Sharpening or Blurring: The Impact of Genomic Ancestry Testing on Americans' Racial Identity

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ABSTRACT

The political and social implications of genomic science remain underdeveloped despite its great scientific import. This article focuses on the impact of genomics on the meaning of race and of racial or ethnic identity. Genomic ancestry testing may either *blur* racial boundaries by showing groups to be indistinct or mixed, or *sharpen* racial lines by revealing a person's ancestral homogeneity or pointing toward a particular set of forebears. We hypothesize that media analyses will follow one of these two models, and that American racial and ethnic groups will differ in response to blurring or sharpening genomic information. We evaluate these hypotheses through two new surveys and two content analyses of newspaper articles.

What genomic scientists are finding differs from what the public prefers or is being taught by the media. To most experts, genomics confirms some variation among population groups but shows the incoherence of any concept of distinct races. In contrast, journalists tend to reinforce the conventional five groups and the public generally prefers sharpening to blurring test results. Preferences differ some by race or ethnicity. However, one survey suggests more support for blurring; when all Americans have access to genome sequencing, the politics of race and genomics may change dramatically.

> There is in biology at the moment a sense of barely contained expectations reminiscent of the physical sciences at the beginning of the 20th century. It is a feeling of advancing into the unknown and [a recognition] that where this advance will lead is both exciting and mysterious…. The analogy between 20th-century physics and 21st-century biology will continue, for both good and ill.
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> - *The Economist* (2007)

> We got to have a re-vote. This ain't right.
>
> - Snoop Dogg, on discovering through DNA ancestry testing that he has more European ancestry than Charles Barkley[1]

The genomics revolution is underway. Its effects appear widely -- in genetic food modification, medical research on issues ranging from schizophrenia to weight gain, laws regarding insurance companies' use of personal genetic information, courts' use of DNA both to convict and to free those wrongfully convicted, identification of victims of the Srebenica massacre and of the corpse of Osama bin Laden, and testing to discover one's genetic heritage. More frivolously, genomics can determine the quality of fish in one's sushi, discover whose dog is soiling the sidewalk, help one find a compatible dating partner, and to determine whether King Louis XVII really was Queen Marie Antoinette's

[1] Barkley's response: "I'll just call you whitey from now on."
http://www.youtube.com/watch?v=Exz0yNdvksg

son. Even cautious researchers confess to "excitement because everyone realizes the field is changing so fast" (Science 2007): 821). Genomic science affects our lives in ways never imagined a decade ago, and we can barely conceive its likely scope and impact over the next few decades.

Genomic science is also moving into public discourse. An NGram (see Figure 1) shows how much the vocabulary of genetics, DNA, and even genomics has diffused into books published since 1950. [For a description of this technology and the data underlying it, see (Michel and et al. 2010).] [2]

Figure 1 here

Despite the breadth and speed of the genomics revolution (or perhaps because of them), the public, policy-makers, and scholars have limited information about and few analytic frameworks for understanding genomic science's political and social import. This article focuses on one facet of the sprawling arena: the impact of DNA ancestry testing on Americans' understandings of race and on their racial or ethnic identity.

At present, DNA ancestry testing is typically described as recreational, but it could have considerable public importance; " determinations of ancestry or 'blood' affect citizenship rights throughout the world; the right of return of displaced people; membership in tribal bands. . .; and affirmative action eligibility. . . . Determining one's ancestry through genetic evidence would fundamentally transform these types of political identity. . . . Genetics can affect questions of ethnic identity. . ., religious identity. . . , family identity. . ., or caste" (Elliot and Brodwin 2002): 1469. Even more expansively,

[2] The designers of NGrams caution that the data after 2000 are not as reliable as those before, given changes in the database of books scanned by Google.com.

some claim that

> DNA testing results have the power to potentially reshape how individuals think of themselves and their ethnic heritage. . . . Genetic ancestry has the potential to separate us from, and bind us to, specific groups of people. . . . We now are likely at the tip of a potential paradigmatic shift in how human ties are viewed and measured (Hirschman and Panther-Yates 2008): 64).

The phrasing is tentative, but the vision is not. And even if genomics does not usher in a paradigmatic shift in how human ties are viewed, given how important racial classification and identity have always been in the United States and many other societies, the possibility that the grounds for classification and identity are changing warrants close attention.

For decades social scientists have portrayed "race" as a social construct. The American Anthropological Association, for example, declared the concept to be "a worldview, a body of prejudgments that distorts our ideas about human differences and group behavior" -- and based its claim partly on evidence from genomic science [(American Anthropological Association 1998). The canonical statement of race as a social construction is (Skerry 1997; UNESCO 1950).] Geneticists concurred, noting that at least 99.5 percent of the human genome is identical across all socially defined groups. J. Craig Venter spoke for most scientists when he announced during the White House celebration of the completed Human Genome Project that "the concept of race has no genetic or scientific basis" (Venter 2007): 315).[3]

[3] The early compendium of worldwide DNA samples concluded a section headed "Scientific Failure of the Concept of Human Races" with the statement that

Nevertheless, genomic scientists and medical researchers are finding that people of different population clusters, often resembling or subsets of conventionally-defined races, show some differences in genomic profiles. These profiles may be associated with variations in susceptibility to certain diseases, responses to particular drugs, or in certain traits or behaviors. As the pharmacogenetics researcher Esteban Burchard reflected, "Race is a complex construct. It includes social factors, it includes self-identity factors, it includes third party factors of how you view me. But it also includes biological factors" (Bliss 2012). On a parallel track, genomic science is enriching studies of human migration and descent with detail and specificity. Individuals can now use DNA tests to trace (part of) their lineage to particular groups or areas of the world, or to learn what proportion of their ancestry derives from various regions or continents.

One of the many questions that these developments raise is their impact on views of one's own and others' racial identity. How do Americans respond to evidence that suggests a biological component to differences often labeled as racial? Conversely, how do Americans respond to evidence showing almost complete identity in humans' genomic pattern? How will people react to evidence about their own deep ancestry?

Given the absence of a well-developed literature, we articulate several initial

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"classification into races has proved to be a futile exercise. . . . The level at which we stop our classification is completely arbitrary. . . . We can identify 'clusters' of populations. . . [but] at no level can clusters be identified with races, since every level of clustering would determine a different partition and there is no biological reason to prefer a particular one. . . . Minor changes in the genes or methods used shift some populations from one cluster to the other" (Cavalli-Sforza, Menozzi and Piazza 1994): 19).

hypotheses about the relationships among genomic ancestry testing and understandings of race. One pair of hypotheses addresses the trajectory of DNA ancestry tests; they might *blur* racial boundaries and make them less distinct, or they might *sharpen* and strengthen racial lines. The second set of hypotheses compares conventionally defined racial and ethnic groups' response to DNA ancestry testing; it focuses on the testers rather than the tests. We explore these hypotheses by analyzing four data sets: an automated content analysis of a wide array newspaper articles, two new surveys, and a hand-coded content analysis of a more focused sample of newspaper articles. Together, these approaches enable us to analyze how the media are reporting on the new technology of DNA ancestry testing, how people in different groups think about racial identity and ancestry testing, and how individuals respond to the actual experience of such tests.

We find that, at present, genomic science and the social uses of genomics are heading in different directions with regard to race. Most genomics research supports the claim that racial boundaries are blurred or that race is an incoherent concept, while much of the social use of genomic science for ancestry testing is moving toward a sharpening of racial boundaries and deepening of people's commitment to their own racial identity. That result, however, comes with a caveat: the split between science and society may disappear or at least change shape over the next few decades. The conclusion of the article explains why.

We proceed as follows: After briefly explaining DNA ancestry tests, we develop an analytic framework for understanding relationships among public opinion, DNA technology, and racial identity. The third, fourth, and fifth sections respectively provide methodology and results for the content analysis of newspaper stories, two new surveys,

and media reports of individuals' experiences with DNA testing. We conclude with discussion of our findings, an outline of future research, and the implications of this research for the role of genomics in politics and social science.

DNA Ancestry Tests: A Brief Tutorial

There are several varieties of commercial DNA-based ancestry tests, all of which analyze a collection of the client's cells, usually from a swab of the inner cheek.[4] Roughly speaking, the tests analyze the genetic composition of particular locations on mitochondrial DNA (for women), Y DNA (for men), or autosomal (non-sex-linked) chromosomes for both sexes. The selected nucleotides from the client's DNA sample are matched with the company's database of samples collected from people with (presumably) known ancestry. The more locations that are tested on the client's DNA sample, the closer the matches; the larger and more representative is the set of comparison samples, the more accurate the results.

Two types of DNA ancestry tests concern us here. Autosomal tests seek to determine the proportions of the client's ancestry from different regions of the world.

[4] Recent estimates suggest up to 40 such firms, although this sector of the economy is very unstable as firms rise and fall. Companies release little information on their clients, procedures, financing and market plans, or databases. Up to a million people (mostly in the United States) have used direct-to-consumer DNA tests; most users are probably highly educated and relatively well-off. (See (Wagner and Weiss 2012) for a careful and recent description of this industry).

