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## Technology Optimism or Pessimism: How Trust in Science Shapes Policy Attitudes toward Genomic Science

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### EXECUTIVE SUMMARY

*There is in biology ... 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 [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.*

-- "Biology's Big Bang," *The Economist*, 2007



Reuters

**J**ust as physics gained

public visibility and ideological contention as it matured over the twentieth century, so genomic science will gain public visibility and competing normative valences as it becomes increasingly important during the twenty-first century. The new biology can help to solve many of humankind's most serious problems, or it can reinforce racial hierarchy and enhance governmental surveillance. Genomic scientists will protect our lives and our planet -- or scientists are tampering dangerously with nature.

As of 2013, the production and use of genomics has been lightly regulated; court cases addressing medical or individual uses of genomics are rare and politicians' engagement even rarer. The American public is just beginning to learn about

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genomic science, its likely uses, and its potential benefits and harms. This relative vacuum permits social scientists to explore how innovations in genomics research are moving into the public arena; rarely do scholars have the chance to watch a new policy regime emerge, especially in such an important and fraught field. As public opinion develops, it may help to shape government funding, regulation, and legislation. Most importantly, to the degree that biology becomes in this century what physics was in the last – a powerful, somewhat mysterious force influencing the destinies of individuals, countries, and the globe – it is essential for any democratic polity to examine what people know, want, believe, and fear about it. Those views will surely change as the science changes, but baseline analyses will enable political actors to know where people are starting.

We begin by describing Americans' level of technology optimism or pessimism across four arenas in genomic science and one arena (climate change) outside genomic science. We then ask "so what?" – do people who perceive more harm than good in genomic science hold different policy preferences from those who perceive more good than harm? Do optimists and pessimists differ in their perceptions of elite actors, or their willingness to be directly involved with the new science? Finally, we consider variations within the public. Is knowledge about genetics associated with more optimism about genomic science? Are people with direct interests in one arena of genomics more optimistic (or pessimistic) about its future than they are about other arenas? Do religiosity or characteristics such as race or gender play a role in levels of optimism about genomics in general or particular genomics arenas?

We conclude, first, that public attitudes toward genomic science are coherent and intelligible, perhaps surprisingly so given how new and complex the substantive issues are, and, second, that citizens differ from most social scientists, legal scholars, and policy advocates in their overall embrace of genomics' possibilities for benefitting society.

## Technology Optimism, Pessimism, and Perceptions of Risk

Intuitively, technology optimism or pessimism is a measure of a person's level of risk seeking or risk aversion. More formally, technology optimism is the "underestimation and neglect of uncertainty" in favor of "widely shared speculative promise" (Hjorliefsson et al. 2008: 379). An optimist "is centered on advancement concerns. . . . [He or she is driven] by motivations for attaining growth and supports *eager strategies* of seeking possible gains even at the risk of committing errors or accepting some loss" (Hazlett et al. 2011: 77, italics in original). Examples are not hard to find. The genomics researcher Mary Claire King describes her postdoctoral Fellows as "banging down the doors at 7 a.m. so they can get to work and see what happened [in the lab] overnight." Entrepreneurs pursue profit from drug development; doctors seek diagnoses and targeted treatments; patients seek cures; individuals seek roots and family ties; legal advocates seek punishment for the guilty and exoneration for the falsely convicted.

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Just as physics gained public visibility and ideological contention as it matured over the twentieth century, so genomic science will gain public visibility and competing normative valences as it becomes increasingly important during the twenty-first century.

In contrast, technology pessimism is the overestimation of threat and harmful impact and insufficient attention to benefits or to people's ability to respond appropriately to risk. A pessimist "is centered on security concerns. . . [and] supports *vigilant strategies* of protecting against possible losses even at the risk of missing opportunities of potential gains" (Hazlett et al. 2011: 77, italics in original). Here too examples abound. Genewatch UK warns that "an over-emphasis on genetic explanations and solutions to these problems [. . . as diverse as hunger, crime, climate change and cancer] can mean that underlying social, economic and environmental issues are ignored," and that "commitments to particular assumptions about science, technology, nature and society are often made behind closed doors, with insufficient public scrutiny" (<http://www.genewatch.org/sub-396416>). A deep technology pessimist anticipates that medical benefits will appear only in the distant future if at all, while genomic science risks reifying the concept of race, introducing new forms of discrimination through genetic inheritance, tempting people into the pursuit of designer babies, and introducing "Frankenfoods" and judicial genomic surveillance.

Technology optimism or pessimism is an element of the broader psychological phenomenon of "perception of risk" (Slovic 1987). Most researchers on the subject agree that it stems from non-experts' [or experts' (Tetlock 2005)] difficulty in estimating danger precisely. People lack relevant information and analytic frameworks; they receive contradictory messages from media and opinion leaders; risks may be intrinsically uncertain or not known; psychological proclivities shape reception of messages. Risk assessment may have as much to do with a person's cultural or social context as with his or her cognitive balancing act or actual knowledge – that is, as much to do with the person as the object being assessed.

