Genetic Options and Constraints: A Randomized Controlled Trial on How Genetic Ancestry Tests Affect Ethnic and Racial Identities[1]

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An estimated 21% of US adults have taken genetic ancestry tests (GATs). Recent studies have found that many test-takers change their ethnic and racial identities based on GAT results, viewing them through social lenses rather than always deferring to genetic information. Yet these studies have several limitations; most fail to consider the counterfactual or account for ancestry percentages reported in admixture tests. In this first randomized controlled trial of GATs, the authors analyze GATs' causal impact on identity change among non-Hispanic White Americans ($N = 802$). The authors address how much identity change can be attributed to GATs and evaluate the independent and interactional effects of identity aspirations and test-reported ancestry percentages. They find very low rates of racial identity change and significant but small amounts of ethnic identity change beyond that experienced by non-test-takers. The authors find support for identity aspirations and GAT-reported ancestry percentages as change mechanisms. They also find that GATs do not support test-takers' claims to Native American ancestry; they are more than twice as likely as non-GAT-takers to drop Native American identities after testing.

An estimated 21% of US adults—more than 50 million Americans—have taken genetic ancestry tests (GATs; Orth 2022). Newspaper stories, TV shows, and YouTube videos commonly depict how these tests have influenced

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the test-takers' ethnic or racial identities. Stories report how people who thought they were Irish "discovered" they were Jewish or those who identified as White came to see themselves as Black (Marcus 2019; Copeland 2020).[2] Some use GATs to support identity claims—such as Elizabeth Warren, who relied on GATs to "prove" her Native American ancestry (Herndon 2018). Others develop reasons to ignore GAT results or insist that the deep genetic ancestries they report do not change who they are (Shim, Alam, and Aouizerat 2018; Kaplan 2019; Panofsky and Donovan 2019). Widespread public conversion of genetic ancestry information into identity or a sense of belonging to contemporary ethnic and racial groups could have tremendous implications for demographics, identity politics, and social concepts about the meaning of race and ethnicity. Indeed, some question whether GATs may have contributed to the sharp increase in the US multiracial population reported in the 2020 census (Galvan and Schneider 2021; Wang 2021). It is therefore crucial to better understand how GATs influence test-takers' identities.

Several recent studies have found that many test-takers change their ethnic and racial identities based on the test results (Nelson 2008; Scully, Brown, and King 2016; Lawton and Foeman 2017; Roth and Ivemark 2018; Roth and Lyon 2018; Johfre, Saperstein, and Hollenbach 2021; Strand and Källén 2021). However, these studies have several limitations. First, none consider the counterfactual: how much change might have occurred in the absence of genetic ancestry testing. Ethnic identities are particularly fluid, with individuals claiming different ones at different moments from the ethnic ancestries they know of (Waters 1990; Yip and Fuligni 2002; Song 2003). Some US research also finds fluidity among racial identities (Harris and Sim 2002; Saperstein and Penner 2012; Alba, Insolera, and Lindeman 2016; Liebler et al. 2017). Some people discover new ancestry information through conversations with relatives or traditional genealogical research

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[2] Throughout this article, we use the word "discover" because receiving GAT results reporting unknown ancestries often feels like a discovery to test-takers. However, we recognize that the labels attached to ancestral clusters are imposed by scientists to represent categories that will be meaningful for the public, rather than an objective truth that can be revealed in the genetic code (Fullwiley 2008; Morning 2014).

(Williams 1996; Broyard 2007; Albright 2012). Studies failing to consider the extent to which identity changes might have happened without GATs misestimate their causal impact.

Second, most studies fail to account for what we consider a crucial element: the percentages of ancestries reported in admixture tests, one of the most popular types of GATs. Although the results are often misinterpreted, higher proportions may be interpreted as a signal for the legitimacy of the results or identities based on them (Bobkowski, Watson, and Aromona 2020). Reported ancestry percentages are relevant for assessing how influenced test-takers are by genetic determinism, the view that genes determine a person's racial or ethnic identity (Heine 2017). Many scholars suggest that people will privilege genetic information and see GAT results as revealing their ethnicity or race (Nash 2004; Bolnick et al. 2007; Duster 2011) and view the format of admixture percentages as particularly likely to be perceived authoritatively (Phelan et al. 2014). We might expect test-takers whose GATs report a large percentage of an ancestry to be more likely to adopt identities based on it than those whose GATs report smaller amounts, following a model closer to genetic determinism.

Some research illustrates how test-takers' identity outcomes are influenced by social considerations, showing they do not necessarily accept identities suggested by their GAT results (Nelson 2008; Scully et al. 2016; Roth and Ivemark 2018; Shim et al. 2018; Panofsky and Donovan 2019). For instance, genetic options theory argues that GAT consumers exercise options in adopting or rejecting new ancestry-based identities based on factors such as their identity aspirations—how strongly they like and aspire to identify with a particular ancestral group (Roth and Ivemark 2018). However, the theory does not consider the role of reported genetic ancestry percentages or how they interact with people's identity aspirations. To understand how social and genetic mechanisms function in shaping identities, it is crucial to examine the interplay between these sources of identity making.

This study presents the results of the first randomized controlled trial (RCT) to determine how GATs change ethnic and racial identity. Widely used to evaluate health care interventions (Schulz, Altman, and Moher 2011), RCTs are rare in sociology, yet their ability to reveal causation recommends them as a valuable addition to the sociological toolkit. Prior research has found that White GAT-takers were more likely to change their ethnic or racial identities (Scully et al. 2016; Roth and Ivemark 2018; Strand and Källén 2021), and non-White test-takers often did not (Nelson 2008; Lawton and Foeman 2017; Shim et al. 2018). We recruited a nationwide sample of native-born non-Hispanic White Americans who were willing to take a GAT but had not previously taken one; we randomly assigned them to receive GATs or not, to rigorously compare these groups' identity changes over time.

Our study population differs from those of most previous studies that capture the early test consumers who were highly motivated to buy GATs even when they were relatively expensive (Nelson 2008, 2016; Nordgren and Juengst 2009; TallBear 2013; Roth and Ivemark 2018; Johfre et al. 2021). Their strong motivations for testing are likely related to identity change, as these early consumers may have had pressing questions about their ancestry or sought support for family narratives they wanted to embrace (Roth and Ivemark 2018; Roth and Lyon 2018; Horowitz et al. 2019; Johfre et al. 2021). GATs may have had larger impacts on these early consumers' identities because of such preexisting motivations. However, these early consumers are also likely distinct from the vast majority of GAT-takers who bought tests after prices dropped considerably; many also received GATs as gifts, were asked to take them by relatives, or received results by participating in research (Regalado 2018, 2019; Roth and Lyon 2018).[3] Our sample represents a population that is willing to take GATs but has not yet done so—which some surveys suggest may be the majority of Americans.[4] By randomly assigning the treatment of taking a GAT, we can observe the causal effects of taking GATs on this population.

Our research design also enables tying individual-level changes in identities to specific test results. We conduct additional nonexperimental analyses of test-takers to assess the role of ancestry percentages relative to other factors such as identity aspirations. We expand the literature by theorizing the distinct processes behind different types of identity change, including temporal fluidity within a set of known family ancestries, adding a newly discovered identity, and omitting a previously claimed one. In doing so, we build on a long scholarship of optional or symbolic identities (Gans 1979; Alba and Chamlin 1983; Lieberson 1985; Waters 1990), bringing it into the genomic age by theorizing about the interactions between genomic understandings and aspirational identities.

We address the following research questions: (1) How much identity change can be attributed to taking a GAT, beyond any temporal identity fluidity that may have happened anyway? (2) Do identity aspirations influence identity change over time? We test the argument that identity desires influence

[3] From 2003 to 2016, nearly 4.5 million people took GATs. The number more than doubled in 2017 (to over 12 million) and again in 2018 (to over 26 million). The sales boom corresponded with a drop in prices from over $250 to under $60 and a blitz of holiday-season advertising and discounts, promoting GATs as holiday gifts and offering two-for-one deals (Ho 2018; Regalado 2018, 2019).

[4] In a survey of registered bone marrow donors, Horowitz et al. (2019) found that 93% of respondents were interested in taking a free GAT but had not taken one, while 5% had. The 2010 General Social Survey showed that 63% of Americans felt favorably toward GATs (Hochschild and Sen 2015).

test-takers' reactions to their GAT results and extend it to a broader theory of all identity change. (3) In influencing test-takers' identity outcomes, what are the relative roles of identity aspirations and the ancestry percentages reported in GATs? This is central to debates on how social factors weigh against genetic information in shaping concepts of the self.

Our study focused on changes in ethnic and racial identities, yet we found very low rates of racial identity change. While we present descriptive findings on both, our multivariate analysis focuses on ethnic identity changes. We find that our GAT-takers change their ethnic identities significantly more than those who do not take GATs, but more than two-thirds of the ethnicity changes would likely have happened without test-taking. We find support for identity aspirations overall, and among some test-takers these aspirations increase the likelihood of adding a desirable ethnicity reported by their tests. However, our test-takers' ethnic identities are more influenced by the ancestry percentages reported in their admixture tests, for both adding and dropping ethnicities.

When GATs do not support a previously claimed identity, even a coveted one, our test-takers tend to drop those identities. Particularly striking, we found a much greater omission of Native American ethnic identities by those who receive GATs than those who do not, as those GATs rarely report the Native ancestry they had claimed. Our study shows how the social construction of ethnicity and race has been working in the United States and how it continues to work even when genomic information is added to the mix. Yet it reveals that high percentages of genetic ancestry do foster a view of ethnic identity as genetically determined. In the genomic age, people form and transform identities with both genetic options and constraints.

DISTINGUISHING ETHNICITY, RACE, AND GENETIC ANCESTRY

There are crucial distinctions between ethnicity, race, and the genetic ancestries that GAT companies report. Ethnicity and race are social constructs rather than biological ones; there are no clear genetic dividing lines that distinguish between ethnic or racial categories, and enormously varying amounts of genetic distance exist within these categories (Conley and Fletcher 2017; Lewis et al. 2022). We define ethnicity as a cognitive structure based on common ancestry, shared history, and cultural focus. We define race as a separate cognitive structure that divides people into groups usually based on social perceptions of physical, biological, or other characteristics believed to be inherent, yet different characteristics provide the basis for racial group membership across different contexts and periods (Cornell and Hartmann 1998; Roth 2012). Originally imposed to justify differential treatment or exploitation, racial categories have assumed new meanings and fostered identities from within (Nelson 2016; Roberts and Rollins 2020).

GAT companies and genetic researchers analyze markers of genetic ancestry that do not equate to social labels of race and ethnicity. In admixture tests, they examine DNA segments called ancestry informative markers (AIMs) that have a higher probability of being found in some populations than others. They associate them with those populations, even though not all members of the population share them and people from different populations may share the segments (Royal et al. 2010). To make their analysis meaningful, they impose categories on ancestry estimation, often at the continental or national level, which can obscure the genetic variation within categories and risks essentializing them (Conley and Fletcher 2017; Lewis et al. 2022).