Direct-to-consumer tests often combine medical testing and health care advice with ancestry testing, so people's primary motivation for taking the tests is not clear.

Table 1 shows the information provided by one (now defunct) company to website viewers:

Table 1 here

Mitochondrial and Y-DNA tests focus on determining a particular ancestral lineage, often identified as a tribe or indigenous population, from the paternal line for men or maternal line for women. One company distinguishes among 24 European groups, while others provide 34 world regions, search for matches among 30 sub-Saharan countries and over 200 ethnic groups within them, or focus on American Indian tribes, the Jewish Cohanim, Vikings or Celts, or Hindu gotras. Table 2 shows an ad for DNA tests aimed at sharpening one's racial (or ethnic, or tribal) self-understanding.

Table 2 here

The two types of test are different, but not empirically or analytically incompatible. One could take both and learn something different from each about one's ancestry. The tests are also asymmetrical. Tests showing proportions of ancestry from different continents might provide blurring *or* sharpening results, depending on the proportions that it reveals. That is, the test could show 100 percent ancestry from one population group – a sharpening result – or equal proportions of descent from all regions of the world – a blurring result -- or any other combination. Tests aimed at determining a single line of ancestry from a specific region or group will not, by definition, show population group mixtures; they are designed to provide information about one particular set of forebears.[5]

[5] One can, of course, take both types of tests in order to obtain separate blurring and sharpening results. We ignore that possibility in this paper, since few people do both and

Analytic Framework and Hypotheses

Based on the logic of these tests, we define one cluster of results from DNA ancestry testing as *blurring:* the tests soften or dissolve distinctions among conventionally-defined races or ethnicities. Blurring may occur either through evidence of mixture among groups, or through denial of any scientific basis for separating socially defined groups.

Thus according to some analysts, the new information available through DNA ancestry tests may finally pry open Americans' artificial and debilitating racial classification system, deconstructing the harmful concept of race and pushing us to recognize previously unimagined connections. The red-haired, freckled, apparently Scottish Jack Hitt reports that "I carry the DNA marker found in great abundance among the Fulbe tribe of contemporary Nigeria;" as a result of his test, he now pays much more attention to information about Africa than he used to (Hitt 2005): 47). Spencer Wells, the Explorer in Residence at the National Geographic Society and director of its Genographic Project, describes the project as "educational: hopefully the idea that we all share common ancestors in our recent past will help people to overcome some of the prejudices

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those who do are likely to have a great deal of knowledge about this new science. Thus they are not relevant to this analysis of what the general public is learning about genomic ancestry testing. See (Nelson 2008) for a good functional explanation of the types of tests and analysis of the ways in which knowledgeable users choose among them.

they might have" (The Genographic Project n.d.): 3).[6] Some go further, anticipating that ancestry testing will show so much commonality that the new science will reinforce the old saw of "there is only one race, the human race." This hope can be almost mystical; as one biologist interviewed for this project put it,

> Less than 0.1 percent of the genome accounts for racial differences. That pushes the question, why are you defining yourselves in racial groups that are less than 1% of your total inheritance? . . . The genome is coming to push us into new stages of understanding our identity. Parts of the genome are designed to push us into larger life, stimulating another stage [of human self-understanding].

Others agree that DNA ancestry tests might blur racial boundaries, but they fear rather than celebrate that change. They worry that if members of a racial or ethnic minority lose their sharp-edged shared identity, they will be overwhelmed by a still hostile majority population. African Americans in particular, in this view, need to maintain racial solidarity, even if not strict identity (Shelby 2005). Dorothy Roberts strenuously opposes even genetic tests that find mixed ancestry for a different reason: any DNA ancestry test "reinforces three central myths about race: that there are pure races, that each race contains people who are fundamentally the same and fundamentally different from people in other races, and that races can be biologically demarcated" (Roberts 2011): 228). Just as with multiracial marriage and identity, the politics around genomic boundary blurring can be contested and intense.

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[6] In another setting, Wells similarly described the goal of the Genographic Project as "highlight[ing] human unity and connectedness while celebrating cultural diversity" (Wolinsky 2006) :1074).

An alternative cluster of results from genomic ancestry tests sharpens rather than blurring racial boundaries. We define sharpening as the use of DNA ancestry tests to harden the apparent distinctions among conventionally-defined races or ethnicities. Sharpening may occur through tests showing complete descent from one group, or through a test that genetically links the person to an identifiable geographic area, tribe, or ethnic group. Sharpening may also be understood as reinforcing the concept of race or ethnicity as a biologically meaningful term.

Like blurring, racial sharpening evokes varied responses. Sociologists of science fear that "the use of markers for individual identification" risks "the subtle, sometimes inadvertent, reinscription of race at the molecular level" [(Duster 2006): XXX (see also (Palmie 2007); (Abu El-Haj 2007); Roberts 2011]. Not only "race" in the abstract, but extant racial categories might be further reified; "aiming for health equity through the biological prism of race may paradoxically *re-inscribe* to the letter (to the As Ts Gs Cs of our genetic code) a belief in racial difference. . . . Through both logics (sic) and practice, DNA frequency differences and race often emerged as the two primary units of analysis. . . . [E]ach was routinely articulated through the other. . . . [such that] racial delineation inspired a gaze of differentiation that conditioned scientific discovery" [(Fullwiley 2007): 2, 4, emphasis in original; see also (Bliss 2011)]. Charles Rotimi offers a more political concern about the effect of sharpening group lines: "wholesale alignment of Diaspora Africans to specific ethnic groups could . . . [lead] to the further politicization of ethnicity and further fragmentation of the African American community" (Rotimi 2003): 157).

But some people cherish this new information about their heritage. Mika Stump, for example, grew up in foster homes, knowing nothing of her roots except that she is

black. “But a DNA test she took recently showed strong similarities between Stump’s genetic code and the Mende and Temne people of Sierra Leone, in Africa. Now, ‘I have a place where I can go back and say, “This is who I am; this is my home.” That’s something I never, ever expected to say’ ” [(Willing 2006); for more systematic analyses see (Nelson 2008); (Wright and Roth 2011)].

In short, the American public is on the receiving end of a complicated and novel mix of political and affective messages about genomics’ tie to racial identity and identification. In general, they endorse the idea of ancestry testing; in the 2010 General Social Survey, 63 percent of respondents favored the “use of DNA in order to research one’s ancestry.” Fully 76 percent of blacks did so. But to understand what respondents mean by this endorsement, we need to make the messages they are receiving about DNA ancestry tests analytically tractable. We therefore simplify the mix of messages into the categories of blurring and sharpening, yielding the first and second hypotheses:

> *$H_{1,}$ Blurring: DNA ancestry tests may blur racial boundaries or undermine the concept of race, as people learning about or taking DNA tests come to understand ancestry as more mixed across conventionally defined groups or less biologically based than they had previously thought.*

Alternatively,

> *H_2, Sharpening: Genomic ancestry tests may sharpen racial lines, as people learning about or taking DNA tests discover ancestral homogeneity, find links to a particular tribe or geographic area, or come to feel a stronger bond with one part of their conventionally understood racial identity.*

If we can show that these two clusters of results are substantively meaningful, the next

step is to understand how different sets of people respond to varying results of DNA ancestry tests. To that end, we offer four hypotheses, two of which have paired alternatives.

First, roughly two-thirds of blacks consistently express a sense of linked fate in public opinion surveys [(Dawson 1994); (McClain and Stewart 2010); (Hutchings et al. 2005); (Gay and Hochschild 2010).] Furthermore, blacks generally cannot trace their ancestry through paper records earlier than the mid-nineteenth century because of the Middle Passage. The combination of those two facts leads us to hypothesize that:

> *H_3, Blacks: African Americans will be more pleased with sharpening than with blurring results. They will find DNA ancestry tests more compelling than do other groups; thus Blacks' racial identity will be reinforced especially by sharpening, but also by blurring, results. They will trust ancestry tests as much as members of other groups do, and will not trust one set of results more than the other.*

The predictions in H_3 should hold regardless of whether the African American is taking the DNA test him- or herself or is learning about it through the media.

Self-defined multiracials present the opposite profile in many ways. We know of no survey that has queried multiracials about their sense of linked fate. But by definition, self-identified multiracials acknowledge ancestry from more than one group, and they are the only set of people to have, again by definition, chosen their racial identity rather than having it assumed by others. Therefore:

> *H_4, Multiracials: Self-defined multiracials will be more pleased with blurring than with sharpening results. They will be more likely to permit blurring than sharpening results to affect their identity. Multiracials will be more likely to trust*

blurring than sharpening results.

This pattern should hold regardless of whether the person of mixed race is taking the DNA test him or herself or is learning about it through the media.

American politics and social scientists offer two distinct frameworks for understanding Hispanics. In one view, Latinos are racialized; within the United States, they are treated as and understand themselves to be a distinct racial group analogous to blacks or whites. The evidence is thinner, but one can find some support for a strong sense of linked fate among Latinos [(Burnside and Rodriguez 2009); (Sanchez 2006); (Lee 1995); (Sanchez 2008); (Gay and Hochschild 2010)].