Researchers disagree, however, on whether people tend to over- or underestimate risk. Some perceive mainly unjustified optimism: "over a wide variety of tasks [put to them by experimental psychologists], subjects' predictions of what will occur correspond closely to what they would like to see happen or to what is socially desirable rather than to what is objectively likely" (Taylor and Brown 1988: 197). But others perceive widespread pessimism: "the dominant perception for most Americans (and one that contrasts sharply with the views of professional risk assessors) is that they face even more risk today than in the past and that future risks will be even greater than today's" (Slovic 1987: 280). Contemporary advanced industrialized societies "are preoccupied with the problem of assessing and managing the risks emerging from the operations of the technological-industrial complex that drives the economy of these societies. . . . Revolutions in technology. . . threaten the prosperity and the very survival of these societies" (Ghatak 2011: 2, paraphrasing Beck 1992).

Other researchers eschew overall judgments, focusing instead on characteristics that shape technology optimism or pessimism. In one framework, an individual's risk perceptions emerge from the level of knowledge about and dread of a given outcome. But "[o]ther psychometric methods. . . produce different spatial models [and] the utility of these models for understanding and predicting behavior remains to be determined" (Slovic 1987: 283). Indeed they do; a second framework explains optimism/pessimism by everything from perceptions that the object or action in

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question is being imposed involuntarily, to the belief that it comes from artificial rather than natural causes (such as pesticides rather than bacteria), generates contradictory judgments from experts, or might have secondary effects beyond its ostensible purpose. Education and scientific knowledge affect perceptions of risk, as do “social influences and communication with members of their social networks” (Urban and Hoban 1997: 301). A third model focuses on the event’s perceived undesirability (the worse it is, the less likely it is to affect me) and probability, prior personal experience, perceived controllability, and stereotypes of the kind of person likely to be harmed (Weinstein 1980).

In short, it appears that almost anything can affect perceptions of risk, and that roughly the same variables appear to generate excessive optimism as excessive pessimism. That rather mundane conclusion is not much help to political actors or policy makers; our goal is to show patterns of optimism/pessimism more clearly and to clarify their implications and explanations in one important arena.

## Technology Optimism and Pessimism in Genomic Science

Predictions about genomic science are indeed sometimes deeply pessimistic and motivated by security concerns. Some ethicists fear that in-vitro fertilization, combined with pre-implantation or prenatal genetic testing, is the first step toward genetic selection. At best, even if genetic selection were eventually deemed acceptable, which many oppose, it will exacerbate social inequalities by being available only to well-off parents. At worst, fetal genetic testing could rehabilitate eugenics through efforts to create ideal humans without disability, disfavored race, low intelligence, or other purported flaws (Papaioannu 2009; Diver and Cohen 2001).

Pessimists also worry that insurers and employers will use genetic information to deny coverage or jobs in order to avoid health care expenses associated with genetic predispositions to illness, obesity, or other conditions (Mittra 2007). The Genetic Information Non-Discrimination Act (GINA) of 2008 is intended to address these concerns by prohibiting health insurers and employers from engaging in genetic discrimination. But GINA excludes life, disability, or long-term care insurance and says nothing about settings beyond the workplace. Those “centered on security concerns” still have plenty to worry about (Rothstein 2011).

Anxiety about American racial dynamics raises new issues: will researchers engage in “searches for a biological basis for criminal behavior”? Arguably only a small step separates the use of race as a shorthand for distinguishing phenotypes or to the use of race as a shorthand for identifying populations with propensities to violence or sexual aggression. And the first race so identified, many anticipate, will be African Americans (Duster 2006). Pessimists fear that “we are ill-prepared to respond to the complex challenges posed by racial arguments bobbing in the unstoppable tide of genetic research” (Kohn 2006; see also Roberts 2011).

Forensic DNA databanks offer yet more fertile ground for technology pessimism. Due to disproportions in arrests, immigrant detentions, felony convictions, or simply family size, about 40 percent of the people with samples in the almost 10 million

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person federal forensic database (CODIS) are black. Hispanics are also disproportionately represented. By one plausible calculation, at least one fifth of the black population, compared with only one-twentieth of non-blacks, is under genetically based police surveillance either directly or through the technique of seeking partial, or familial, matches (Greely et al. 2006). Eventually, according to one attorney, “what you’re gonna end up seeing is nearly the majority of the African American population being under genetic surveillance. If you do the math, that’s where you end up” (Schorn 2007).

In contrast, one can fill the societal vacuum around genomics with technology optimism (see, on both sides, Hochschild et al. 2012). Genomics research may hasten cures for cancer, heart failure, and a host of other frightening and deadly maladies; it already points to novel treatments for relatively simple genetic diseases. It may reduce particular groups’ incidence of Tay Sachs disease, sickle-cell anemia, or aggressive breast cancer. Prenatal testing enables treatment of fetuses, better care for newborns, and, if needed, informed parental decisions about pregnancy termination. Individuals who learn their genomic profile can act to offset their tendency toward diabetes or heart failure or to plan for a possible debilitating disease. Life expectancy may rise with personalized medicine, and those who will benefit the most will be those who currently receive the lowest-quality health care – that is, poor people and residents of poor countries. People can find their genetic ancestry, sink roots into a particular heritage, or realize at a visceral level the meaning of the claim that racial boundaries are artificially constructed.

