apparent tension between my claim that signals must reliably track the category and the fact that signal manipulations vary the signal without also changing the category. In the artwork example, when one tests the effect of authenticity by seeing what buyers would offer for an authentic painting that is listed as a forgery, one is making it the case that the signal *fails* to reliably track what it is supposed to. The key to resolving this tension is that the possibility of altering the reliability of the signal within the contrived scenario of the experiment does not undermine its reliability outside of the experimental context. In fact, the reason why the signal manipulation is deemed relevant to understanding the behavior of the category outside of the experiment is precisely because one manipulates the signal in the experiment to what it would be in the real world under the condition in which the category would be different from what it is. The experiment in which a genuine artwork is signaled to be a forgery is informative precisely because the signal in the experiment corresponds to the one that would be manifest in the actual world were the artwork to be a forgery.

Of course, the question of what makes someone count as being of a certain race is by no means as clear cut as that of what makes a work of art authentic, and we should expect a fair amount of vagueness in racial characterizations. But none of this undermines the possibility of distinguishing between what race is (within a society) and how it is perceived in particular contexts. Race corresponds to a status that individuals are understood to have independent of its particular manifestations by which it is detected. The racial signals have the effects they do *because* they are taken as signals for the relevant social status. Even though one can only manipulate race via its signals, this does not mean that race is nothing over and above its signals.

Kohler-Hausmann (pp. 1205-6) presents a criticism of the Greiner and Rubin proposal that may seem to carry over to the signal manipulation approach. She claims that if race is a multifaceted social construct, then the perception of race will be so as well, implying that their proposal only gets off the ground if one identifies race with superficial features such as skin color. Whatever the merits of this criticism for the Greiner and Rubin proposal, it does not touch the signal manipulation approach. Even granting that race is a social construct, one is not required see race as identical to – or constituted by – the signals by which it is identified.

birthmark causes her being distressed via – and, we could imagine, *only* via – stigmatization. So it seems like the causal model should be *birthmark* → *stigmatization* → *distress*. This model entails that were one to hold stigmatization fixed, intervening on the birthmark would not have any effect on distress. Prescott-Couch then considers the scenario in which one intervenes to remove Georgina's birthmark, while holding fixed the fact that she is mercilessly teased by her classmates for having one. The Twilight Zone-esque scenario in which she is teased for a birthmark she doesn't have would be distressing indeed – and presumably in a different way and to a different degree than in the scenario where she in fact has a birthmark. Nevertheless, Prescott-Couch compellingly resists the conclusion that (contra the proposed model) the birthmark *does* have a direct effect on distress not via stigmatization. The lesson I draw from this is that to the extent we are interested in the social effects of having a birthmark in the ordinary scenario, the aberrant Twilight Zone scenario need not be considered.

6 When is it Fruitful to Model Race Causally?

Contra Kohler-Hausmann, the fact that race is a social construct does not rule out the possibility of detecting race by intervening on its signals – her Royals example provides a good illustration of precisely such an intervention. We’ve seen that the relationship between race and its signals does not behave like an ordinary causal relationship, but I’ve argued that this should not stand in the way of using signal manipulations to test claims about the effects of race. In this section, I consider one final objection, which claims that the challenges that stand in the way of manipulating race carry over to manipulations on its purported signals. Through addressing this objection, I will provide a clearer characterization of when it is and is not fruitful to model race causally.

Kohler-Hausmann (2018, p. 1216) considers a faulty test of gender discrimination in which male and female candidates come to an interview wearing the same dress. This test fails because in comparing genders we need not merely vary the gender of the applicant, but also the associated gender-conforming behaviors. This furnishes a nice example of how manipulations on gender may call for multiple simultaneous interventions going beyond gender in its most narrow sense. Moreover, the knowledge that one needs to manipulate the candidates’ outfits comes from a broader understanding of how gender functions in society. This is worrisome for the signal manipulation proposal, since the question of which factors need to be varied to count as a suitable manipulation on race or gender applies just as much to their signals as to the categories themselves. Bertrand and Mullainathan’s audit study wouldn’t work if, after manipulating the name, the candidate’s race could still be inferred from the neighborhood that they grew up in or the college they attended. While the signal manipulation proposal promises to create space between questions of what race is and questions of how one tests for its localized discriminatory effects, perhaps this is just an illusion. Perhaps all of the issues that arise in trying to model manipulations on race itself simply reappear when one seeks to spell out all of the variables that must be manipulated as part of a signal manipulation.