We do not view the GAT-reported genetic ancestries as entailing ethnic or racial ancestries. Indeed, the social construction of ethnic and racial categories is largely independent of the biological reality of genetic ancestry markers. Our goal is to understand how the presentation of these genetic ancestry labels—which overlap with common racial and ethnic groups, even though their use is not supported by purely genetic considerations—contribute to social identity construction. We refer to "corresponding" genetic ancestries and identities. By examining changes in how individuals mark their race and ethnicity, we consider how the GAT-reported ancestries influence which social groups they see themselves belonging to.

IDENTITY CHANGE PROCESSES

Temporal Fluidity and New Discoveries

Little of the emerging scholarship on GATs and ethnic and racial identity considers the fact that identities may change over time not because of GATs but because of temporal fluidity. People often change their sense of which ethnicities or races best describe them (Waters 1990; Harris and Sim 2002; Yip and Fuligni 2002; Song 2003; Liebler et al. 2017). Studies in the 1970s that reinterviewed respondents in the Current Population Survey and the General Social Survey found high rates of ethnic fluidity; between 26% and 35% of respondents did not give the same response about their ethnicity one year later (Waters 1990). GAT research that examines only test-takers overattributes any changes to the GATs without considering the counterfactual (Nelson 2008, 2016; Scully et al. 2016; Lawton and Foeman 2017; Roth and Ivemark 2018; Strand and Källén 2021). Johfre et al. (2021) compare the racial classifications of people who have and have not taken GATs in the past, but they cannot differentiate the direction of causation—whether GAT-taking causes changes in racial identification or whether differences in racial identification motivate people to take GATs. By contrast, our RCT design can determine whether taking GATs causes identity changes within our sample population.

We distinguish two theoretically distinct types of identity change. The first are changes in identification with "known ancestries," the set of different ancestries people believe they have based on family history (Roth 2016).[5] Waters (1990) shows that later-generation Whites often simplify their ethnic identities; they know of a larger set of family ancestries than they typically claim when asked their ethnicity. In particular, the most fluid ethnicities are from groups whose peak immigration years were the most distant—such as northwestern Europeans who had been in the United States the longest; such identities are likely to be symbolic and not always highly salient in their lives (Gans 1979). Even racial identities may be simplified in certain contexts; for instance, young people who identify as multiracial at home often identify as a single race at school (Harris and Sim 2002). The "known" identities people list on surveys may change because different parts of their identities become more salient over time or in different contexts (Yip and Fuligni 2002; Loveman and Muniz 2007; Saperstein and Penner 2012; Liebler et al. 2017).

Adopting identities based on discoveries of new ancestries respondents were not previously aware of represents a theoretically distinct kind of identity change; we refer to these as "new additions." This type of change need not happen only through GATs. People may learn of a new ancestry through traditional genealogical research or from family members. A genre of memoirs focuses on discovered family secrets, including adoptions, racial passing, and other buried histories affecting people's understanding of their race or ethnicity (e.g., Williams 1996; Broyard 2007; Albright 2012). Most theories of ethnic and racial identity development focus on adolescence and young adulthood, assuming that the process is completed within those developmental stages (Umaña-Taylor et al. 2014; Cross et al. 2017). Yet a meta-analysis shows that identity development is achieved by early adulthood in only half of the studies (Kroger, Martinussen, and Marcia 2010). New discoveries can present identity challenges in adulthood that are not adequately addressed in the identity development literature.

Some level of identity change or fluidity should be expected regardless of test-takers' experiences with GATs. The challenge is to identify how much change occurs specifically due to GAT results. We address this in three ways: (1) through the comparison to a control group that did not receive GATs to determine what identity changes would likely have occurred anyway; (2) by considering people's known ancestry, composed of the ancestral origins of their biological parents as well as their initial identities, to determine whether an identity change reflects fluidity within previously known

[5] We adopt the terminology of "known ancestry" (Roth 2016), while recognizing that information passed down through family history may itself be incorrect or incomplete (Lieberson 1985).

ancestries or a new addition; and (3) for the treatment group, by tying the identity changes to the test results. We determine whether specific identity changes are supported by the GAT—for instance, whether a new identity is accompanied by the discovery of a corresponding ancestry in the results. These steps give us greater confidence that the identity changes we identify are GAT inspired.

Genetic Determinism, Genetic Options, and Identity Aspirations

Critiques of GATs frequently argue that they will foster genetic determinism and reify racial constructs (Bolnick et al. 2007; Duster 2011; Byrd and Hughey 2015; Roberts and Rollins 2020). Some assert that, due to the authority test-takers attribute to genetic science and the actions of GAT companies to promote genetics-based group identities, the genetic ancestries reported effectively become a person's identity (Nash 2004; Bliss 2013). The genetic determinism theory of identity formation asserts that GATs have a direct and causal impact on identity. Those who discover their genetic ancestry view it as definitive proof of who they are and transform or maintain their identities in light of this genetic information, producing "geneticized identities" shaped by this knowledge (Nelson 2008; Roth and Ivemark 2018).

The genetic options theory of identity formation maintains that GAT consumers select ancestries from their results that offer them positive and distinct social identities they believe others will accept, while disregarding other genetic ancestries (Roth and Ivemark 2018). While acknowledging that genetics influences people's identities, the theory claims test-takers filter the genetic information through two social mechanisms that can weaken its impact: their identity aspirations for the identities they seek to claim and their social appraisals of how others will accept their identity claims. The result is a continuum of geneticization. Given the combination of previously held identities, specific test results, and identity aspirations and social appraisals, consumers may be influenced by genetic determinism to greater or lesser extents.

Different populations may subscribe to different identity aspirations. The White test consumers Roth and Ivemark (2018) interviewed often aspired to discover new ancestries that would make them more distinctive than "just White"; this was particularly true for those whose families had been in the United States for several generations and who had lost a sense of ethnic connection. Yet the study's respondents of color were less likely to aspire to identity change. Other research on non-White test-takers similarly shows that these populations tend not to change their identities despite an interest in the GAT results (Nelson 2008; Lawton and Foeman 2017; Shim et al. 2018). Some subgroups of test-takers approach GATs with distinctive aspirations and agendas, such as White nationalists who take GATs not to seek

identity change but to support an existing claim to Whiteness (Panofsky and Donovan 2019). Yet even members of this group, whose belief in racial essentialism might be expected to weight their reactions toward genetic determinism, rely heavily on the social appraisals of their online nationalist community for permission to remain White.

Genetic options theory does not predict the specific identity aspirations that individuals will have. Indeed, the emerging literature on post-GAT identity change offers few concrete predictions for which racial or ethnic identities GAT-takers will aspire to. Yet in general, some ethnic and racial identities have been found more desirable, others less so. Waters (1990) found that Italian was a popular ethnicity, frequently claimed for children whose parents listed it among their ancestries, while Scottish was relatively unpopular. Some identities become less desirable because of world events. Many German ethnics altered their names, language, and ethnic involvement around World War II; Middle Eastern identities may have suffered a similar stigmatization after 9/11 (Lieberson 1985; Maghbouleh 2017). Ethnic and racial ranking systems sometimes lead people toward identities that generate advantages and away from those of lower status (Lieberson 1985; Cornell and Hartmann 1998). Traditionally, Whiteness was associated with "racial purity" and socioeconomic advantage while non-White identities were stigmatized, as those who "passed" undoubtedly knew (Williams 1996; Broyard 2007). More recently, however, multiracial identities have become more accepted and widespread (Galvan and Schneider 2021). Native American identities are seen as particularly desirable, potentially because they are romanticized in popular culture, associated with tribal benefits, or suggest long-standing geographic belonging that can assuage guilt over settler colonialism (Golbeck and Roth 2012; TallBear 2013; Leroux 2018). How favorable people feel toward an ethnic or racial group, shaped by larger social norms, likely influences their identity incorporation.

Test consumers' process of assessing their GAT results resembles how people generally assess nongenetic sources of ancestry information, according to Roth and Ivemark (2018). They note that people in general select ethnic, and to some extent racial, identities that they view positively and that make them feel distinctive (Waters 1990; Song 2003; Lacy 2007), and their identities are shaped by reflected appraisals of how others see them. Although the authors acknowledge that genetic information may be attributed great authority, they suggest the process of assessing ancestry information through these mechanisms is not unique to GAT-takers and resembles the general process of adopting symbolic identities (Gans 1979). However, their focus on only GAT-takers does not provide support for these broader claims.

We assess whether identity aspirations act as a general mechanism of identity formation as well as an influence on GAT-takers. Identity aspirations

are considered the stronger of the mechanisms and are particularly relevant for White test-takers' claims to ethnic identities, especially new European ethnicities that may not be visibly distinctive.[6] We further specify how identity aspirations influence different types of identity change—that is, adding or dropping an identity. The cognitive processes guiding the decision to add a new identity versus relinquishing a previously held one likely differ. Because acts of addition involve the prospect of joining a new group, people's desire to adopt that identity will involve their feelings toward an external group—whether they hold it in high or low regard. Addition does not pose a threat to the previous identities in which the individual has invested over time.

Omission involves a more personal assessment of the significance an existing identity plays in a person's sense of self. Removing an identity may be difficult if people have invested considerably in it. The importance or centrality of that identity to their sense of self—a fundamental aspect of the development of ethnic and racial identities (Umaña-Taylor et al. 2014; Cross et al. 2017)—becomes the focus of their cognitive processing. Their identity aspirations will be motivated more by how positively they view the personal identity as part of themselves rather than their regard for the group overall. We therefore divide most of our hypotheses into those involving acts of addition and omission and operationalize independent variables that reflect the cognitive processes guiding identity aspirations for each type of act.

The Influence of Admixture Ancestry Percentages

Although direct-to-consumer GAT companies sell several types of tests, admixture tests have most captured the public imagination. Unlike mtDNA or Y-DNA tests that trace only one ancestral line, admixture tests present information about the purported biogeographical origins of ancestors across the genome. The results are typically shown as a percentage breakdown. Although these percentages technically refer to the portion of AIMs tested that are more commonly found among one region's contemporary population than in others, they are frequently misinterpreted as representing the fraction of a person's total ancestry from that population (Bolnick et al. 2007; Duster 2011; Bobkowski et al. 2020).

We expect the reported admixture percentage of genetic ancestry to factor into test-takers' considerations as they process their results; specifically, higher percentages should be seen as more deterministic and less likely due to error. We expect test-takers will be more likely to incorporate new ancestries reported at higher percentages. By contrast, the role of identity aspirations

[6] Our study included questions on social appraisals for racial identity changes, but we found too few cases of racial changes to allow substantive analysis of this mechanism.

will be most powerful for identity additions when reported ancestry percentages are lower. Similarly, we expect higher reported percentages to decrease the likelihood of omitting an identity that an individual has previously claimed. Thus, we expect that when reported ancestry percentages are lower, a person's identity aspirations—assigning greater importance to that previously held identity—will have more effect in reducing its likelihood of omission.

HYPOTHESES

We present the following hypotheses, reflecting the different expected processes for acts of identity addition and omission.