In another view, Latinos, at least the native-born, are an ethnic group characterized by racial mixture. Their culture is Hispanic, but their race and racial identity is some combination of white, pre-Columbian indigenous, black, and possibly Asian. Also in this view, Latinos see the barriers between themselves and mainstream society as reasonably penetrable and worth breaching; many eventually identify as white [(Alba and Islam 2009); (Trejo and Duncan 2007); (Trejo and Duncan forthcoming)]. In either framework, Hispanics are less constrained than are blacks in tracing their ancestry through paper records and so are less dependent on DNA to find their roots.

Given these alternative characterizations of Latinos, we offer alternative hypotheses:

H_{5a}, Hispanic Racialization: Hispanics will be more pleased with sharpening than with blurring results, and will be as pleased with sharpening results as are blacks. They will be equally likely to trust both sets of results. Hispanics will be more willing to permit sharpening than blurring results to affect their identity.

Or,

H_{5b}, Hispanic Mestizaje: Hispanics will be more pleased with blurring than with sharpening results, and will be more pleased with blurring results than will blacks. They will be more likely to trust blurring than sharpening results. Hispanics will be more willing to permit blurring than sharpening results to affect their identity.

Either pattern should hold regardless of whether the Latino/a is taking the DNA test him- or herself or is learning about it through the media.

We also offer two competing frameworks for understanding whites' relationship to race and ancestry. On the one hand, for most of American history, many whites celebrated racial purity; in that context we would expect European Americans to prefer sharpening over blurring DNA test results. On the other hand, during the past half-century, anti-miscegenation laws were declared unconstitutional, many whites abjured the logic of one-drop-of-blood rules, and most know that they should not celebrate such rules in public. Thus:

H_{6a}, White Racial Purity: Whites will be more pleased with sharpening than with blurring results, and will be as pleased with sharpening results as are blacks. They will be equally likely to trust both sets of results. Whites will be more willing to permit sharpening than blurring results to affect their identity .

Or,

H_{6b}, White Racial Liberalism: Whites will be more pleased with blurring than with sharpening results, and will be more pleased with blurring results than will blacks. They will be equally likely to trust both sets of results. Whites will be more willing to permit blurring than sharpening results to affect their identity.

We have no clear hypotheses about Asian Americans, about whom there is simply

too little evidence for us to venture a prediction. Few scholars have measured levels of linked fate among Asians, for example, and the results that do exist are mixed [(Lien 2001); (Kim and Lee 2001); (Masuoka 2006); (Gay and Hochschild 2010)]. Historically, Asian Americans have generally welcomed intermarriage more than blacks or whites did, and by 2008, nearly three fourths of new marriages among native-born Asian Americans were to people outside that group (Pew Research Center 2010). But Asians have not traditionally defined themselves as a racially mixed population. Perhaps most importantly, the category of "Asian" is even more disparate than that of the other groups – linguistically, culturally, politically, and geographically. Thus the category of "Asian" may be too inchoate for a single hypothesis to be compelling.

Media Presentations of Genomic Ancestry Testing

To obtain the widest vantage point on the movement of genomic ancestry testing into American society, we conducted an automated content analysis of what we believe to be all newspaper articles published in the United States on the topic of genetic testing and race through 2009. Unlike that of most media scholars, our goal was not to explore newspapers' influence on people's level of attention of knowledge, policy priorities, or political views. Instead, we used the media as a lens through which to view the initial stages of public learning about the relationship between genomics and racial or ethnic identity. That is, we used these articles as an indicator of the kind of information to which the public is exposed.

The universe of articles came from Lexis-Nexis Academic's online database of U.S. newspapers, which encompasses everything from the *New York Times* and *Washington Post* to small regional newspapers such as the *Flint Journal* or the *Dodge*

County Independent News. It also includes a smattering of trade publications, business journals, and law-oriented publications. We used the broadest available database, on the grounds that it would best serve as an indication of how the media are reporting advances in DNA technology and how Americans are learning about them. For the same reason, we made no effort to eliminate duplicates; the appearance of an article in more than one newspaper is, under this reasoning, directly relevant to what people are learning about genomics and ancestry through the media.

We searched the database for texts that mentioned a genetics-related search term ("DNA," "genetic," or "genomics")[7] within the same sentence as a word associated with race, ethnicity, or heredity ("race," "racial," "ethnicity," "genealogy," "descendant," "ancestor," "race," "racial," "ancestor," or "lineage"). We added keywords to prevent the search from returning articles clearly outside of the scope of our inquiry, such as those discussing rape or murder forensics, genetic food modification, television schedules, and death notices. We avoided words that would slant the search in the direction of any particular group (e.g., "black," "white," "African," "Celtic"). The final search yielded 5,580 newspaper articles from 1969 through 2009.

Figure 2 shows the number of articles per year from 1988 through 2009.[8] The

[7] In the search, we truncated the keywords by using the root of each followed by an exclamation mark (**!**). That enabled us to find articles containing all words formed by adding letters to the keyword's root (as in genetic, genetics, geneticist using the keyword genetic!).

[8] There were too few articles from 1969-1987 (between zero and twenty a year) for the automated content analysis program to estimate proportions in each category.

number of articles per year increased from roughly 100 in most of the 1990s to 400 to 500 in the late 2000s. The number of articles peaks around 2006, coinciding with Henry Louis Gates' public television documentary on the use of genetic testing by prominent African Americans. Nevertheless, journalistic interest remained strong through 2009.

Figure 2 here

Since we could not code almost 6000 articles by hand, we used an automated content analysis method (Hopkins and King 2010). Two research assistants as well as the authors first hand coded over 600 articles selected across the full period, dividing them into four mutually exclusive categories described below. This was the "training set." We ran the content analysis program on the training set, thereby allowing the program to pick up the vocabulary patterns generated by hand-coding. We then used the trained computer program to analyze all 5,580 articles. The program estimated the proportion of articles in each of the four substantive categories.

The four categories were designed to reflect the first two hypotheses, that DNA testing can blur or sharpen conceptions of race. The categories were:

Blend. The article implied or stated that recent advances in genetics or DNA technology blend racial or ethnic identity or identification. Articles that imply common ancestry would also fall under this category.

Strengthen. The article suggested that recent advances in genetics or DNA

Furthermore, because Lexis Nexis does not keep records of additions or deletions to its database of U.S. newspapers (which are frequent), we opted for consistency and therefore present results from the data that were collected in a single sitting. These articles stop at December 31, 2009.

technology could reify, strengthen, or focus racial or ethnic identity or classification by others.

Both. The article stated or implied that advances in genetics or DNA technology can both blend and strengthen racial identity or classification by others. Or it discusses different people, some of whom move in the direction of blending and others in the direction of strengthening racial identity.

Neither. The article did not mention these issues, or expressed or implied no view on whether advancements in genetics blend or reinforce racial identity.

Table 3 shows the results of the automated content analysis. About three tenths of the articles framed DNA ancestry testing in terms of sharpening racial lines, while a fifth focused on racial boundary blurring. Another tenth used both theories. [9] Thus, since genomics research has come into public view Americans have been more exposed to the idea that advances in DNA research distinguish races genetically than to the idea that genomic science erodes group boundaries. This runs contrary to social scientists' assertions that race is a social construct, as well as to life scientists' assertions that genomics provides no grounds for sharp differentiation among ancestry groups.

Table 3 here

Figure 3 provides a more nuanced portrayal of what newspapers are conveying to Americans about genomics and race. It shows the proportion of articles in each of the three substantive coding categories separately by year from 1988 through 2009. (The

[9] Since our search terms were intentionally over-inclusive, many unrelated articles were swept into the database. We would have been concerned by a small percentage of unrelated articles, which would have suggested a possibly under-inclusive initial search.

online appendix provides this information for each year, along with the annual number of newspaper articles.)

Figure 3 here

The proportion of articles discussing both blurring and sharpening (the dashed line) is consistent but low. More importantly, after the instability due to a small number of articles in the early 1990s settles down, in almost every year the articles focus as much or more on sharpening (dark line) as on blurring (dotted line). The only exception is 2001, which is probably due to publicity about completion of the Human Genome Project and the message from the many scientists connected with it that "the concept of race has no genetic or scientific basis," as Venter put it. Judging by the years after 2001, the media have only intermittently conveyed that message.

In short, newspapers are doing more to teach Americans that race or ethnicity has a genetic component that sharpens differences among groups, than to teach Americans that genomics mainly shows human similarities or mixture across conventional group lines. The first hypothesis receives some support, but the second has more.[10]

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[10] Arguably more Americans obtain information from television than from newspapers. Documentary series such as Henry Louis Gates' "African American Lives" and "Faces of America," talk shows such as "The Oprah Winfrey Show" and "Dr. Oz," entertainment and variety shows such as "The Colbert Report" and "The George Lopez Show," or news shows such as "60 Minutes" or "20/20" have all have aired episodes exploring links between DNA technology and race or ancestry.