This worry has some merit and in fact provides clues as to why in some cases it may no longer make sense to think about certain demographic variables causally. Fortunately, however, the problem does not generalize to all cases. Distinguishing between the cases in which the problem can and cannot be addressed will thus be helpful for seeing why certain demographic variables only sometimes can be treated causally.

Consider the question of whether viewers of the first 2016 presidential debate discriminated against Hillary Clinton based on her gender. Although Clinton was widely perceived as coming out ahead in the debate, Trump was deemed by many observers to have performed adequately. Given the obvious disparity in the knowledgeability of the candidates on issues of substance, it was fair to wonder if the debate would have been deemed to be so close had the gender roles been reversed. To test this, some academics commissioned a play in which each candidate was played by an actor of the opposite gender, who otherwise copied the candidate’s words verbatim, along with the accompanying gestures

(Reynolds, 2017). Surprisingly, many attendees of the play reacted more negatively to the male “Clinton” than they had to the original. Why was he smiling so much? And didn’t he seem a bit effeminate?

One might initially treat this result as proving the absence of gender discrimination. But a bit of reflection suggests the need for some caution. How audience members react to Clinton’s smiling, for example, is not independent of her gender. So perhaps a better experiment would not simply swap the gestures, but also modify them in appropriate gender-conforming ways (e.g. by having the male candidate smile less). The problem with this solution is that once it becomes clear that testing for the effects of gender would involve manipulations on any behaviors or gestures that would be interpreted in a gendered way, one begins to wonder what *wouldn’t* have to be manipulated. As the list of signals to be manipulated becomes large and open-ended, the gap between the questions “how would Clinton have been treated had she been of a different gender?” and “how are politicians of different genders treated within a society?” narrows to the point of imperceptibility. To the extent one cannot distinguish between these causal and merely evidential questions, the informal and plausible claim that Clinton’s gender causally influenced how she was treated cannot be given a rigorous explication.⁵

Such issues are in no way limited to gender. Imagine an audit study involving an in-person interview instead of just a resume submission. If the employer selects a white candidate over a black candidate on the basis that the former made an “inappropriate joke”, we should not immediately assume that race was not in play. Even if we could know that the joke was the only difference, questions about what makes a joke appropriate and who can get away with an inappropriate joke are not independent of the demographic profile and social status of the one telling it. Examples such as this one help make sense of Kohler-Hausmann’s refusal to distinguish between race and the ways an individual is treated based on her race.

To the extent that the set of signals one would have to manipulate to test the effects of race or gender is open-ended, claims about discrimination based on these categories will have no clear causal interpretation. Fortunately, not all cases are like this. In the Bertrand and Mullainathan (2004) study, one is able to manipulate an isolated signal conveying information about the person’s race. Of course, this only works as well as it does given the contrived scenario in which the employer has no independent access to the candidate’s race. The lesson to draw from this is neither that the study has no relevance to in-person scenarios, nor that there are not sensible ways to further explore the causal impact of race in the in-person case. It seems plausible that there exists a spectrum of scenarios ranging from the cases where it is most feasible to isolate an effect of race via manipulation of a signal to those in which race operates in such a holistic manner that such manipulations are no longer coherent.

Earlier I suggested that the issue with manipulability of race wasn’t metaphysical identity, but whether race could be manipulated independently of other

⁵My presentation of this example benefitted greatly from a discussion with Emily Sullivan.

properties of an individual. In the context of signal manipulation, one does not intervene on race, but rather on its signals. So the issue instead is whether one can manipulate some signals independently of others. The justification for manipulating some signals but not others need not be that the non-manipulated signals do not relate to race. In the simple hiring model in figure 1, the applicant's qualifications do convey information about her race. The reason for only considering the direct path in that scenario is that, in the particular context, we would likely not treat an employer who took these qualifications into account as discriminating against the candidate. In other words, although all paths in the model are related to race, only some are relevant for establishing discrimination in the particular context.

We see that whether it makes sense to evaluate a particular demographic variable causally depends not just on the variable, but also on the particular query. The more one asks specific questions about how particular individuals were treated in localized and well-defined contexts, the better the chances one will be able to provide a causal analysis. But there will, of course, be lots of borderline cases and any empirical analysis will rely on certain idealizations and simplifying assumptions about the influences of a variable in a context. In light of this, the most pressing question is: what do we gain by this modeling exercise of trying to model race causally? One could imagine Kohler-Hausmann granting a great deal of what I've said here, but taking it as showing that the counterfactual analysis only applies to idealized experimental scenarios. If what we really care about is the broad sociological concept of race, and I've granted that such sociological factors are necessary for specifying the manipulations required for testing discrimination, why go through the effort of seeking out an idealized case to which causal concepts apply?