Any Change

HYPOTHESIS 1.—*People who take GATs will exhibit higher rates of change in their ethnic identification than people who did not take GATs.*

Acts of Addition

HYPOTHESIS 2a.—*The more favorable one feels toward the associated ethnic group, the more likely one is to adopt an identity.*

HYPOTHESIS 2b.—*The more favorable test-takers feel toward the associated ethnic group, the more likely they are to adopt an identity when their admixture test reports a corresponding ancestry.*

HYPOTHESIS 3.—*The higher the percentage of a new ancestry reported in admixture tests, the higher the likelihood of test-takers adopting a corresponding identity.*

HYPOTHESIS 4.—*The lower the percentage of a new ancestry reported in admixture tests, the more the test-takers' likelihood of adopting a corresponding identity will be influenced by how favorably they feel toward the associated ethnic group.*

Acts of Omission

HYPOTHESIS 5a.—*The more important an existing ethnic identity is to people, the less likely they will be to omit it.*

HYPOTHESIS 5b.—*The more important an existing ethnic identity is to test-takers, the less likely they will be to omit it when it is not supported by the admixture test.*

HYPOTHESIS 6.—*The higher the percentage of a claimed ancestry in the admixture tests, the lower the likelihood that test-takers will omit a corresponding identity.*

HYPOTHESIS 7.—*The lower the percentage of a claimed ancestry in the admixture tests, the more the test-takers' likelihood of omitting a corresponding identity will be influenced by how important the identity is to them.*

Figure 1 presents a theoretical map of the predicted relationships. Hypothesis 1 is our experimental hypothesis. Hypotheses 2a and 5a test the role of identity aspirations as a general theory of identity change, regardless of test-taking, while hypotheses 2b and 5b consider the additional role that identity aspirations play for test-takers in processing their GATs. The remaining hypotheses focus on the treatment group only, to assess how specific GAT

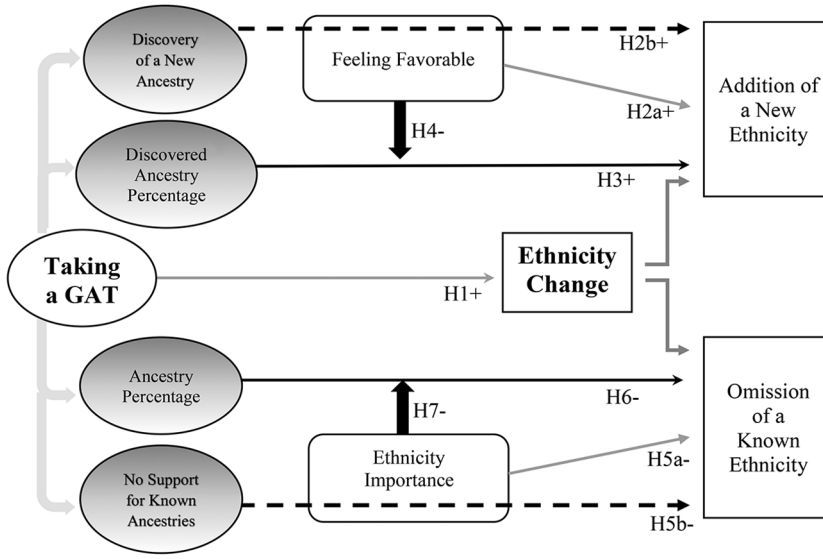

FIG. 1.—Theoretical map of hypothesized relationships. Our hypotheses are centered around the effects of taking a GAT and the different types of information it provides (*circles on left*) on ethnicity change, including its two primary forms: addition of a new ethnicity and omission of a known ethnicity (*rectangles on right*). Identity aspirations influence these effects and are operationalized in two ways: feeling favorable toward a new ancestry (for additions) and ethnicity importance (for omissions). Lighter arrows show the hypothesized effects for the general population, and darker arrows show the hypothesized effects for GAT-takers. Vertical arrows indicate interaction effects. Dashed lines indicate restrictions to the conditions of the GAT results on the left (i.e., the effect of feeling favorable under the condition of discovering a new ancestry from the GAT, and the effect of ethnicity importance under the condition that the GAT shows no support for the known ancestry). Hypotheses are listed next to their respective arrows, with the + and − signs indicating the predicted positive or negative direction of effects.

results interact with identity aspirations. Table 1 summarizes our hypotheses, the dependent and independent variables used in testing them (described below), and the sample each hypothesis is tested on.

DATA AND METHODS

The data come from an original, unblinded, parallel arm RCT testing the social impacts of genetic ancestry testing. We hired NRG Research Group to recruit participants using random digit dialing across the continental United States to screen for eligibility. Individuals were eligible if they were born in the United States, self-identified their race as only non-Hispanic White, were age 19 or older, neither they nor an immediate family member had taken a GAT, and they were willing to take a GAT. We restricted our sample to one group because of study costs; the focus on non-Hispanic White Americans was both practical and theoretically motivated. Our informal communications with several testing company representatives indicated that they were the largest consumer group of GATs. Prior research also found that White test consumers are particularly motivated to embrace new ethnic or racial identities after testing (Roth and Ivemark 2018). Their choosing to adopt non-White racial identities could thus have significant implications for how race and discrimination are measured and the implementation of policies to address racial inequalities.

We stratified our sampling by age, gender, education, and region based on the national population of native-born non-Hispanic Whites ages 19 and older, to improve the demographic diversity of our sample. Figure A1 (apps. A–J are available online) provides a flow chart for the study design and response, following the CONSORT 2010 RCT reporting guidelines (Schulz et al. 2011). NRG called landlines and cellphones, told prospective participants what the study involved, and asked for their e-mail address if they were interested in learning more; 90.3% of those eligible agreed to be contacted by the researchers ($N = 1{,}550$).

Because the study required long consent forms, the institutional review board reviewing the study requested that treatment and control groups receive tailored consent forms to minimize length and promote legibility. Random allocation into the control group ($N = 783$) or the treatment group ($N = 767$) therefore occurred when prospective participants provided their e-mail address. Using a random number generator, we applied a randomly generated series of zeros (control) and ones (treatment) to the individuals in the order in which they were recruited by NRG, using a 1:1 ratio, to determine which consent form they would receive. We offered small financial incentives for completing each online survey. We asked those assigned to the control group not to take any GATs before the study's end and said they would receive a discount coupon to purchase the same tests at half price after

TABLE 1
SUMMARY OF HYPOTHESES, SAMPLES, VARIABLES, AND RESULTS

Hypothesis	Sample	Dependent Variable	Independent Variable	Results
1: People who take GATs will exhibit higher rates of change in their ethnic identification than people who did not take GATs	Full sample	Any ethnicity addition, any ethnicity omission, and any ethnicity change	Treatment group	Supported
2a: The more favorable one feels toward the associated ethnic group, the more likely one is to adopt an identity	Full sample	Ethnicity Addition	Feeling Favorable	Supported
2b: The more favorable test-takers feel toward the associated ethnic group, the more likely they are to adopt an identity when their admixture test reports a corresponding ancestry	Treatment group only	Discovered Ethnicity Addition	Feeling Favorable	Supported only in South
3: The higher the percentage of a new ancestry reported in admixture tests, the higher the likelihood of test-takers adopting a corresponding identity	Treatment group only	Discovered Ethnicity Addition	Ancestry Percentages	Supported
4: The lower the percentage of a new ancestry reported in admixture tests, the more the test-takers' likelihood of adopting a corresponding identity will be influenced by how favorably they feel toward the associated ethnic group	Treatment group only	Discovered Ethnicity Addition	Feeling Favorable × Ancestry Percentages	Not supported
5a: The more important an existing ethnic identity is to people, the less likely they will be to omit it	Full sample	Ethnicity Omission	Ethnicity Importance	Supported
5b: The more important an existing ethnic identity is to test-takers, the less likely they will be to omit it when it is not supported by the admixture test	Treatment group; ethnicities not supported by test only	Ethnicity Omission	Ethnicity Importance	Not supported
6: The higher the percentage of a claimed ancestry in the admixture tests, the lower the likelihood that test-takers will omit a corresponding identity	Treatment group only	Ethnicity Omission	Ancestry Percentages	Supported
7: The lower the percentage of a claimed ancestry in the admixture tests, the more the test-takers' likelihood of omitting a corresponding identity will be influenced by how important the identity is to them	Treatment group only	Ethnicity Omission	Ethnicity Importance × Ancestry Percentages	Not supported

the study; this provided an additional participation incentive and a motivator not to purchase the tests during the study. At this point, 64.1% of those allocated to the control group ($N = 502$) and 65.8% of those allocated to the treatment group ($N = 505$) consented to participate and completed the online pretest survey, between October 2014 and February 2015.

When treatment respondents completed their pretest survey, we mailed them a test kit, with instructions for sending a DNA sample to the testing company. We used Family Tree DNA (FTDNA), one of the largest direct-to-consumer GAT companies at the time, so that the test reports would be comparable to what many test consumers receive. We also chose a company that does not provide genetic disease risk estimates because of ethical concerns with providing such information. Admixture and mtDNA tests were conducted on the treatment respondents' samples.[7] When the tests were completed, usually six to eight weeks later, we e-mailed the respondents a link to view their results online and reported their admixture breakdown in the e-mail. Figures A2 and A3 show examples of test results.[8] We asked treatment respondents to spend at least half an hour looking through their results and then take a short First Reactions survey. This ensured that they viewed their results and captured their initial reactions.

Both groups were invited to take the online posttest survey 11 months after they completed their pretest survey. These were completed between September 2015 and March 2016. Nine control respondents were excluded from analysis because they ($N = 3$) or a relative ($N = 6$) had taken a GAT since their pretest survey and they were aware of the results. The final experimental sample includes 802 participants (control $N = 425$; treatment $N = 377$). The completion rate was 84.7% of control and 74.7% of treatment participants. We examined pretreatment equivalence across treatment and control groups and assessed attrition patterns for systematic difference relevant to our hypotheses (app. sec. A.2). The groups were balanced and suitable for the RCT.[9]

In additional, nonexperimental analyses restricted to the treatment group alone, we supplement the randomly assigned treatment group with 55 treatment participants who were not subject to random assignment. Because attrition was expected to be higher in the treatment group due to the extra study steps (e.g., sending in kit, taking First Reactions survey), we enrolled more

[7] Mitochondrial (mtDNA) tests trace direct matrilineal ancestry using the DNA in people's mitochondria and can be taken by both female and male respondents. However, we focus analysis on the admixture tests because they provide categories of ancestry and because respondents often did not remember or understand the mtDNA results.

[8] The admixture and mtDNA results included several web pages that respondents could view; figs. A2 and A3 are the primary images we recommended.

[9] See app. B for a comparison of the sample to the US-born non-Hispanic White population.

treatment participants after randomization was completed to have additional analytical power when considering the impact of the GAT results on the treatment sample.[10] These cases are included only in analyses where random assignment is not relevant; all experimental comparisons of treatment and control groups include only randomized participants.

Measuring Ethnic Identity

To capture ethnic identification, we asked the open-ended question "What is your ethnic identity?" in both the pretest and posttest surveys. Respondents could write in up to six ethnicities.