We know of no complete database for television programs analogous to Lexis-Nexis, so we have not been able to conduct similar analyses. However, the information

Vignettes: Views on Racial Sharpening and Boundary Blurring

Even the best analysis of newspaper stories tells us only what is available, not what people are actually reading, understanding, or absorbing. Thus the next step in analyzing what Americans are learning about race and ethnicity through DNA ancestry tests needs to ask explicitly about individuals' views. We therefore conducted two new public opinion surveys.

To our knowledge, only one published article uses surveys to compare attitudes among people who have and have not taken DNA ancestry tests. The authors (Wagner and Weiss 2012) analyzed relevant blogs, recruited "highly educated, online individuals" in one community for one survey, and recruited a small sample of participants in Facebook groups on genetic ancestry topics for another. The blog posts were "overwhelmingly neutral" (p. 46); few promoted or criticized DNA testing, distinguished among types of ancestry tests, or identified motives for or effects of testing. Most survey respondents agreed that DNA ancestry tests could "tell you a person's race" at least to some extent. Results agreed with pre-test racial identity for three-fifths of the Facebook testers, strengthened pre-test identity for half, and increased affiliation with those who

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conveyed by television and newspapers is likely to be similar. For example, "African American Lives" and its successor "Faces of America" profiled celebrities whose experiences on the shows comprise a fair number of the articles in the print media. Similarly, Snoop Dogg's experiences with DNA testing appeared on television and then in newspaper stories discussing the television show. More generally, television and the print media usually cover the same events or innovations, and rely on the same experts – not surprising in a substantive arena that is new and unfamiliar to most reporters.

matched the test results among 70 percent. Most respondents in both surveys were white, and the article does not report results separately by race or ethnicity. This research provides an interesting initial foray into this arena, in short, but the authors are correct to describe it as "preliminary."

Our surveys were larger and, most importantly, provided random samples.[11] The first included 1,095 American adults, divided among 242 non-Hispanic whites, 201 non-Hispanic blacks, 233 non-Hispanic Asian Americans, 205 Hispanics, and 214 non-Hispanic multiracials. All respondents identified their own race or ethnicity. Our module was part of an omnibus survey conducted over the Internet by Knowledge Networks, through the peer-reviewed Time-sharing Experiments for the Social Sciences (TESS) program (http://tess.experimentcentral.org/). The survey was conducted in August 2010.

Because we were examining difficult concepts about which few people have direct experience, we relied on hypothetical vignettes (Finch 1987) featuring imaginary individuals who have just received the results of a DNA test detailing their racial or ethnic ancestry. Each respondent received four such vignettes, two signaling racial blurring and two signaling racial sharpening. In all cases, the respondent's gender matched the gender of the vignette subject. Two vignettes (one each for blurring and sharpening) asked the respondent to imagine that he or she was the vignette individual; in

[11] A comparative analysis between our surveys (GKAP and TESS), and demographic information taken from the 2010 American Community Survey shows that our survey samples were roughly inline with national averages. However, it does appear that survey respondents are slightly overeducated compared to national averages, and survey respondents number less in very high income brackets.

these cases, the respondent's pre-test race matched the pre-test race of each vignette subject. The other two vignettes (one each for blurring and sharpening), asked the respondent to imagine how the vignette individual would feel after receiving either blurring or sharpening test results. In those cases, the respondent's pre-test race differed randomly from the pre-test race of each vignette subject. These variations provide an indication of the internal validity of responses to the vignettes. That is, we assume that, given the United States' fraught racial history, if people are providing meaningful answers, they will vary in intelligible ways in whether they expect vignette subjects of a different race from their own to have the same reactions as themselves.

Each vignette had the same three sets of response categories, addressing 1) emotional reactions to the results of the DNA ancestry test (a seven-point scale from "pleased" to "displeased"); 2) cognitive or analytic responses (a seven-point scale from "believable" to "unbelievable"); and 3) the test's impact (two alternatives: "would the results matter a lot to your identity" *or "*. . . not matter at all to your identity"). [12] For each vignette, the computer screen showed a map of the world with the relevant continent(s) highlighted, as in Figure 4.

Figure 4 here

Table 4 provides examples of the vignettes.

Table 4 here

Table 5 presents the results from the vignette survey for the pleased/displeased scale, after collapsing the seven-point response scale into all pleased responses, neither pleased

[12] The material in these vignettes was randomized in four ways, so question or response order effects are not a concern.

nor displeased, and all displeased responses. (Write-in responses and nonreponses were dropped from all analyses; results were weighted to reflect accurately either the national population or the particular racial or ethnic group) The first row shows results for "pleased" if the respondent were the vignette subject; the second shows results for "pleased" when the respondent predicts the reaction of a vignette subject of a different race to the test results. As noted above, we expect the results to differ across the two lines. (The online appendix provides results for "neither pleased nor displeased" and "displeased.")

Table 5 here

Consider first the top row, which shows the results presumed to be closest to the respondent's views about blurring and sharpening his or her own racial identity. Respondents overall, and respondents of all groups except for multiracials,[13] are more likely to be pleased with DNA tests that strengthened their pre-test group identity than with tests that challenged that identity by blurring across continents.[14] Blacks and, to a lesser degree, Hispanics are especially pleased by strengthening results; whites and multiracials are relatively less pleased by strengthening results. Difference-in-means t-tests are significant at the 0.07 level for whites, and at the 0.05 level for all other groups

[13] That result may be an artifact of the question wording, which did not (as we now see, in retrospect) sufficiently differentiate a blurred from a sharpened outcome for multiracials.

[14] Most of the remaining respondents would be neither pleased nor displeased with any test results; between 8 and 20 percent would be displeased with blurring results and between 6 and 10 percent say the same about sharpening results.

except for multiracials. The null hypothesis that a respondent's race and his or her answer to the question are unrelated is rejected by a simple Chi Square test under the sharpening prompt (Chi square statistic = 53.57, *p*-value = 0.00) and under the blurring prompt (Chi square statistic = 15.89, *p*-value = 0.04).

Thus, the first part of H_3 (Blacks) is confirmed, and the first part of H_4 (Multiracials) is weakly confirmed. The first part of H_{5a} (Hispanic Racialization) is confirmed over the comparable section of H_{5b} (Hispanic Mestizaje), and the first part of H_{6a} (White Racial Purity) is partially confirmed over the comparable section of H_{6b} (White Racial Liberalism). Most generally, these results concur with the findings from the newspaper content analysis in emphasizing sharpening over blurring through DNA ancestry tests.

Next, one can compare the two types of vignettes -- in which respondents were asked to imagine how they would feel versus how the vignette subject would feel -- by examining rows 1 and 3 of Table 5. Overall, and in all five groups, there is a noticeable and sometimes significant difference in responses to the two sharpening vignettes and very little difference in responses to the two blurring vignettes. Using a simple t-test, we can reject the null for the two sharpening prompts for all respondents, (*p*-value = 0.05), for whites (*p*-value = 0.00), and for multiracials (*p*-value = 0.00); we cannot reject the null hypothesis for the two blurring prompts for any group. That is, most respondents believe that others would feel the same as themselves about having a racially mixed ancestry; in contrast, there are some statistically distinguishable differences when a test result returns a strengthening result. Descriptively, blacks and Asians in this sample are more likely to expect people of other races to be *less* pleased than they would be about

sharper racial lines (although we narrowly fail to reject the null hypothesis for these two groups), while whites, Hispanics, and multiracials are more likely to expect others to be *more* pleased than themselves about sharper racial lines (although we cannot reject the null hypothesis of no difference between the two prompts for Hispanics). Substantively, the two groups in this sample that have been most strongly racialized throughout American history – blacks and Asians -- embrace their distinctiveness more than they think people of other races would, while the three groups for whom race is less salient, or who have been less sharply defined – whites, Hispanics, and multiracials -- believe that others care more about racial boundaries than they do.

Finally, consider the percentages themselves. For both sets of questions, blacks and Hispanics are not only the most pleased with sharpening results but are also the most pleased (along with multiracials) with blurring results – that is, they are more fully engaged with the enterprise of DNA ancestry testing, regardless of its outcome, than are the others. The reason presumably has to do with disparities in one's capacity to trace ancestral heritage through other means. As Henry Louis Gates put it,

> for the first time since the seventeenth century, we are able, symbolically at least, to reverse the Middle Passage. Our ancestors brought something with them that not even the slave trade could take away: their own distinctive strands of DNA. And because their DNA has been passed down to us, their direct descendants, it can serve as a key to unlocking our African past" (Gates Jr. 2009): 10).

Overall, answers to the "pleased/displeased" question suggest that respondents took the survey seriously, attending to differences across the vignettes, and engaging with the vignettes in ways that are historically and emotionally meaningful.