My answer to this is that conceding that race cannot be modelled causally would be crippling for any attempt to design legal protections against racial discrimination. In typical hiring scenarios, there is nothing barring an employer from eliminating a candidate from consideration based on brute dislike. To designate race as a protected category, one must be capable of distinguishing cases in which candidates are denied a position *because* of their race, rather than as a result of such brute dislike. In the extreme scenario – the one that I've deemed non-causal on the basis that one cannot differentiate among the signals that are and are not signals for race – such a distinction is no longer tenable. If one truly could not differentiate changing and individual's race from changing everything about them, the distinction between discrimination based on race and brute dislike collapses.

A remaining concern is that without being able to specify hypothetical manipulations of race, one cannot address concerns relevant to confounding. This is especially pressing in contexts where one wants to separate the influence of race from closely related social categories such as class. Unfortunately, the signal manipulation proposal contains no means for answering this question. The way one chooses to manipulate a signal *presupposes* certain ways of thinking about the race/class distinction rather than providing a novel way to draw it. But it is not really clear that subtle issues regarding if and how one can differentiate

the influences of race and class within a society are to be addressed with particular experiments, or even sets of experiments. Here the tool kits of sociologists and historians seem more directly relevant. I by no means want to deny the urgency of these questions, or to foreclose the possibility that experiments have some role to play in addressing them. Fortunately, however, we do not need to definitively resolve them in order to make progress in the design of experiments for detecting discrimination.

7 Conclusion

Instead of answering the question “is race a cause?”, I have here sought to determine when it is fruitful to reason causally about race. Although many will still desire an answer to the first question, I see the type of project started in this paper as being essential for understanding both why manipulability matters (to the extent it does) as well as the specific problems arising when modeling race. Manipulability matters to the extent that when a variable cannot be varied independently of others, the distinction between causal and evidential relevance collapses. In the context of race, the question becomes one of whether it is possible to distinguish between someone’s race being evidence for an outcome and its bringing about that outcome. It appears that, depending on the context and the query, this distinction is only sometimes coherent, but, to the extent it is, causal reasoning has a role to play. An account of the causal status of race should have something to say about the cases that can and cannot be modeled causally.

A general challenge in researching the causal status of race involves determining how to combine the methodological literature on causal modeling with social scientific work on race. Both Sen and Wasow (2016) and Kohler-Hausmann (2018) draw conclusions about the relationship between the manipulability of race and its status as a social construct, with the former seeing social constructivism as licensing manipulability and the latter seeing the two concepts as incompatible. The forgoing discussion provides reason to be cautious of drawing any direct inferences from the social constructedness of race to its (non-)manipulability. *That* race functions as a social construct is less important than *how* it does. I’ve proposed that the reason that race eludes manipulability is that it is understood within society as having an existence independent of its particular manifestations. This is a particular claim about how the concept functions within the society and it is further important for understanding why it would be limiting to insist that one treat it as reducing to the signals that are in fact manipulated.

I have sought here to be as non-committal as possible regarding the nature of race. One might wonder how far this strategy can be stretched. Would my proposal be compatible with race being a fiction?⁶ At a minimum, it seems that

⁶Several people raised questions in this direction. Tom Wysocki pointedly asked whether my modeling strategy could also capture the effects of witchhood, and an anonymous reviewer asked about signals for phlogiston.

in order for society members to reliably track an individual's race, race needs to correlate with some cluster of relatively superficial features. As emphasized, this does not entail that race is identical to those features. What all this means for the reality and ontology of race remains a topic of future research.

In the process of working through the philosophical and methodological issues involved in causally interpreting race, it is important that this research should aid rather than hinder experimental work on detecting racial discrimination. Audit studies offer a good experimental design for testing for a particular type of discrimination in particular contexts. The fact that the proposals reviewed in this paper make such studies more difficult to interpret suggests that something has gone wrong. The signal manipulation proposal provides a framework within which to continue to explore the thornier methodological questions without losing sight of what goes right in existing experiments. It straightforwardly yields the result that one can test for the effects of race by intervening upon its signals, but that one does not need to understand the effect as being simply that of the signals themselves. This is an important feature of audit studies that has been lost in prior theorizing, and the question of how much the signal manipulation proposal can be generalized beyond simple experimental designs is a fruitful starting point for further work. The category-signal relationship is not an ordinary causal one. But the conclusion to draw is not that we should avoid discussing such relationships, but rather that by analyzing them more carefully, we can gain insight into the particular challenges in causally understanding race.