We coded these responses using the detailed ancestry code list from the 1990 Census Public Use Microdata Survey. We then assigned these codes to the admixture categories to which they corresponded, drawing on FTDNA's description of its categories and the regions whose populations they are meant to represent. For example, responses such as British, Welsh, Irish, or Irish American were coded under the FTDNA subcategory British Isles, within their primary category European (see table C1). We created dummy variables, for both pretest and posttest survey responses, identifying the respondents' ethnicity responses in categories corresponding to the admixture categories (e.g., a British Isles identity listed).

Measuring Racial Identity

In the phone screening survey for study enrolment, NRG asked "Do you consider yourself Latino, Hispanic, or of Latin American origin?" Only those who said no were eligible to continue. They then asked: "People in the U.S. come from many racial or cultural groups. You may belong to more than one group on the following list. Do you consider yourself primarily: White or Caucasian? Black? Asian? Arab? Native American or American Indian? A combination of more than one of these groups? Or Other?" After each option, respondents were asked for a yes/no response. Only individuals who responded yes to White or Caucasian but no to every other option were eligible for the study.

The online posttest survey asked respondents how they classify their race with the question, "Please think about your racial identity. What race or races do you consider yourself to be? Please check all that apply." The response options were White or Caucasian, Black or African-American, Asian, Native American or American Indian, and Hispanic or Latino/a. The next question

[10] See app. sec. A.1. Excluding the nonrandom supplement from the treatment-only analyses does not change our results (available on request).

asked "Is there any other race you consider yourself to be?" and allowed open-ended responses if respondents said yes.

While the goal of the screening survey was to identify people who initially considered themselves only non-Hispanic White, we included Hispanic or Latino/a as a response category for the posttest race question because of substantial research before our study that many Americans view this as a racialized category (Golash-Boza 2006; Frank, Akresh, and Lu 2010; Roth 2012; Dowling 2014). After the launch of our data collection, several studies drew attention to how Middle Eastern populations frequently consider themselves, and believe they are viewed as, non-White (Maghbouleh 2017; Khoshneviss 2019; Maghbouleh, Schachter, and Flores 2022), and the Census Bureau recommended adding a Middle Eastern or North African (MENA) response category to the OMB Standards on Race and Ethnicity (Mathews et al. 2017). Although we did not provide a MENA category in the posttest question, follow-up qualitative interviews did not reveal any respondents identifying racially as MENA when asked in open-ended terms; because of this, and because no respondents chose "other race" and wrote in MENA and practically no respondents adopted a MENA ethnic identity, we believe the omission of MENA as a listed race category is unlikely to have a meaningful impact on our results (see discussion and qualitative findings in app. G). We present descriptive data for racial identity changes based on posttest race responses but focus our remaining variables for multivariate analysis on ethnic identities.

Dependent Variables: Measuring Ethnicity Changes

We created several sets of variables capturing different types of identity changes. For acts of addition, we distinguish the adoption of new ethnic identities that were previously "unknown," what we call "new additions," from temporal identity fluidity within respondents' "known" ancestries. In the pretest survey, we asked respondents to list all the ethnic origins they knew of for their biological mother's and father's ancestors (up to eight ancestries for each). The respondents' pretest ethnic identities, together with their parents' ethnic origins, provide us with a set of respondents' known ancestries. We only code "new additions" (i.e., ethnic identities added in the posttest survey and not listed for either the respondents or their biological parents in the pretest survey) as acts of addition.[11]

[11] For descriptive data on racial identity change (table 2), when respondents listed non-European pretest ethnicities, we treated these as known ancestries that could inform a corresponding racial identity in the posttest to provide a more conservative estimate of racial new additions. Even including known ancestries as race additions would not provide enough cases of racial identity change for multivariate analysis (app. sec. D.1 and tables D1 and D3).

Some respondents listed broad answers such as White or European, which we present descriptively (see table J5), but they were uninformative for the purposes of assessing specific unknown ethnicity changes. For ethnicity additions, we coded these as missing only if responses were uninformative for both the respondents and their parents in the pretest survey, because we did not have any information about their known ancestries (see app. secs. D.2 and D.3).

We hypothesized that the more favorable people's feelings are toward an ethnic group, the more likely they are to add the associated identity (hypothesis 2a), following the logic of identity aspirations. We therefore created a set of 10 dichotomous Ethnicity Addition variables that correspond to 10 groups we asked respondents their feelings about: Middle Easterners, East Asians, African-Americans, South Asians, Jews, Southern Europeans, Eastern Europeans, Western Europeans, the British and Irish, and Native Americans or American Indians (table C1).[12] Each Ethnicity Addition variable (e.g., addition of Middle Eastern ethnicity, addition of Eastern European ethnicity) is coded 1 if the respondent adds an ethnicity in the posttest survey belonging to the respective category that was not known (not listed for respondent or parents in the pretest survey) and 0 otherwise (table D2).

The next set of addition hypotheses focuses on the treatment group specifically (hypotheses 2b, 3, and 4). As one step to increase confidence that the observed identity addition occurs because of the GAT results, we created a set of dependent variables incorporating information about the test results. These Discovered Ethnicity Addition variables code whether ethnicities corresponding to GAT-reported ancestries that are new discoveries for the respondent were added. These binary variables are coded 1 if the respondent adopts a new ethnic identity that was not part of their known ancestry but a corresponding genetic ancestry appears in the GAT and 0 otherwise. We create Discovered Ethnicity Addition variables for each of the 10 ethnic groups about which we asked respondents' feelings, allowing us to test the effect of feeling favorably toward the group.[13]

To test the omission hypotheses (hypotheses 5a–7), we developed a series of dichotomous Ethnicity Omission variables. We created these for each of the up to six ethnic identities respondents listed in the pretest survey; they are coded 1 if the pretest ethnicity is omitted in the posttest survey and as 0

[12] We asked separate questions about how favorable respondents felt toward Africans (e.g., Nigerians, Ethiopians) in their society and toward African-Americans. When testing how feelings toward a group affected adding an African ethnicity, we used the question about African-Americans. Using the question on Africans showed no difference.

[13] See tables J1 and J2 for frequencies of discoveries and discovered ethnicity additions, respectively.

if it is listed again (see app. sec. D.4). If the respondents did not list a specific ethnicity for themselves, we coded it as missing. The biological parents' ethnic origins do not factor into Ethnicity Omission, because this is about ceasing to claim something that was previously claimed. These variables were defined to correspond with the key independent variable, Ethnicity Importance, which is similarly measured for each ethnic identity respondents claimed on the pretest survey.

We created three simplified variables to test our experimental hypothesis that respondents who took GATs experienced higher rates of ethnic identity change than those who did not (hypothesis 1). Any Ethnicity Addition is coded 1 if any of the set of Ethnicity Addition variables is coded 1 to indicate new additions and 0 otherwise. Likewise, Any Ethnicity Omission is coded 1 if any of the set of Ethnicity Omission variables is coded 1 and 0 otherwise. The Any Ethnicity Change variable is coded 1 if the respondent added or omitted any ethnicity in the posttest survey and 0 otherwise.

To illustrate our coding, consider the example of a respondent who listed Welsh, Italian, and Native American ethnicities in the pretest survey for herself and Welsh, Italian, Native American, French, and Irish for her parents. If this respondent listed English, Welsh, Italian, and French in the posttest survey, English would be the only new addition (as French was listed for her parents) and Native American would be considered an omission. English and Native American would be coded for Any Ethnicity Change. In our coding, we adopted conservative rules for comparing pre- and posttest ethnicities to underestimate rather than overestimate identity change (see app. sec. D.2). For analyzing hypothesis 1, we also created sets of dichotomous variables indicating any addition, omission, or any change of European and non-European ethnicities separately.

Key Independent Variables

A dichotomous variable, Treatment Group, is coded 1 for members of the treatment group and 0 for the control group. This captures the effect of receiving GATs and is the main independent variable in our tests of hypothesis 1.

For several hypotheses about acts of addition (hypotheses 2a, 2b, and 4), a key independent variable is Feeling Favorable toward a specific ethnic group. In the pretest survey, respondents answered feelings thermometer questions asking how favorable or warm they feel toward 10 different groups in the United States. The questions focused on groups recognized in US society that corresponded to the FTDNA admixture categories, and each contained examples such as "Western Europeans (e.g. Germans, French)." The variables are continuous and range from 0 (not at all favorable or warm) to 10 (very

favorable or warm). The categories and summary statistics are shown in table J3. Mean values are highest for European groups (6.6–7.4) and Native Americans (7.0) and lowest for Middle Easterners (5.6) and South Asians (6.0).

Some hypotheses for acts of omission predict that the more important an existing ethnic identity is to people, the less likely they are to omit it (hypotheses 5a and 5b). Our key independent variable here is Ethnicity Importance, measured with the pretest survey questions "How important is your _____ identity to you?" Response options use a five-point Likert scale, ranging from 1 (not important at all) to 5 (very important). This question was repeated for each ethnic identity the respondents listed for themselves in the pretest survey.

A key variable for several hypotheses (hypotheses 3, 4, 6, and 7) is Ancestry Percentages. In their admixture tests, FTDNA reported genetic ancestry for our respondents in the following categories and subcategories: European (British Isles, Western and Central Europe, Scandinavia, Eastern Europe, Southern Europe, Finland, and Northern Siberia), Jewish Diaspora (Ashkenazi Diaspora), Middle Eastern (Asia Minor, North Africa, Eastern Middle East), East Asian (Northeast Asia), Central South Asia (Central Asia), African (West Africa, East Central Africa), and New World (Native American).[14] Ancestry Percentages is a set of continuous variables, ranging from 0 to 100, indicating the percentage of the ancestry reported in each FTDNA subcategory. We entered this information from the admixture test's report of Ethnic Makeup for each respondent (see fig. A2).

In addition to the Ancestry Percentages independent variables, we use admixture test result information to restrict the sample for our analysis of hypothesis 5b, which focuses only on ethnic identities that are not supported by treatment respondents' admixture tests. For this, we created a dichotomous variable called Ethnicity Supported for each ethnicity treatment respondents listed in the pretest survey. We code it 1 if the admixture test reported any amount of the corresponding FTDNA subcategory and as 0 if the corresponding genetic ancestry was not reported at all (see table C1).

Control Variables

Our models control for several demographic and social variables from the pretest survey, including gender (Male: 1 = male, 0 = female), Age (19–34, 35–54, 55 and above), and Education (high school or less, some college, college degree, more than college degree). We also control for living in the South. We expect that the legacy of slavery and Jim Crow there may have led to different perceptions of race and ethnicity, potentially including whether it is genetically determined (Davis 1991). Furthermore, White Southerners

[14] Other genetic ancestry categories are used by FTDNA but were not reported for our respondents. The tests do not report Latin American ancestry (app. C).

may be more likely to have weak ethnic attachments. Studies have found that "unhyphenated Whites"—those who list their ethnicity only as "American"—and those who do not know where their ancestors came from are more likely to live in the South, potentially due to the large proportion of Southern families who have been in the United States for four or more generations or a relative de-emphasis of ethnic distinctions in the region (Alba and Chamlin 1983; Lieberson 1985). This could increase their aspirations to claim more distinctive identities (Roth and Ivemark 2018). Because these conditions may modify Southerners' reactions to GATs, we include interaction effects between South and our variables of interest.