To test further whether genomic ancestry testing is likely to be taken seriously, we turn next to the question of whether DNA test results would be met with skepticism or acceptance. (See the online appendix for full results.) With one exception, across all racial and ethnic groups and both prompts (blur or sharpen), between half and three-fourths of the respondents would find the test outcome believable if they were the vignette subject;[15] we cannot reject the null hypothesis that race and response are independent under both the blur prompt (Chi-squared statistic = 8.71, *p*-value = 0.37) and the reification prompt (Chi-squared statistic= 7.17, *p*-value = 0.52). Only 8 percent of respondents would disbelieve the sharpening outcome if they were the vignette subject. Twenty-three percent (with higher proportions among blacks and Asians) would disbelieve the blurring outcome – again indicating the tendency to associate genomic ancestry tests with reinforcement of racial lines.[16]

With regard to our hypotheses about groups' trust in DNA ancestry tests, H_3 (Blacks) is partly confirmed and partly disconfirmed; blacks who envision themselves

[15] The exception; only 44 percent of Asian Americans would trust blurring results.

[16] Comparisons between answers when respondents are asked to think about their own views versus imagining the vignette subject's views show few differences. We cannot reject the null that the sample means across all groups and across the two question prompts are equal (*p*-value = 0.49 for all respondents for the blurring prompt; *p*-value = 0.69 for the sharpening prompt).) Substantively, respondents see no reason to predict that others will disbelieve the results of a DNA ancestry test any more than they themselves would; this pattern of responses is reassuring in terms of internal validity.

taking a DNA test do find it as believable as members of other groups do, but they do not trust both sets of results equally (blur: 51 percent "believable;" sharpen: 74 percent "believable": test of difference-in-means *p*-value = 0.00). H_4 (Multiracials) is largely confirmed: although even people of mixed race believe sharpening more than blurring results, the disparity is much smaller than in any other group (blur: 60 percent "believable;" sharpen: 65 percent "believable": difference-in-means *p*-value = 0.03). Neither version of H_5 (Hispanic Racialization and Mestizaje), or of H_6 (White Racial Purity or Racial Liberalism) is confirmed; we had not expected respondents in all groups to find DNA test results that sharpen racial lines so compelling.

Given that a majority of respondents found the test results believable and that more would be pleased than displeased if they were the vignette subject, we can turn to the final question -- whether the test results would affect respondents' pre-test group identity. The answer is not easy to predict; as the subject of one interview put it, ancestry testing is "one part of who you are, not your identity, only as much of your identity as you want it to be." Table 6 shows the results for "it would matter a lot." As in table 5, row 1 shows agreement when the respondent was asked to imagine that he or she was the vignette subject, and row 3 shows the respondent's expectation of what the vignette subject (of a different race) would say.

Table 6 here

As with the analysis of pleased/displeased, consider first the top row of table 6, which shows the results presumably closest to the respondent's views about blurring and sharpening his or her own group identity. Overall, just over a quarter of respondents think that, regardless of its outcome, a DNA ancestry test would matter a great deal to

them. The most dramatic inter-group difference is the importance of DNA test results to blacks, especially but not only if the test sharpened racial lines. The same pattern holds more weakly for Latinos; simple Chi-square tests show that we can reject the null hypothesis of no relationship between a respondent's race and his or her response under both the blur prompt (Chi-squared = 28.90, *p*-value = 0.00) and the reification prompt (Chi-squared = 67.60, *p*-value = 0.00) when respondents are asked to imagine themselves as the test takers.

Substantively, the group for whom race matters most in determining life chances, African Americans, would be most affected by ancestry tests that accord with the predominant media presentation of DNA tests and violate genomic scientists' denial of a genetic basis for race. Conversely, the group for whom race is least salient, non-Hispanic whites, would be least influenced by any results; the other groups line up intelligibly in between.

The part of H_3 (Blacks) that addresses impact of the tests is fully confirmed, but the relevant section of H_4 (Multiracials) is not. For Latinos, once again H_{5a} (Racialization) is confirmed while H_{5b} (Mestizaje) is not; for whites, neither H_{6a} (Racial Purity) nor H_{6b} (Racial Liberalism) receives support.

Now compare the two types of vignettes, one in which respondents are asked to imagine themselves taking the test and the other in which respondents are asked to imagine how a subject of a different race would respond (that is, compare rows 1 and 3 of table 4). Except for blacks in the sharpening mode, respondents overall and members of each group believe that others not like them would be more affected by the DNA ancestry test results than they themselves would be. For all groups, we reject the null that

respondents would be similarly influenced: under both the blur and the sharpening prompts, the *p*-value for a difference-in-means test across all groups is 0.00. Although the amount of disparity between self and other varies across group and test result, the consistency of the pattern is reassuring since it suggests that respondents were making a meaningful distinction between projecting themselves into the vignette situation and predicting how others might react. Even the single anomaly makes sense; blacks not only are an exception to the general pattern of impact when they are in the sharpening mode, but also this result suggests that they know themselves to be an exception.

Finally, consider the percentages across all of the prompts. Given only two choices in this question, it is clear that (except for blacks in the sharpening mode) a majority of respondents believe that DNA test results would not matter a lot to their identity. In contrast, DNA testing would be matter a lot to blacks' identity, particularly if they were to receive a test result suggesting the sharpening of racial boundaries. That half of black respondents feel this way, while fewer would expect the test to under a blurring prompt, further supports H_3.

To summarize: DNA ancestry testing is more consequential for blacks and, to a lesser degree, Hispanics than for whites, Asian Americans, and multiracials. African Americans are more pleased with sharpening racial lines than are members of any other group (although they are also relatively pleased with blurring racial boundaries). They find sharpening results especially believable, and are the most willing to say that a DNA ancestry test would affect their identity, particularly if it sharpens racial lines. For Latinos, Racialization dominates Mestizaje, while for whites, Racial Purity somewhat overrides Racial Liberalism. Overall, if these vignettes are replicated in actual practice,

social uses of genomic science will do more to reinforce than to undermine conventional American racial categories. Genomic science is at present heading in one direction while the media and the public are heading the opposite way.

Media Reports of DNA Test-takers

To move beyond hypothetical vignettes and to explore why sharpening results are especially compelling, we conducted a content analysis of newspaper stories about individuals who have actually taken such tests.[17] The articles again come from Lexis-Nexis Academic's database of U.S. newspapers. As before, we chose search terms with the goal of being somewhat but not too overinclusive: we began with the same search terms as in the larger database, collecting any article with a genetics-related term in the same sentence as any one of a variety of words associated with or synonymous with race, ethnicity, or heredity. For this examination, however, we constrained the search to include only articles that also used (in the same sentence) a variety of stems related to particular ethnic and racial groups: Asian, Asian American, white, Pacific Islander, Native American, Alaskan Native, Latino/a, Hispanic, African American, black, and Afro American (and their plurals or other variants). We once again included in the query keywords that eliminated many extraneous articles.

The search yielded 717 articles; its manageable size permitted hand coding of all relevant items in the database. Using the same categorization scheme as for the automated content analysis, two trained undergraduate research assistants noted

[17] Our secondary goal was similar to that of the automated content analysis analyzed above: to discover what American newspaper readers are being told about the actual practice of taking such tests.

(separately) each profiled individual's pre-test race and whether his or her DNA test result was blurring or sharpening. They next noted each profiled person's reaction to the test results, as follows:

> **Positive:** The individual expresses a positive, happy, satisfied, enthusiastic, optimistic, or trusting sentiment about DNA or genomics testing and his or her test results.
>
> **Negative:** The individual expresses a negative, sad, disappointed, upset, anxious, skeptical, or distrustful sentiment about DNA or genomics testing and his or her test results.
>
> **Neutral:** The individual is reported to have a neutral emotional reaction or no reaction to DNA testing and the results.
>
> **Mixed:** The individual expresses both positive and negative emotional valances about DNA or genomics testing and the test results.

We conducted multiple inter-coder reliability checks, revising the code sheet several times to increase the coders' level of agreement. Both authors then separately recoded each article for each profiled person. We used consensus to decide on the final categorization if disagreement remained.

For our first examination, the unit of analysis is 132 unique profiled individuals. Eighty-three (64 percent) identified as African American, 34 (26 percent) as white, six as Hispanic (which we treat as a distinct group), seven as racially mixed, and one as unknown.[18] Note that this analysis reflects five layers of selection: who chose to take a

[18] No one identifying as Asian American or Native American was profiled in the depth needed for coding, although a few were mentioned in passing.

DNA ancestry test, whether they took Y-DNA/mitochondrial or autosomal tests, whether they were profiled by a journalist, what they told the journalist, and what appeared in the newspaper. These data tell us about the social practices of a self-selected group as filtered through journalists' stories -- not about demographics or genealogy.

Nevertheless, the stories are illuminating. Some test results were startling: Danny Villarreal, for example, is a Hispanic Texan who believed himself to be of pure Spanish blood. But his DNA test showed him to be closely related to Jewish populations in Hungary, Belarus, and Poland; he is, genetically speaking, more of an Ashkenazi Jew than a Spaniard. His reaction: "I was kinda surprised. . . . I'm a good ol' Catholic boy" (Lomax 2005). The results could also be moving: Reverend Al Simpson traveled from Chicago to Sierra Leone to give tribal elders of the village of Lunsar documentation of his Temne lineage. He remembers saying, "Five hundred years ago my DNA was removed from here by slave traders and taken to America, so I'm coming back for my seat. My seat's been vacant." He asked for a Temne name in order "to reclaim what was taken away from me" (Gibson 2007).