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References

- Angrist, J. D., G. W. Imbens, and D. B. Rubin (1996). Identification of causal effects using instrumental variables. *Journal of the American statistical Association* 91(434), 444–455.
- Bertrand, M. and S. Mullainathan (2004). Are emily and greg more employable than lakisha and jamal? a field experiment on labor market discrimination. *American economic review* 94(4), 991–1013.
- Dembroff, R., I. Kohler-Hausmann, and E. Sugarman (2020). What taylor swift and beyoncé teach us about sex and causes. *U. Pa. L. Rev. Online* 169, 1.

- Fosse, E. and C. Winship (2019). Analyzing age-period-cohort data: A review and critique. *Annual Review of Sociology* 45, 467–492.
- Glymour, C. (2007). Statistical jokes and social effects: intervention and invariance in social relations. In A. Gopnik and L. Schulz (Eds.), *Causal learning. Psychology, philosophy, and computation*, pp. 294–300. Oxford University Press.
- Glymour, C. and M. R. Glymour (2014). Commentary: race and sex are causes. *Epidemiology* 25(4), 488–490.
- Greiner, D. J. and D. B. Rubin (2011). Causal effects of perceived immutable characteristics. *Review of Economics and Statistics* 93(3), 775–785.
- Grogger, J. and G. Ridgeway (2006). Testing for racial profiling in traffic stops from behind a veil of darkness. *Journal of the American Statistical Association* 101(475), 878–887.
- Haslanger, S. (2012). *Resisting reality: Social construction and social critique*. Oxford University Press.
- Hochman, A. (2017). Replacing race: Interactive constructionism about racialized groups. *Ergo: An open Access journal of philosophy* 4.
- Holland, P. W. (1986). Statistics and causal inference. *Journal of the American statistical Association* 81(396), 945–960.
- Holland, P. W. (2008). Causation and race. *White logic, white methods: Racism and methodology*, 93–109.
- Imai, K., L. Keele, and D. Tingley (2010). A general approach to causal mediation analysis. *Psychological methods* 15(4), 309.
- Khalifa, K. and R. Lauer (2021). Do the social sciences vindicate race’s reality? *Philosophers* 21(21).
- Kincaid, H. (2018). Debating the reality of race, caste, and ethnicity. *Philosophy of the Social Sciences* 48(2), 139–167.
- Kohler-Hausmann, I. (2018). Eddie murphy and the dangers of counterfactual causal thinking about detecting racial discrimination. *Nw. UL Rev.* 113, 1163.
- Mallon, R. (2017). Social construction and achieving reference. *Nous* 51(1), 113–131.
- Mallon, R. (2018). Constructing race: racialization, causal effects, or both? *Philosophical Studies* 175(5), 1039–1056.
- Marcellesi, A. (2013). Is race a cause? *Philosophy of Science* 80(5), 650–659.

- Msimang, P. (2019). Racializing races: The racialized groups of interactive constructionism do not undermine social theories of race. *Ergo, an Open Access Journal of Philosophy* 6.
- Pearl, J. (2001). Direct and Indirect Effects. In J. Breese and D. Koller (Eds.), *Proceedings of the Seventeenth Conference on Uncertainty in Artificial Intelligence*, pp. 411–420.
- Pearl, J. (2009). *Causality* (2nd ed.). Cambridge: Cambridge University Press.
- Pearl, J. (2018). Does obesity shorten life? or is it the soda? on non-manipulable causes. *Journal of Causal Inference* 6(2).
- Prescott-Couch, A. (2017). Explanation and manipulation 1. *Nous* 51(3), 484–520.
- Prince, A. E. and D. Schwarcz (2019). Proxy discrimination in the age of artificial intelligence and big data. *Iowa L. Rev.* 105, 1257.
- Reynolds, E. (2017). What if donald trump and hillary clinton had swapped genders. *NYU News (online)*.
- Sen, M. and O. Wasow (2016). Race as a bundle of sticks: Designs that estimate effects of seemingly immutable characteristics. *Annual Review of Political Science* 19, 499–522.
- Spirtes, P. and R. Scheines (2004). Causal inference of ambiguous manipulations. *Philosophy of Science* 71(5), 833–845.
- VanderWeele, T. J. and W. R. Robinson (2014). On causal interpretation of race in regressions adjusting for confounding and mediating variables. *Epidemiology (Cambridge, Mass.)* 25(4), 473.
- Weinberger, N. (2015). If intelligence is a cause, it is a within-subjects cause. *Theory & Psychology* 25(3), 346–361.
- Weinberger, N. (2019). Path-specific effects. *The British Journal for the Philosophy of Science* 70(1), 53–76.
- Woodward, J. (2003). *Making things happen: A theory of causal explanation*. Oxford University Press.