We include a control for racial interaction, which influences Whites' racial attitudes and may also affect their reading of the tests and how favorably they feel toward other groups (Roth, Côté, and Eastmond 2022). Interaction with non-Whites is a composite measure averaging the respondents' reported frequency of having a conversation with someone who is Black, Asian, Latino, Native American, or Middle Eastern, respectively, over the past six months in the pretest survey; the seven-point response scale ranges from "not at all" to "every day." Our measure of political party preference comes from feelings thermometer questions about how favorable or warm respondents feel toward the Republican Party and the Democratic Party, respectively (from 0 = not at all to 10 = very favorable or warm). Because they are correlated ($r = -.55$), we created a difference scale of feelings toward Republicans minus feelings toward Democrats, for a measure indicating Republican Leaning, ranging from −10 to 10. We also control for Genetic Essentialism, the belief that races are discrete genetic categories with innate essences indicating different abilities or skills. Taking GATs can lead to changes in the essentialist beliefs about race (Roth et al. 2020). We use the Genetic Essentialist Scale for Race (Yaylacı, Roth, and Jaffe 2021), as measured in the pretest survey, which ranges from 0 to 1 with higher values indicating greater belief in genetic essentialism. Summary statistics for the control variables are shown in table J4.

Analysis

In testing hypothesis 1—our experimental hypothesis that test-takers will change ethnic identification more than non-test-takers—the respondent is our unit of analysis. For the remaining hypotheses, our unit of analysis is the ethnic identity. Since ethnicity additions or omissions may occur across several identities for a single respondent, we stack identities into two distinct long-form data sets nested under respondents. For acts of addition, because the dependent variables (Ethnicity Addition and Discovered Ethnicity Addition) correspond with each FTDNA admixture subcategory, each row of the first long-form data set represents an admixture subcategory.

By contrast, the dependent variable for acts of omission (Ethnicity Omission) is generated for each ethnic identity listed in the pretest survey. Thus, each row of the second long-form data set represents an ethnicity the respondent listed in the pretest survey.

Because an individual's responses may be correlated across ethnicities, we use multilevel models when possible, treating identities as the first level and respondent as the second level. In cases when a multilevel model fails to converge, we use models with clustered errors. Because all the dependent variables are binary, we use logistic regression for estimation.[15]

In the following sections, we briefly summarize descriptive patterns for ethnic and racial identity change, with detailed tables in the appendix. Focusing on ethnicity changes, we next present our experimental analysis of hypothesis 1, drawing on the randomization of the RCT to test the causal impact of taking GATs on ethnic identity by comparing the treatment and control groups. Our analyses of identity aspiration processes in general (hypotheses 2a and 5a) include our full sample. The remaining analyses are limited to only the treatment group, and because these analyses are nonexperimental, we include the nonrandom supplement cases.

FINDINGS

Descriptive Findings

In the pretest survey, respondents mostly listed European ethnicities for themselves and their parents, and the distribution was very similar for the control and treatment groups (table J5). For both groups, the most commonly listed were British Isles (74.02% of control and 80.06% of treatment respondents listing it for themselves or their parents), Western and Central European (64.7% and 67.86%), and Eastern European (21.82% and 20.78%). Respondents listed Scandinavian (18.14% and 15.24%) and Jewish (5.39% and 7.76%) less frequently. Of the non-European ethnicities, respondents listed Native American most frequently (15.93% in control and 16.34% in treatment group). Other non-European ancestries were rarely mentioned; less than 1% of respondents in either group listed Middle Eastern, Asian, or African identities for themselves or their parents' origins.

For large proportions of treatment respondents, the European ethnicities they claimed for themselves or their parents were supported by the admixture results—the test reported a genetic ancestry that corresponded with what they listed (table J6). Even if the test reported a broader category (e.g., Eastern European rather than Polish), we view this as supporting a known ancestry because previous research indicates that respondents commonly

[15] See app. E for the formal model.

view it that way (Roth and Ivemark 2018).[16] Of the respondents who listed British Isles, 89.09% received results that supported it. Scandinavian (85.71%) and Eastern European (79.78%) were also supported by the tests for large proportions of treatment respondents who listed them. Other European ethnicities were generally supported for about two-thirds of treatment respondents. The pattern is rather different for the non-European ethnicities they listed. Only two treatment respondents listed a Middle Eastern ethnicity, and both received tests supporting it. Yet most of the non-European ethnicities that treatment respondents listed were not supported by the tests. While the numbers are small, none of the treatment respondents who listed a Central Asian ($N = 2$) or South-Central African ethnicity ($N = 1$) received supporting test results. Native American ethnicity shows the starkest result: of the 64 treatment group respondents who listed it, the GAT did not support the ancestry for 98.44% of them—all but one.

However, many treatment respondents received admixture results that reported non-European ancestries (table J1): 60.38% of them in all. Other than three respondents for whom this was a known ancestry, the remaining test-reported non-European ancestries were discoveries. Overall, 48.79% discovered Middle Eastern ancestry, 14.73% discovered Central and South Asian ancestry, 1.93% discovered East Asian ancestry, 3.38% discovered African ancestry, and 0.97% discovered Native American ancestry from their tests.

Some treatment respondents also discovered new European ancestries that they had not listed for themselves or their parents (table J1). The most common were Scandinavian (discovered by 57.00% of treatment respondents), Southern European (45.41%), Eastern European (32.85%), and Finnish and Siberian ancestries (22.95%). In addition, 6.04% of treatment respondents discovered Ashkenazi Jewish ancestry.

In terms of identity change, treatment respondents experienced more change to their ethnic or racial identities than did control respondents. Table 2 shows that 32.05% of treatment respondents experienced any identity change, compared to 23.87% of control respondents.[17] Specifically, 12.31% of treatment respondents added at least one new ethnicity, compared to 6.95% of control respondents, and 29.47% omitted at least one ethnicity, relative to 21.25% of control respondents.[18] While the amount of identity

[16] Subsequent follow-up interviews with treatment respondents also confirmed this expectation.

[17] Table 2 shows only new additions; table D3 shows all identity change, including fluidity within known ancestries.

[18] Just omitting ethnic identities is the most common form of ethnicity change. In the control group, 60 respondents only dropped an ethnicity, while 18 only added, and 8 respondents both added and dropped an ethnicity. In the treatment group, 64 respondents only dropped an ethnicity, 21 only added, and 20 respondents both added and dropped an ethnicity.

TABLE 2
FREQUENCIES OF ETHNIC AND RACIAL IDENTITY CHANGE

	Description	Control	Treatment
Ethnic Identity Change:			
Any Ethnicity Addition	At least one new (not previously known) ethnicity is added	6.95% 26	12.31% 41
Any Ethnicity Omission*	At least one ethnicity listed in first wave is omitted	21.25% 68	29.47% 84
Any Ethnicity Change	At least one new ethnicity is added or one listed ethnicity is omitted	22.99% 86	31.53% 105
N		374	333
Racial Identity Change:†			
Any Race Addition	At least one new non-White race is added	1.86% 7	2.07% 7
Any Race Omission	White race is omitted	0% 0	.30% 1
Any Race Change	A new non-White race is added or White race is omitted	1.86% 7	2.96% 10
N		377	337
Any ethnic or racial identity change	At least one new ethnicity or race is added or one listed identity is omitted	23.87% 90	32.05% 108

NOTE.—Ethnicity and race additions include only new additions of previously unknown ancestries. Table D3 shows all identity change, including within known ancestries. Sample sizes differ slightly for ethnicity and racial identity change variables because three control and four treatment group respondents did not provide informative ethnicity responses for themselves or their parents but provided racial identity information.

* The total number of respondents for any ethnicity omission differs slightly (N control = 320, N treatment = 285) because our coding procedure excluded cases with no informative ethnicity information. For any ethnicity addition, these cases were included if there was informative ancestry information for their parents.

† For racial identity change, we do not include cases in which respondents selected in the posttest survey a non-White racial identity that they had listed as an ethnic identity in the pretest survey, because these ancestries were previously known. See app. sec. D.1 for further discussion.

change in the control group might seem surprising, in fact it is consistent with what other research in this area has shown (Waters 1990) and is most likely a combination of changes in the salience of certain ethnicities between times; omissions from the parents' ancestral origins during the pretest survey, despite our best efforts to capture the universe of known origins; and some control respondents learning new information about their family ancestry from sources other than GATs, resulting in changes to their self-understanding (see app. E).

Tables D2 and J2 detail which types of ethnicities were added and omitted. Particularly striking is the much greater omission of Native American ethnicity by treatment respondents (60.00%) than control respondents (28.12%; table D2); this suggests that treatment respondents whose tests did not support a previously claimed Native American ethnicity tended to drop that ethnicity.[19]

There were very low levels of racial identity change overall. Only 2.07% of treatment respondents and 1.86% of control respondents added a new non-White racial identity to their posttest responses. Because we focus on new additions only, this excludes cases in which a corresponding non-European ancestry was previously known and listed either in respondents' pretest ethnic identities or for their parents' ethnic origins. We show responses to the posttest race question in table D1. This reveals that several respondents who had listed a Native American ethnicity for themselves or their parents in the pretest added Native American as a racial identity in the posttest (5.35% of control and 3.26% of treatment respondents). Given that only one treatment respondent received GAT results indicating any Native American ancestry, the slightly lower rate among treatment respondents suggests that some may have elected not to add Native American as a racial identity based on those results.

Of those who did add a new racial identity in the posttest survey, all but one listed White as well.[20] This is consistent with previous findings that GAT-takers are more likely to list multiracial identities by adding new races rather than swapping one racial identity for another (Lawton and Foeman 2017; Roth and Ivemark 2018; Johfre et al. 2021). Because of the low levels of racial identity change, we focus on ethnic identity change for the remaining analysis.

Testing Hypotheses: Multivariate Results

We test hypothesis 1—that people who take GATs exhibit higher rates of ethnic identity change than those who do not—using logistic regression models with aggregated Any Ethnicity Addition, Any Ethnicity Omission, and Any Ethnicity Change variables for all ethnic identities, as well as versions distinguishing European and non-European ethnicities. Based on those models, figure 2 shows the relative probabilities of identity change and reveals that the treatment group is more likely to change ethnic identification than the control group, in every case except for the addition of non-European

[19] Some respondents who had listed Native American as an ethnic identity in the pretest survey instead listed Native American as a racial identity in the posttest survey. If we view these cases as retaining a Native American identity, then 48.48% of treatment respondents omitted a Native American identity, relative to 12.12% of control respondents.

[20] This respondent omitted his White racial identity and listed only Hispanic.