Overall, the stories showed roughly the same pattern as the automated content analysis and the vignette survey. The DNA tests of 33 out of the 84 blacks (two fifths) revealed a mixed ancestry, usually African and European; tests for the remaining three-fifths strengthened their initial racial identity, generally by providing a link to a tribe or geographic area in Africa. In contrast, test results for 19 (almost three-fifths) of the 34 whites showed blurring, as did test results for all six Hispanics. Thus, as with the automated content analysis, H_1 (Blurring) received some support (44 percent of the stories), while H_2 (Sharpening) received more (56 percent of the stories).

The first part of H_3 (Blacks) was once again confirmed; African Americans preferred sharpening to blurring results. Thirteen of the 33 blacks (two-fifths) with blurring results were positive about the outcome, compared with 40 of the 48 (over four-fifths) with sharpening results (the other three were coded "neither" or "both"). Even with the small number of observations, the difference between the two groups was statistically significant, with a Chi-square statistic of 13.07 (*p*-value of 0.00).

Among whites, the first part of H_{6a} (Racial Purity) again received stronger support than H_{6b} (Racial Liberalism). Nine of the nineteen (half) with blurring results had positive reactions, compared with eight of the twelve (two-thirds) with sharpening results (the remaining three were "neither" or "both"). The difference between these two groups was, however, not statistically significant (Chi Square statistic = .7424, *p*-value = 0.39).

We also examined the 717 articles using mentions, not persons, as the unit of analysis, in order to shift the focus to what the public is reading rather than what the testers are saying. Individuals were depicted in 211 newspaper stories.[19] Results are very similar; overall, the first part of H_3 (Blacks) again receives support while H_{6a} (White Racial Purity) once more receives slightly more support than does H_{6b} (White Racial Liberalism). Genomic science and the American public's response to genomic science in the arena of race are moving in opposite directions.

Survey Reports of Direct Experience with DNA Ancestry Testing

None of the evidence so far provides both a representative sample and direct experience; our second survey does. Although the results are mostly descriptive because of the small

[19] All of the top repeats were black. Henry Louis Gates was named in eleven articles, the author Pearl Duncan in nine, Oprah Winfrey in five, and geneticist Rick Kittles in four.

size of the relevant population, they show a pattern unlike that seen so far, and they are a unique sample in the research literature.

Again through Knowledge Networks, we conducted an online survey in May 2011 of 4,291 United States adults. The Survey on Genomics Knowledge, Attitudes, and Policy Views (GKAP) included 1,143 non-Hispanic whites, and oversamples of non-Hispanic African Americans (n = 1,031), non-Hispanic Asians (n = 337), self-defined non-Hispanic multiracials[20] (n = 635), and Hispanics (n = 1,096). The latter could take the survey in Spanish (n = 578) or in English (n = 518).[21]

GKAP asked if respondents or immediate family members had taken genomics ancestry tests; an answer of "yes" was followed by questions about their experience. The survey also asked all respondents about knowledge of DNA ancestry tests (the items are listed in the online appendix). Of the 4,291 respondents, 139 (2.1 percent, weighted)

[20] That is, people who identified with more than one racial, not ethnic, group

[21] The sample also included 49 Native Hawaiian and Pacific Islanders; we exclude them here because there are too few to analyze. Unlike in the vignette survey, a respondent could identify with a racial group or as multiracial while also being Hispanic (that is, "Hispanic" is considered an ethnicity rather than a race for purposes of this survey). Because many self-identified Hispanics opted not to provide a racial identification, however, we divided the sample into mutually exclusive categories. Any given respondent was therefore either (1) non-Hispanic white, (2) non-Hispanic black, (3) non-Hispanic Asian American, (4) non-Hispanic multiracial, or (5) Hispanic.

reported experience with the test.[22] The proportions varied by no more than 1 to 2 percent across the racial and ethnic groups. In addition, about 4 percent of respondents reported "a lot" of familiarity with DNA ancestry testing, and another 23 percent reported "some." Asians showed the greatest knowledge; 39 percent claimed a lot or some. In descending order after them came multiracials, then Hispanics, blacks, and whites, with between a quarter and a third of the three latter groups claiming a lot or some knowledge of these tests.

Regression analyses revealed a somewhat surprising set of characteristics among people with experience of or knowledge about DNA ancestry tests.[23] Even with an array of controls, Asian Americans report more knowledge than non-Hispanic whites do (this difference is statistically significant), though no more experience with DNA testing. Also

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[22] Results for "All" are weighted to reflect accurately the U.S. population as a whole. Results from each racial or ethnic group are weighted to reflect the portion of the U.S. population belonging to that group. Results for all GKAP analyses are in the online appendix.

[23] Given that the outcome variables are either dichotomous or substantively ordered and mutually exclusive, we employ logit and ordered logit specifications. Respondents who did not answer a question were dropped from the analysis. Since at most 3 percent of respondents did not answer any given question, this is unlikely to cause significant bias.

We report regression results here by including dummy variables for respondent's race or ethnicity; separate within-race regressions are in the online appendix. We used the Zelig package within the statistical software program R for all regression analyses.

with controls, Hispanics still report more knowledge and more testing experience than do non-Hispanic whites (with both findings statistically significant); multiracials are slightly more informed than non-Hispanic whites (with the difference being statistically significant), but no more frequently tested; and blacks do not differ in any meaningful way from whites on either question. To our surprise, income has no meaningful impact on either self-reported knowledge or use, and age is statistically significant but substantively marginal. Men, the well-educated, residents of small households, non-workers, and conservatives all report greater knowledge of DNA ancestry testing, while men and conservatives report greater use.

The 139 respondents who reported direct or family experience with ancestral DNA tests warrant closer examination because they are a unique sample. A few respondents had not received their test results or did not complete further questions, so we analyze the 126 with complete responses. Fifty-two percent found more ancestral groups in their test results than they had expected, while only 9 percent found fewer (the tests for the rest showed "about as many [ancestral groups] as expected"). About half of the white and Hispanic respondents, and two-fifths of blacks and multiracials, discovered a more blurred ancestry than they had anticipated, while only among blacks (one-fifth) did more than a tenth find fewer than the expected number of ancestral groups.[24] Thus, in contrast to the evidence discussed so far, the GKAP survey shows more movement

[24] Note the small subsample sizes: 25 whites, 39 blacks, 35 Hispanics, 30 multiracials, and 8 Asian Americans reported having taken a DNA ancestry tests. We report no results for Asians, and the small subsamples make extracting meaningful inferences about the general population difficult.

toward blurring than toward sharpening of racial boundaries. Indeed, a simple t-test shows a statistically significant difference between these two outcomes (p-value < 0.01). These results are especially intriguing because they imply that many respondents chose to take ancestry-wide autosomal tests rather than lineage-specific Y-DNA or mt-DNA tests.

Responses to questions about gratification and impact on identity also differed somewhat from those in the vignette survey (although one must always bear in mind the subsample sizes in GKAP). First, blacks were slightly less pleased than the others with their test results.[25] Second, slightly more respondents (39 percent) were pleased to find more groups than expected than were gratified by finding the number of groups they had anticipated (34 percent). (We narrowly fail to reject the null that the sample proportions are equal, p-value = 0.06.) Although we have too few respondents to make definitive inferences, that general pattern held for all four racial or ethnic groups. Descriptively, then, blurring is preferred to sharpening in GKAP, unlike in our three earlier analyses, and blacks are the least gratified with DNA ancestry testing, unlike in the vignette survey and individual media stories.

About half of the GKAP respondents found the test results "very believable," and most of the rest found them "somewhat believable." (Almost none said "not too believable" or "not at all believable.") Overall, and among whites and blacks but not Hispanics and multiracials, respondents trusted test results that showed the expected ancestry groups more than results that showed a larger number of groups. Only half as many black respondents as others strongly trusted the tests. With that partial exception,

[25] Around two fifths of test takers were pleased (most of the rest were neither pleased nor displeased).

these results roughly parallel those in the vignette survey; the central message is that respondents accept the legitimacy of genomics ancestry testing.

Finally, just over a third of GKAP test-takers described the tests as "very important" to their group identity, and another 44 percent found them "somewhat important." It is not surprising that only a fifth of those who have chosen to take (and pay for!) a DNA ancestry test deemed it unimportant to their identity; more intriguing is the fact that more respondents reported influence from test results that showed blurring than from test results that confirmed their expectations for the number of ancestral groups (47 to 17 percent; despite the small sample size, we can reject the null that the two groups have the same sample mean (p-value = 0.01)). Groups differed little in the proportion who found the test results very important to their identity; in all cases at least twice as many were affected by "more than expected" as by "as many as expected."