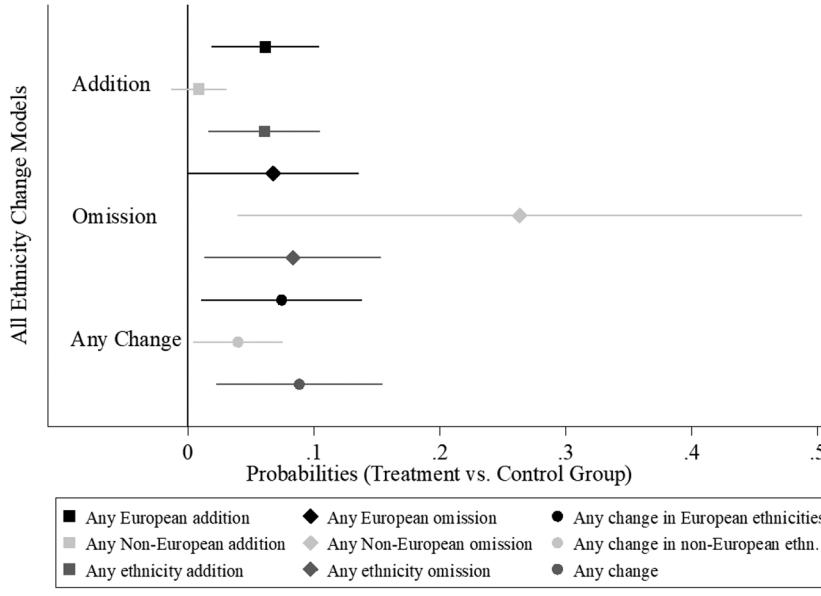

FIG. 2.—Contrast of average marginal predicted probabilities for the treatment group to experience each type of ethnicity change compared to the control group, based on the models shown in table J7. The analysis controls for gender, age, education, living in the South, Republican leaning, and interaction with non-Whites, all measured in the pretest survey. Jewish identities are coded European for this analysis (all GAT-reported Jewish ancestry for participants was Ashkenazi); models including Jewish in the non-European group found no substantive difference in results. Unadjusted results (without control variables) remain the same and are available on request.

ethnicities (models in table J7). Specifically, the predicted probabilities for treatment group respondents are 6.1% higher than the control group for adding any new ethnicity, 8.3% higher for omitting any ethnicity, and 8.8% higher for experiencing any change, all of which are significant at the 95% level. Furthermore, these changes do not represent temporal fluidity within known ancestries, which is excluded. These results support hypothesis 1. Yet the size of the difference between treatment and control groups is relatively small, showing that the amount of additional change that can confidently be attributed to taking GATs is lower here than what previous studies have implied.

We test our hypotheses regarding acts of addition (hypotheses 2a–4) in table 3 (full models in table J8). In hypothesis 2a, we hypothesized that feeling favorable toward an ethnic group will increase the likelihood of adopting that identity in general, not just for test-takers, so we test it on our full sample. Model 1 shows that, controlling for the GAT treatment effect, Feeling Favorable toward the associated ethnic group significantly increases the likelihood of ethnicity addition, supporting hypothesis 2a. We also checked

TABLE 3
TEST OF HYPOTHESES ON ACTS OF ADDITION

	ETHNICITY ADDITION		DISCOVERED ETHNICITY ADDITION				
	Hypothesis 2a		Hypothesis 2b		Hypothesis 3		Hypothesis 4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment group	.542*	.535*					
	(.257)	(.258)					
Feeling Favorable	.206**	.165*	.167*	.096	.139	.147	.201
	(.065)	(.069)	(.076)	(.088)	(.089)	(.090)	(.133)
South	.156	−.835	−.040	−2.515	.038	.528	.057
	(.291)	(1.062)	(.411)	(1.379)	(.456)	(.607)	(.460)
South × Feeling Favorable		.132		.342*			
		(.141)		(.173)			
Ancestry Percentages					.040***	.043***	.052*
					(.006)	(.007)	(.022)
South × Ancestry Percentages						−.014	
						(.013)	
Feeling Favorable × Ancestry Percentages							−.002
							(.003)
South × Feeling Favorable × Ancestry Percentages							
Constant	−6.046***	−5.740***	−4.771***	−4.279***	−6.475***	−6.696***	−6.877***
	(1.084)	(.988)	(1.082)	(1.095)	(1.330)	(1.349)	(1.468)
N identities	6,989	6,989	870	870	870	870	870
N respondents	700	700	359	359	359	359	359
Sample	Full	Full	Treatment	Treatment	Treatment	Treatment	Treatment

NOTE.—Estimation model is logistic regression, and SEs (in parentheses) are clustered by respondents. Models 4 and 5 are not estimable using linear mixed effect models; for consistency we opted for using logistic regression with clustered SEs. Results remain effectively the same when using linear mixed models for the remaining models and are available on request. Coefficients are log odds. Full sample refers to sample with both the control and treatment groups. The nonrandom supplement cases are included in treatment-group-only models (3–7). All models include the control variables: male, age, education, Republican leaning, interaction with non-Whites, and genetic essentialism. See table J8 for full models. Two-tailed significance tests.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

whether the effect of Feeling Favorable is contingent on the region (South vs. non-South) but did not find any interaction effect (table 3, model 2; see also fig. 3*A*). Feeling very favorable toward a group (a 10 on the scale) versus feeling just slightly favorable (a 6) more than doubles the estimated probability of adding the associated identity (from 0.92% to 2.1% overall).

Models 3–7 of table 3 are restricted to the treatment sample and use Discovered Ethnicity Addition as the dependent variable, to analyze the addition of new ethnicities discovered through GATs. In hypothesis 2b, we hypothesized that feeling favorable toward a group will increase the likelihood of adding a new ethnicity discovered through GATs. Model 3 shows that Feeling Favorable has a significant positive effect on the likelihood of identifying with new ancestries discovered through the GAT, supporting hypothesis 2b. Yet, when we look at the interaction of Feeling Favorable with South (model 4), we see that the positive effect is only seen in the South. Indeed, figure 3*B* shows that going from 6 to 10 points on the Feeling Favorable

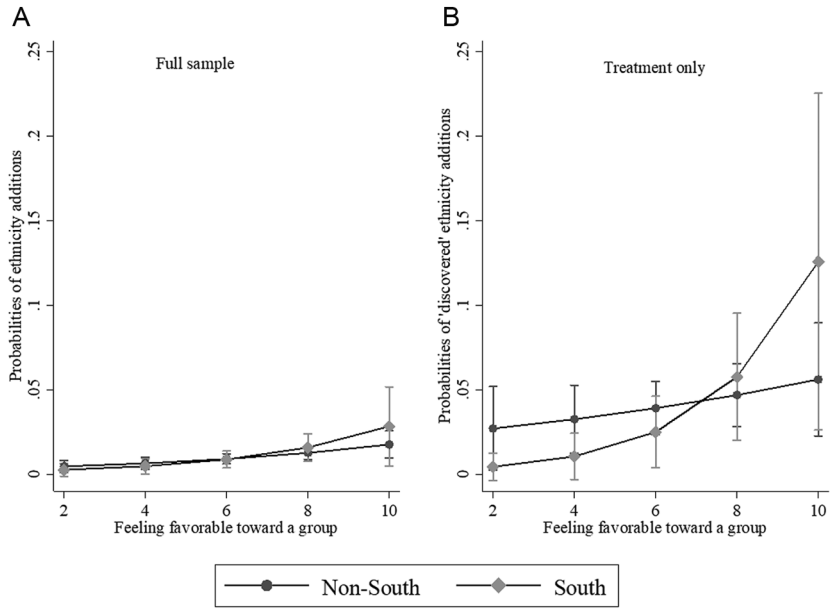

FIG. 3.—Marginal predicted probabilities of adding a new ethnicity in the posttest survey for five different points (2, 4, 6, 8, 10) on the Feeling Favorable variable, which ranges from 0 to 10. *A*, Estimated effect of feeling favorable toward a group on adding a new ethnicity associated with the group for both South and non-South in the full sample. *B*, Treatment group only, and additions are of discovered ethnicities (not previously known ancestries that are reported by admixture test results). The treatment-only sample includes nonrandom supplement cases.

scale increases the estimated marginal probability of adopting a new identity reported by GATs in the South by 10.07 percentage points (from 2.51% to 12.58%), whereas in other regions the marginal increase is only 1.7 percentage points (from 3.92% to 5.62%). Although feeling favorable toward a group influences adding a related ethnic identity as a general identity change process, its effect is stronger in the South when it comes to adding ethnicities discovered through GATs, suggesting that GATs may have the potential to amplify the identity aspiration process in the South.

Hypothesis 3 predicts that the higher the admixture percentage of the reported ancestry, the higher the likelihood of test-takers adopting an associated identity. Table 3, model 5 shows that ancestry percentages have a highly significant, positive effect on the likelihood of adding a newly discovered identity, supporting hypothesis 3. Higher percentages may convince test-takers that the result is not a testing error. They may also foster a deterministic belief that the ancestry is more meaningful to their identity if it makes up a larger part of "who they are." Figure 4 shows that the estimated probability of adopting an identity for a genetic ancestry reported at 80% (probability of 0.252) is 22 percentage points higher than for an ancestry reported at 20% (probability of 0.032), a jump significant at the 99% confidence level. The effect of ancestry percentages is not conditional on region (model 6).

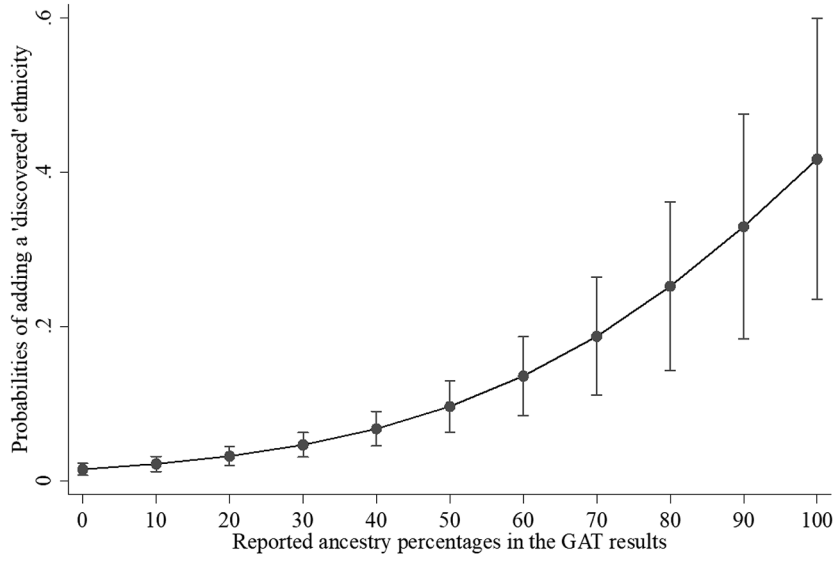

FIG. 4.—Marginal predicted probabilities of adding a discovered ethnicity for increasing percentages of ancestries reported by the GATs. The sample is treatment group only and includes nonrandom supplement cases.

In hypothesis 4, we hypothesized that the lower the reported percentage of a new ancestry, the stronger the effect of feeling favorably toward the associated group on ethnicity addition. To test this, we interacted Feeling Favorable with Ancestry Percentages. Table 3, model 7 does not show a significant interaction; neither does one with a three-way interaction with the South (table J8, model 8). We fail to reject the null hypothesis for hypothesis 4.