This is the strongest counterevidence so far to the results of the automated content analysis, vignette survey, and individual content analysis – all of which pointed to the importance of sharpening over blurring. Among a random sample of people who have actually taken DNA ancestry tests, discovering that the race of one's ancestors was multiple rather than singular was pleasurable, believable, and meaningful.[26]

These profiles could be overturned by more data -- but at present, they are the best available. They confirm H_1 (Blurring) and H_2 (Sharpening) in the sense that both

[26] We ran regression analyses on the questions regarding pleasure and impact (there was too little variance on the believability item). Even combining all respondents with experience with the DNA ancestry test, there were few substantively or statistically meaningful results overall or across groups. Analyses are available from the authors.

concepts were meaningful to respondents and useful in analyzing genomic ancestry test results. But GKAP results work against all parts of H_3 (Blacks); black respondents seem to be experimenting with the idea of racial blurring and not finding it distasteful. GKAP results support H_4 (Multiracials) since people of mixed race were generally pleased with blurring and allowed it to influence their identity. GKAP results incline more toward H_{5b} (Mestizaje) than toward H_{5a} (Racialization) for Latinos; like blacks, this group presents a profile of trying out racial blurring and finding it attractive. GKAP shows mixed results for H_{6a} (Racial Purity) and H_{6b} (Racial Liberalism) for whites, but like the others, more whites were inclined to be influenced by blurring than by sharpening. Overall, the survey that examines the direct experience of people who actually took a genomics ancestry test tends in the opposite direction from the survey that asks people to imagine how they would respond to a genomics ancestry test.

Conclusion, So Far

More research is needed. It always is, of course, but perhaps even more than usual in the case of what Americans are learning about race and group identity from genomic ancestry tests. The four bodies of evidence in this paper point to a deep empirical and political tension that will be resolved only with additional evidence and the evolution of a new social practice.

On the one hand, we see a split between what genomic scientists say and what the public prefers or is learning about the link between genomics and race. Almost all researchers insist that genomics shows the incoherence of sharply delineated races. Research on the human genome can reveal ancestry groups, which may be increasingly important for medical diagnosis, and treatment – but ancestry groups are much narrower

than what we understand as races, and do not necessarily bear much resemblance to the conventional five groups. Journalists, however, tend to reinforce the American public's use of the conventional five groups by featuring the search for tribal roots and depicting it in the language of race. Without claiming causation in one direction or the other, we note that the vignette survey results are consistent with the journalists' choices and the qualitative narratives; black and Hispanic respondents generally favor sharpening results, while white respondents are split between sharpening and blurring results.

On the other hand, the future may not resemble the past in this arena. The GKAP survey, providing a random sample of people who have actually taken this test or are closely related to someone who has, shows different results. Most test-takers found more group boundary blurring than they anticipated, and on balance they were pleased with, trusting of, and influenced by it. Blacks, Hispanics, and multiracials all endorsed their blurring results, although whites remained ambivalent.

Each type of evidence has strengths and weaknesses, so it is hard to know which to rely on most. The vignette survey is more reliable since the sample sizes in each group are relatively large, but it is difficult to judge its validity. The GKAP survey has high validity since we are examining actual test takers, but its results are not reliable since there are so few relevant respondents.

And the substantive uncertainties outweigh the methodological ones; one cannot predict whether the early stages of genomic ancestry testing can be projected into the future. "Genotyping cost is asymptoting to free;" within a generation "it will be easier to know someone's genome than their name" (Altman 2008) . Under those conditions, everyone's genetic heritage will be known – figuratively stapled to their birth certificate, included in their electronic health record, discussed at the dinner table and coffee break. Will

the high probability that most people will have evidence of blurring across ancestral groups affect their identity and classification of others, or be irrelevant in the face of continued racial dynamics?[27] Will the political, social, and medical uses of racial and ethnic categories become more fixed, or more fluid? We cannot tell. As one self-described "hacker" put it, "who knows what the world – what humanity – will look like on the other side of the biotech boom?" (quoted in (Nordgren and Juengst 2009): 163).

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[27] As the authoritative white paper from the American Society of Human Genetics puts it, an apparently inconsistent test result from lineage-based genetic tests "reflects the high likelihood that nearly everyone will have ancestors from different geographic locations" (Royal and al. 2010). For one graphic demonstration, see (Via and al. 2009): 228).

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FIGURE 1: NGRAMS FOR KEYWORDS: DNA, GENETIC, AND VARIANTS OF GENOMICS, 1950-2008

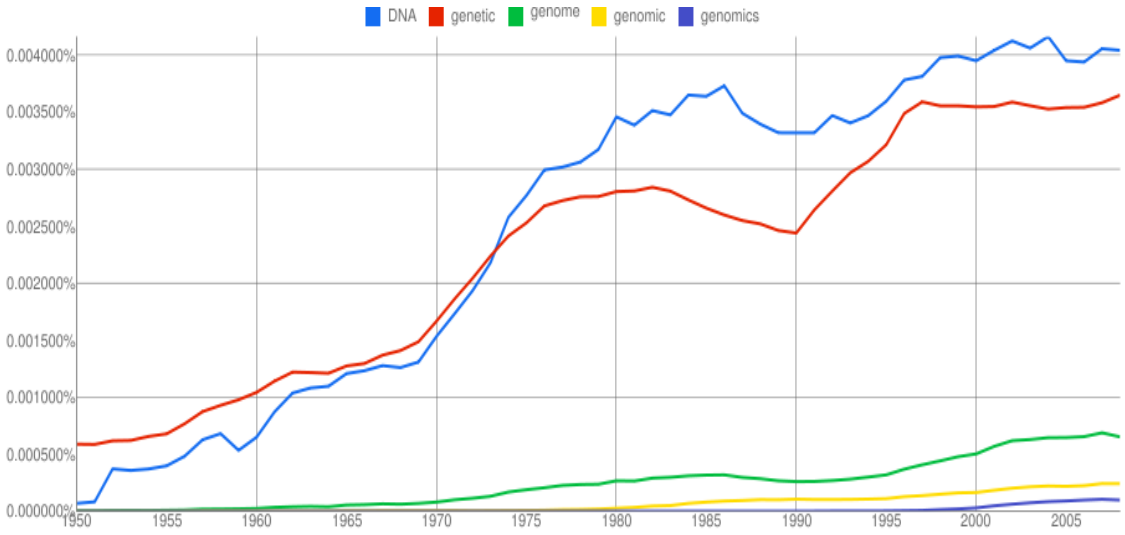

FIGURE 2: NUMBER OF NEWSPAPER ARTICLES PER YEAR ADDRESSING RACE OR ANCESTRY AND DNA

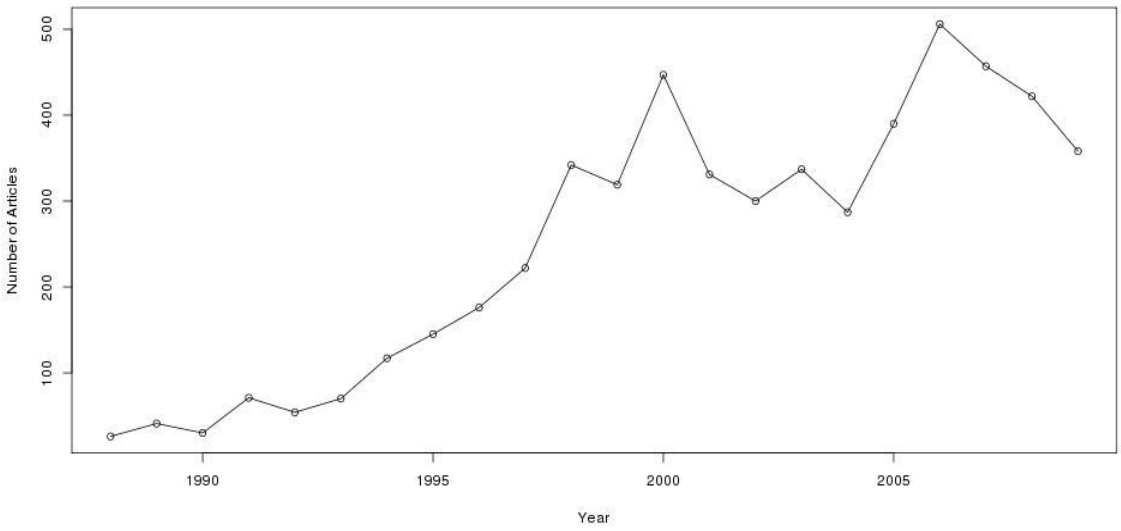
Number of Articles
100
200
300
400
500
1990
1995
2000
2005
Year