We test our hypotheses regarding acts of omission (hypotheses 5a–7) in table 4 (full models in table J9). In hypothesis 5a, we offered a broad hypothesis about identity omission processes in general: the more important an existing identity is to people's sense of self, the less likely they will be to omit it. Model 1 tests this on the full sample. Controlling for the effect of receiving GATs, it shows that as Ethnicity Importance rises, the likelihood of omitting that ethnicity declines significantly, supporting hypothesis 5a. This is illustrated by the predicted probabilities for Ethnicity Omission as ratings of the ethnicity's importance increase (see fig. I3). While the probability of omitting an ethnicity that is not important at all is 24.5%, it is only 6.4% for ethnicities that are very important. The negative effect of Ethnicity Importance on Ethnicity Omission does not vary by region (model 2).

In hypothesis 5b, we hypothesized that the more important an ethnicity is to test-takers' sense of self, the less likely they will be to omit it if it is not supported by the test. To test this, we ran model 3 on a sample restricted to ethnicities not supported by the test (i.e., where the admixture test does not report the associated ancestry at all). As model 3 shows, Ethnicity Importance has a negative effect, as hypothesized, but is not statistically significant, so we fail to reject the null hypothesis. The results do not vary by region (model 4). When the associated ancestry does not appear in the admixture results at all, we cannot conclude that the ethnicity's importance to the test-takers reduces their likelihood of dropping it.

In hypothesis 6, we hypothesized that the higher the percentage of the claimed ancestry in the admixture test, the lower the likelihood that test-takers will omit a corresponding identity. In table 4, we see that Ancestry Percentages has a significant negative effect on Ethnicity Omission (model 5), and the effect does not differ across regions (model 6). To illustrate, an ancestry reported by GAT results to be 70% versus 10% decreases the probability of omission by more than 11 percentage points (from 21% to 9.6%; see fig. I4). We therefore find support for hypothesis 6.

In hypothesis 7, we predicted that the lower the percentage of the claimed ancestry in admixture tests, the more the test-takers' likelihood of omitting a corresponding identity will be influenced by how important the identity is to them. In other words, we expected Ethnicity Importance (our measure of identity aspirations for acts of omission) to have a stronger effect when ancestry percentages are low. In table 4, model 7, we add an interaction

TABLE 4
TESTS OF HYPOTHESES ON ACTS OF OMISSION

	Hypothesis 5a		Hypothesis 5b		Hypothesis 6		Hypothesis 7
	(1)	(2)	(3)	(4)	(5)	6)	(7)
Treatment group	.343	.336					
	(.194)	(.195)					
Ethnicity Importance	−.414***	−.478***	−.306	−.415	−.361***	−.361***	−.263
	(.081)	(.097)	(.225)	(.279)	(.103)	(.103)	(.142)
South	.374	−.285	1.404*	.333	.685*	.829*	.688*
	(.220)	(.573)	(.573)	(1.583)	(.291)	(.381)	(.293)
South × Ethnicity Importance		.208		.335			
		(.166)		(.471)			
Ancestry Percentages					−.018***	−.016**	−.006
					(.004)	(.005)	(.012)
South × Ancestry Percentages						−.005	
						(.009)	
Ancestry % × Ethnicity Importance							−.004
							(.004)

Constant	−.056	.150	−.324	.128	.537	.468	.254
	(.650)	(.672)	(1.994)	(2.115)	(.909)	(.911)	(.956)
Random effect parameters:							
Variance ID	.983**	.992**	1.742	1.790	.926*	.897*	.948*
	(.335)	(.337)	(1.608)	(1.622)	(.431)	(.428)	(.439)
N identities	1,475	1,475	172	172	806	806	806
N respondents	619	619	122	122	342	342	342
Sample	Full	Full	Treatment; ethnicities not supported by test only	Treatment; ethnicities not supported by test only	Treatment	Treatment	Treatment

NOTE.—Dependent variable is Ethnicity Omission. Estimation model is logistic regression, and linear mixed models are used. Coefficients are log odds. Numbers in parentheses are SEs. Full sample refers to sample with both the control and treatment groups. The nonrandom supplement cases are included in treatment-group-only models (3–7). All models include the control variables: male, age, education, Republican leaning, interaction with non-Whites, and genetic essentialism. See table J9 for full models. Two-tailed significance tests.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

between Ethnicity Importance and Ancestry Percentages, but it shows no significant effect. A three-way interaction between these and South shows the null effect is present across regions (see table J9, model 8).

However, to explore whether there might be a nonlinear effect, we ran the marginal effects of Ethnicity Importance (the effect of a 1 unit increase in Ethnicity Importance) on Ethnicity Omission at each percentage point of the Ancestry Percentages variable (summarized in table 5). We found that Ethnicity Importance does not significantly affect the omission of ethnicities when Ancestry Percentages was at 10% or below or above 85%, but when Ancestry Percentages was between 11% and 85% each added unit of importance did significantly decrease the probabilities of omission by 4.4% ($P < .001$). More precisely, for an ancestry reported as between 11% and 85% in the admixture test, assigning an Ethnicity Importance level of 5 (very important) decreases the probability of omission by 18.5% compared to an Ethnicity Importance level of 1 (not at all important; see table J10). However, for ancestries reported outside this percentage range in the GAT, the importance of the identity to the person's sense of self does not significantly affect the probability of omitting that previously claimed identity. Although we do not find support for hypothesis 7, that an ethnicity's importance matters more when ancestry percentages are lower, this suggests an effect in a middle range—not at the lowest or the highest ancestry percentages. The importance of a previously held identity to a person's sense of self plays an important role in identity omissions, but a role that is bounded and constrained by GATs' reported ancestry percentages.

DISCUSSION AND CONCLUSION

Ethnic and racial identities can change, even in adulthood. For millions of people, genetic ancestry information may be a consideration in identity formation. This article elucidates important aspects of that phenomenon in several innovative ways. Using a novel RCT experiment, it is the first to analyze the causal impact of genetic ancestry testing on identity change. We distinguish between temporal fluidity among known ancestries and new discoveries and use comparisons between control and treatment groups to distinguish the level of identity change that can be attributed to taking GATs. We distinguish theoretically between the processes of adding and omitting identities, operationalizing distinct measures of identity aspirations for each, and show empirically that respondents are more likely to omit previously held identities than to add new ones. We test the impact of identity aspirations on ethnic identity formation, both for test-takers and in general. And we examine how the amounts of genetic ancestries reported in admixture tests affect identity change.

TABLE 5
MARGINAL EFFECTS OF ETHNICITY IMPORTANCE ON THE PROBABILITIES OF ETHNICITY OMISSION AT DIFFERENT LEVELS OF ANCESTRY PERCENTAGES, TREATMENT GROUP ONLY

Ancestry Percentages	Marginal Effect of Ethnicity Importance	SE	z	$P > \|z\|$	95% Confidence Interval	
0	−.030	.029	−1.03	.302	−.0861	.0267
1–10	−.070	.039	−1.78	.075	−.1464	.0069
11–85	−.044	.013	−3.39	.001	−.0691	−.0184
86–100	−.009	.033	−.27	.787	−.0743	.0563

NOTE.—Interaction effect between Ethnicity Importance and Ancestry Percentage on the predicted probabilities of omitting ethnic identities (model 7 in table 4). The second column shows the marginal effect of a 1-unit increase in Ethnicity Importance at the different levels of Ancestry Percentages. Because the sample is treatment group only, it includes nonrandom supplement cases. Full table showing results at each percentage point of the continuous Ancestry Percentage variable is available on request.

Our study shows that for our sample, non-Hispanic White Americans willing to take GATs, taking GATs does lead to changes in identity beyond any temporal fluidity that might have happened anyway. Yet the amount is smaller than we might have expected. About one-third of test-takers (32.05%) changed their ethnic or racial identity, compared to 23.87% of those who did not take GATs. Because we focus only on the addition of ethnicities not previously known to respondents, these findings underestimate the overall amount of identity change that occurs in responses over time, but this comparison is most theoretically appropriate for understanding the effect of GATs on our study population. Our findings are consistent with the growing literature pointing to identity fluidity, even though this fluidity has yet to be widely recognized in the public imagination. Ethnic and racial identities are largely thought to be permanent throughout adulthood, although sociological and demographic research make it clear that this is not the case. Our article contributes to this literature—which initially focused on ethnic fluidity (Gans 1979; Alba and Chamlin 1983; Lieberson 1985; Waters 1990) and has more recently focused on racial fluidity (Saperstein and Penner 2012; Alba et al. 2016; Liebler et al. 2017; Davenport 2020)—by looking at both together and considering how genomic information can be relevant for both.

We found support for the impact of identity aspirations for identity development in general and some support for their role in response to GAT results. Among our GAT-takers, how favorable the person feels toward the group influences the likelihood of adopting a discovered ethnicity, but only in the South. Yet higher percentages of reported ancestry increase the likelihood of adopting a discovered ethnicity across regions. And regardless of our test-takers' feelings toward the group, simply having ancestry at a high percentage strongly increases their likelihood of ethnicity addition, consistent with genetic determinism theory.

For previously held ethnicities in general, the more important an identity is to our respondents, the less likely they are to omit it, whether they take GATs or not. But for our test-takers, when a previously held ethnicity is not supported by admixture results (i.e., when the corresponding genetic ancestry does not appear at all) the importance of that identity does not significantly affect their likelihood of omitting it. Contrary to our expectations, the social influence of people's identity aspirations does not overcome the complete absence of perceived genetic support, even for identities they previously claimed. Yet the identity's importance to the test-taker does significantly reduce omissions when we include ethnicities that are supported by the GAT results. Higher percentages of GAT-reported ancestries also make our test-takers less likely to drop an associated identity and bound the effect of the identity's importance so that it operates when genetic ancestry percentages are between 11% and 85% but not above or below. Identity aspirations matter in the range where genetic ancestries are more ambiguous and open to interpretation. People may not place much confidence in ancestries reported at very low percentages, and they seem to place considerable stock in those reported at very high percentages. But in the middle, their identity aspirations come into play.

We suspect the greater tendency of GAT-takers in the South to let their identity aspirations guide their ethnicity additions reflects the greater concentration there of people who have assimilated so fully into White America that they have lost a connection to their ethnic origins. Past work found a greater concentration in the South of White people who do not identify with or have knowledge of a specific European origin (Alba and Chamlin 1983; Lieberson 1985). Research also shows that White Americans in the third or later generation who are uncertain of their ancestry are among the most likely to be interested in taking GATs (Horowitz et al. 2019). Furthermore, White GAT consumers who lack knowledge of their ethnic ancestry are particularly eager to find and adopt new ethnic or racial identities that make them more distinctive than "just White" (Roth and Ivemark 2018). In our study, respondents who only identified their ethnicity in the pretest survey as White, European, Anglo-Saxon, or American—responses that did not shed light on specific European ethnic origins—were more than twice as likely to live in the South (27.31% vs. 13.15% elsewhere). And while few listed no specific ethnicities or ancestral origins for their parents, those who did were more than six times as likely to live in the South (8.79% vs. 1.43% elsewhere). Southerners are not generally more interested in taking GATs than those in other regions (Horowitz et al. 2019), but among those who do take GATs, a greater lack of information about ancestral origins may make White Southerners more eager to adopt new identities with groups suggested by their results that they aspire to belong to.

However, most families do pass down information about their ancestral origins, albeit potentially in ways involving choices about the stories they

want to tell and those they want to omit. For many of our GAT-takers, the European ethnicities and origins they listed were supported by their admixture results. This is particularly true for the ancestries traditionally most esteemed in America—British Isles and Western and Central European. Yet 60% of test-takers discovered an unknown non-European ancestry. While we must be careful not to interpret the GAT results as objective truth (Fullwiley 2008; Benjamin 2015), this reminds us how ethnic and racial identities have historically been socially constructed, with certain pieces of information pruned from family trees while others are cultivated. Higher status ancestries may have been passed down or emphasized more, while those that challenge the family's status—especially the "purity" of Whiteness—can be excised from what then becomes their known ancestry.

A striking finding is that our treatment respondents were much more likely to omit Native American ancestries. Overall, 8.86% of treatment respondents and 9.07% of control respondents listed a Native American ethnic identity in the pretest survey (while 16.34% and 15.93% respectively listed Native American for themselves or their parents; table J5). Indeed, Native American was the most commonly listed non-European ancestry, suggesting that this ancestry is valued and retained within these families despite their not meeting the groups' criteria for membership (TallBear 2013). Yet 98.44% of treatment respondents who listed Native American ethnicity or origins received admixture results showing no Native American ancestry. And of those who had listed a Native American ethnic identity, 60.00% of treatment respondents dropped this ethnicity in the posttest survey, compared to 28.12% of control respondents. Other studies report that people are reluctant to part with a prized Native American identity based on GAT results (Golbeck and Roth 2012; Roth and Ivemark 2018), and our findings still show that 54.55% of people who had claimed a Native American ethnicity that was not supported by their GAT continue to claim Native American as an ethnic or racial identity. Nonetheless, the data reveal an important pattern: for these White test-takers who claim Native American ancestry but discover no genetic support for it, GATs can lead to relinquishing identity claims.

Given these findings, we argue that our GAT-takers' identity options are more constrained by GAT results than genetic options theory articulates. New genetic ancestries at high percentages are likely to be added into our test-takers' identities even if they do not fit their identity aspirations. How important an existing ethnic identity is to them makes little difference if GAT results do not support it or show a very low percentage; they tend to omit it anyway. We cannot analyze the relative role of social appraisals here, although we suspect that some test-takers view their ancestry percentages as relevant for how others assess their identity claims. They may expect that others would reject new ethnicity claims that were based only on small amounts of reported genetic ancestry. While we find support for identity aspirations as a

mechanism shaping ethnic identity, we also argue that on the continuum of geneticization, the percentages of ancestry reported in admixture tests push more of these test-takers toward the geneticized identity side of the continuum.

Very few people in our study of non-Hispanic White, willing test-takers added new racial identities, despite many test-takers discovering non-European ancestry. In this, our results seem to differ from studies finding that White test consumers are the most likely to change their racial or ethnic identities (Roth and Ivemark 2018). There are several possible reasons for this finding. One is that the percentages of non-European ancestry they discovered were generally quite low. Asian ancestry ranged between 0% and 5%, and both sub-Saharan African and Native American ancestries ranged between 0% and 7%. While some treatment respondents' tests reported higher percentages of Middle Eastern ancestry, the vast majority received test results reporting low amounts; 86% of them discovered Middle Eastern ancestry percentages of 10% or less. We expect these low percentages would lead test-takers to lack confidence in the results or believe that identity claims based on them would not be accepted by others. There does not seem to be a genetic one-drop rule for African or other non-European identities.

Some treatment respondents ($N = 30$) did receive tests estimating higher percentages of Middle Eastern ancestry, ranging from 11% to 53%, yet only one person added Middle Eastern as an ethnic identity, and no one checked "other" and listed Middle Eastern as a racial identity. As we discuss in appendix G, our follow-up qualitative interviews revealed several reasons why even those with larger percentages of reported Middle Eastern ancestry did not find it meaningful for their identities. Those with the largest percentages of Middle Eastern ancestry, often people of Italian ancestry, tended to "explain away" these results as a likely product of historical proximity, as people moved and mixed within the Mediterranean region. They saw the ancestry as consistent with their existing family narratives, rather than as challenges to them. Indeed, their interpretation of Middle Eastern ancestry as Mediterranean when viewed through the lens of their past, rather than the Arab-Muslim interpretation frequently associated with the contemporary MENA category, may be worthy of further exploration. Other respondents explained that they saw their identities as shaped more by personal connections and socialization, and the Middle Eastern genetic ancestry was therefore interesting but too removed from their experience to change how they viewed themselves. Other interviews revealed that racism or fear of Middle Easterners may have played a role in disregarding that ancestry, even as they incorporated other new identities. These patterns of selective incorporation of new ancestries based on identity aspirations are consistent with genetic options theory. While our RCT treatment respondents' ethnicity changes are more consistent with genetic determinism theory overall, it is possible that if we had more respondents who discovered non-European

ancestries in higher percentages we would have seen racial identity changes more consistent with genetic options theory; unfortunately, we have too few cases with high percentages of other non-European ancestries to rigorously test this.

Conflicting patterns between our study and others may also relate to how their samples differ. We expect there are different patterns of identity change among consumers who buy GATs themselves, and even potentially between early and later consumers, and among groups who receive free tests or learn genetic ancestry information from relatives' tests (Johfre et al. 2021). Several studies focused on self-selecting early adopters of GATs, who purchased these tests within a few years of their becoming available, when costs were high (Nelson 2008, 2016; Roth and Ivemark 2018; Roth and Lyon 2018). Such consumers typically had strong motivations for testing, such as particular identity aspirations (e.g., confirming a suspected ethnicity; Golbeck and Roth 2012; Leroux 2018; Strand and Källén 2021), connecting to a lost past (e.g., African-Americans seeking an African ethnicity; Nelson 2016), or discovering something that made them more unique or interesting (Roth and Ivemark 2018). Our participants were not motivated enough to buy the tests before the study. We expect that these differences at least partly account for the greater reluctance among our sample to claim new racial identities or non-European ethnic identities. The motivation to discover or confirm an ancestry often coincides with an eagerness to identify with it. Those who were more eager to do so may have already purchased tests, making them ineligible for this study. Yet we do not see the smaller identity change effects in our study population as undercutting the value of the findings; indeed, the contrast between our study and previous work emphasizes the role of motivations for testing on identity outcomes more clearly than any previous work alone. This further supports the concept of identity aspirations, with those aspirations prompting GAT purchase as well as reactions.

Furthermore, our study provides a clearer sense of the implications of the GAT industry for demographics and identity change in the future. Any future growth of the GAT-taking population, at least among non-Hispanic Whites, is more likely to resemble our study population than the early test consumers. Journalists questioned whether GATs contributed to the high proportions of the US population selecting multiple races in the 2020 census. Early GAT consumers may have partly contributed to this growth; some did add new racial identities and selected multiple races on the 2010 census (Roth and Ivemark 2018). But we view it as unlikely that future test-takers will fuel continued rates of growth in the population deliberately checking two or more races.[21] Companies like 23andMe will draw more profits

[21] However, changes to the census race question format—particularly write-in spaces for "origins"—may prompt GAT-takers to write in detailed genetic ancestries they do

from their collaborations with pharmaceutical companies than from test sales (Carson and Chaykowski 2019), creating incentives to expand their databases through free or low-cost tests for such willing-but-unmotivated populations. Indeed, the high proportion of untested people interested in taking GATs (Johfre et al. 2021) suggests that future GAT-takers are more likely to resemble our study population in their testing motivations than the samples of earlier studies.

Our study is limited in several ways. It represents a specific population: native-born, non-Hispanic White Americans who are willing to take GATs. This population is older and more educated than the general US population, just as US GAT-takers overall are older and of higher socioeconomic status (Orth 2022). Indeed, the older profile of the sample reinforces how ethnic and racial identities can develop and change at later stages of life, beyond adolescence and young adulthood (Kroger et al. 2010). Focusing on this group does not let us examine whether non-White populations react differently to their GAT results. Given past research, we would expect less identity change among non-Whites, perhaps because GAT results do not provide them with a "usable past" (Nelson 2008), because they have "subsumed multiraciality" that is consistent with their existing identities (Roth and Ivemark 2018) or because they interpret the GAT results cognitively without changing how they identify (Shim et al. 2018). Future researchers should extend rigorous testing of identity formation theories to additional populations.

Simply participating in this study may lead our control respondents toward adopting new ethnic or racial identities more than is typical. Completing the surveys and consenting to not purchase GATs before the study's end may encourage them to think more about their identity and inquire about their family's past. This does not challenge our inference that the difference in identity changes between our control and treatment groups can be attributed to taking GATs, but the effect sizes of taking GATs could be underestimated. Future RCT studies could benefit from an additional blinded study arm in which the focus on GATs is not mentioned and GAT-related questions are removed.

We are unable to analyze the role of social appraisals—whether people believe their identity claims will be accepted by others. Our survey included questions on social appraisals for racial identities, which left us unable to test this mechanism when we found very low rates of racial identity change. Future work should assess the impact of social appraisals relative to percentages of reported ancestry, as well as whether they matter for Whites in the adoption of new European ethnicities. Are others more likely to accept a White person's claims to a new geneticized European identity because they

not consider racial identities, which the Census Bureau subsequently recodes as race responses.

assume this may not be visible in their appearance or indicated in behavior? We suspect they are, especially relative to the types of challenges that might be raised around identity claims crossing racial lines.

We are also limited by the nature of the admixture categories and how they compare to the types of identities individuals claim. The admixture results reported broad, regional categories such as British Isles or Eastern European, whereas identities tend to reflect specific ethnicities such as Irish or Polish. As such, we can only determine whether percentages of corresponding broad regional categories influence the omission or addition of specific ethnic identities that fall within them. While we adopt conservative coding decisions that would produce underestimates rather than overestimates, the mismatch in the level of categories could affect the impact of ancestry percentages for these identities. Future research may be better positioned to address this limitation, as many GAT companies have developed more detailed admixture categories corresponding to many specific ethnicities. While we do not suggest that such GAT categories are more accurate, they may have stronger influences on test-takers' identities if they view them as more relevant at that lower scale (Nelson 2008).

Genetic options theory emphasized the role of options—the social processes that factor into people's interpretations and use of genetic information (Roth and Ivemark 2018). We argue that options do exist, but, within our sample, they are more restricted than the theory indicated. By this, we do not mean that genetic determinism is a better model for understanding how GATs influence ethnic or racial identities. Despite much speculation about how GATs will reify race, we found very few respondents changed their racial identity, even though more than half discovered some non-European ancestry. We also underscore that only a minority of treatment respondents (32.05%) experience any identity change, and according to estimates for our control group, most of them would arguably have experienced identity change even without testing. Nonetheless, we find that respondents whose tests report higher percentages of genetic ancestries are more likely to adopt or retain corresponding identities. And while we find support for the role of identity aspirations in identity formation in general, its effect is limited by the reported admixture percentages. In short, as we bring the study of ethnic and racial identity into the genomic age, we see that genetic ancestry information provides both genetic options and constraints.

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