FIGURE 3: PROPORTION OF NEWSPAPER ARTICLES FOCUSED ON BLURRING, SHARPENING, OR BOTH, 1988-2009 SEPARATELY BY YEAR

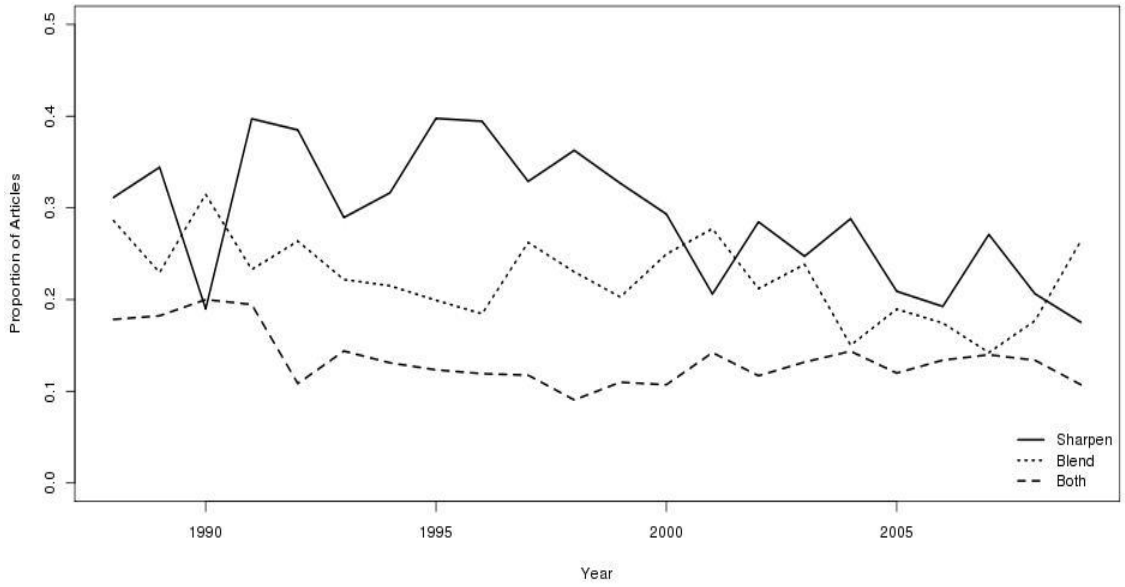

FIGURE 4: MAP SHOWING HIGHLIGHTED CONTINENTS FOR RACIAL BLURRING TEST RESULT IN VIGNETTE SURVEY, 2010

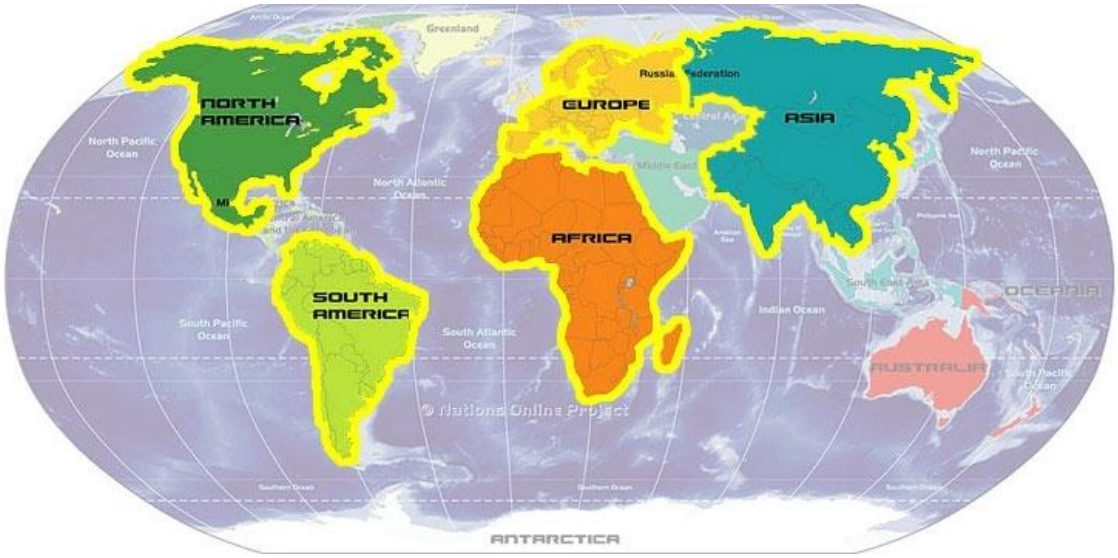

TABLE 1: EXAMPLE OF INFORMATION PROVIDED TO CUSTOMERS ABOUT ADMIXTURE

TESTS FOR LEARNING PROPORTIONS OF ANCESTRY FROM DIFFERENT CONTINENTS

Ancestry*by*DNA™ tests are performed to determine an individual's bio-geographic ancestry. Whether you're interested in researching your family history, or just simply want to learn more about yourself, this test can provide you with a better understanding of your genetic ancestry and provide a window into further research about your possible ancestors.
This test gives an estimated percentage of ancestry from four population groups:
Indigenous American. This group is composed of people who migrated to inhabit North, South and Central America.
European. This people group includes Europeans, Middle Easterners, and South Asians.
East Asian. This people group includes the Japanese, Chinese, Koreans, and Pacific Islanders.
African. This group includes people with roots in the Sub-Saharan region of Africa.
Please note that this test does not predict or establish a person's race*; it only gives an estimate of genetic ancestry or heritage.

TABLE 2: EXAMPLE OF INFORMATION PROVIDED TO CUSTOMERS ABOUT ADMIXTURE TESTS FOR LEARNING ANCESTRY FROM SPECIFIC GEOGRAPHIC AREAS, ETHNIC GROUPS, AND TRIBES.

Our Exclusive African Lineage Database
Our exclusive African Lineage Database is the largest and most comprehensive resource of African lineages available today. It includes lineages from 30 countries and over 200 ethnic groups.
Paternal lineages: 11,747 samples
Maternal lineages: 13,690 samples
The data is a compilation of published sources, research collaborations and primary research. The populations sampled are based on direction from historians, anthropologists, linguists and other geneticists.
Source: http://africanancestry.com/database.html

TABLE 3: PROPORTION OF NEWSPAPER ARTICLES FOCUSED ON BLURRING, SHARPENING, OR BOTH, TOTAL 1969-2009

Substantive Category	Estimate (SE)	95% Confidence Interval
Blur	0.21 (0.018)	(0.24, 0.17)
Sharpen	0.30 (0.021)	(0.34, 0.26)
Both	0.09 (0.011)	(0.11, 0.06)
Neither	0.41 (0.022)	(0.45, 0.36)

Standard errors (in parenthesis) are bootstrapped standard errors.

TABLE 4: ILLUSTRATIVE VIGNETTES IN THE 2010 DNA ANCESTRY TEST SURVEY

Hypothesis		Race of vignette subject and respondent	Whose views is the respondent asked to imagine?
Sharpen	Isabella is a woman who identifies as African American. She has taken a DNA test that indicates that her female lineage can be traced *primarily* to Africa. [or, Michael is a man…]	Both: Non-Hispanic black Vignette subject: randomly chosen race other than non-Hispanic black Respondent: non-Hispanic black	If you were **[**Isabella/Michael**]**, how would you feel about that? How would **[**Isabella/Michael**]**, how would you feel about that?
Blur	Emily is a woman who identifies as African American. She has taken a DNA test that indicates that her female lineage is *spread across* Europe or the Middle East, Africa, North America, Latin America or Spain, and Asia. [or, Christopher is a man…]	Both: Non-Hispanic black Vignette subject: randomly chosen race other than non-Hispanic black Respondent: non-Hispanic black	If you were **[**Isabella/Michael**]**, how would you feel about that? If you were **[**Isabella/Michael**]**, how would you feel about that?

Notes: Questions for non-Hispanic whites, Hispanics, and Asian Americans parallel those for non-Hispanic blacks. In the sharpening vignettes, the language and map for Hispanics showed Europe and South America; for multiracials, they showed two randomly chosen continents.

We chose names for the vignette subjects from the list of newborn names in New York City in the mid-2000s that were most common across all four racial or ethnic groups. Full question wording for an example of each type of vignette is in the on-line appendix.

TABLE 5: EMOTIONAL REACTIONS TO VIGNETTE SUBJECT'S DNA TEST RESULTS

	Blacks		Whites		Hispanics		Asian Americans		Multiracials		All	
	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen
"Pleased," if R were vignette individual	41%	65%	29%	38%	41%	57%	28%	49%	42%	41%	33%	45%
Total N	196	196	227	232	192	195	220	231	202	202	1037	1056
"Pleased," if R imagines vignette individual's response	42%	58%	28%	53%	45%	63%	33%	42%	37%	55%	32%	55%
Total N	194	194	224	231	194	196	225	228	195	205	1032	1054

TABLE 6: IMPACT ON RESPONDENT'S RACIAL/ETHNIC IDENTITY OF VIGNETTE SUBJECT'S DNA TEST RESULTS

	Blacks		Whites		Hispanics		Asian Americans		Multiracials		All	
	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen	Blur	Sharpen
"Would matter a lot," if R were vignette individual	39%	50%	21%	20%	35%	40%	34%	33%	22%	27%	26%	27%
Total N	194	193	226	233	190	192	221	229	194	187	1025	1034
"Would matter a lot," if R imagines vignette individual's response	46%	45%	27%	29%	46%	45%	38%	41%	44%	37%	33%	34%
Total N	196	189	227	231	187	187	225	226	194	192	1029	1025