An optimist can go further -- predicting that genomic science will overcome nutritional deficiencies and even eliminate famines by enhancing the nutrients in food. J. Craig Venter predicts that genomics will protect the environment by reducing the need for pesticides, creating oil-spill-eating bacteria, and combating climate change. Courts can use DNA evidence to reopen unsolved criminal cases, exonerate those wrongfully convicted (Gross et al. 2004), and come to more accurate verdicts in new cases. Here too, the most socially and racially disadvantaged Americans could reap the most benefits if genomics offsets rather than reinforcing racial bias in the criminal justice system. After all, as the saying goes, “genes aren’t racist; people are racist.”

So far, Americans are consistent optimists. Among the more than 34,600 respondents accumulated across most years since 1973 in the nationally representative General Social Survey, 43 percent express “a great deal” of confidence in “the scientific community,” while only 7 percent report “hardly any confidence at all.” Even more, 48 percent of the 37,000 queried since 1973, have a great deal of confidence in medicine. These are the two strongest endorsements among the thirteen institutions that have been the subjects of the GSS’s repeated confidence items.<sup>1</sup> In more focused questions over three decades, despite substantially different wordings,

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<sup>1</sup> The next highest is the Army, at 40 percent across 36,400 respondents since 1973. In contrast, across four decades, 12 percent have endorsed organized labor and 14 percent have expressed confidence in both television and Congress.

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Americans have generally agreed that the benefits of genetic testing outweigh its harms. A majority expresses technology optimism about genomic science in 14 of the 20 surveys – including all since 2000 -- and a plurality in three more. More specifically, in all three surveys that asked this question during the 2000s, four out of five respondents agreed that medical genetic testing should be readily available “to all who want it” (Virginia Commonwealth University, 2001, 2004, 2008, in iPoll).

## **Survey on Genomics Knowledge, Attitudes, and Policy Views**

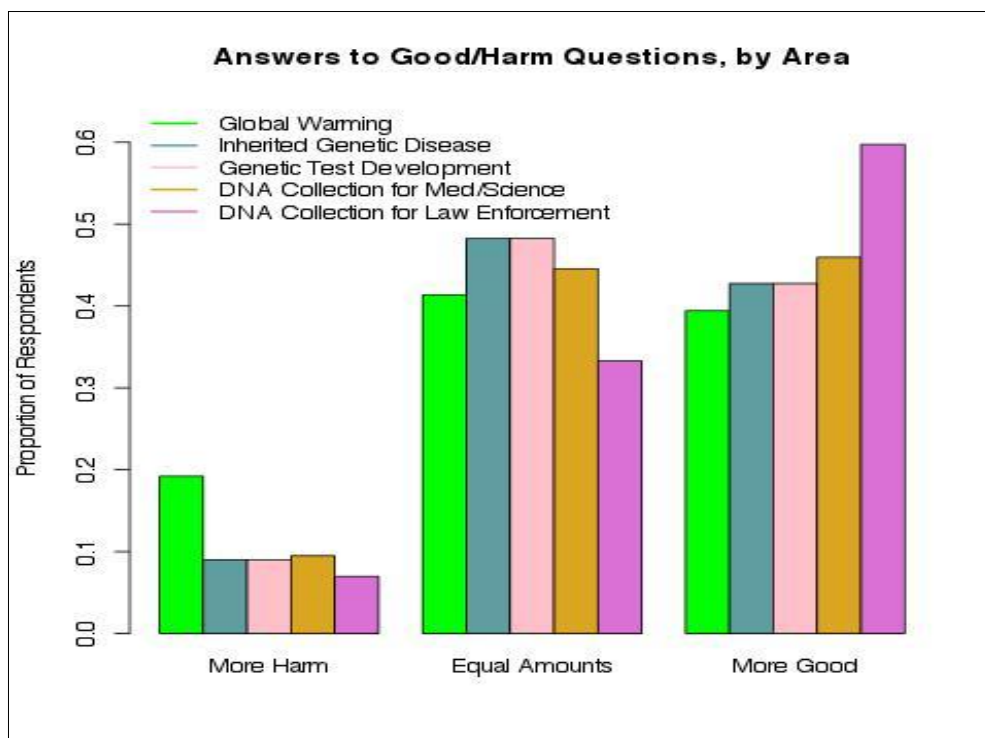
Given these results, we start with the assumption that ordinary Americans are more likely to see benefits than dangers in genomic science -- despite the fact that genomics is not well known, generates contradictory judgments from experts, has the potential for secondary effects, and rests on little previous personal experience. We explored this assumption, and its causes and effects, through an online 20-minute survey in May 2011 of 4,291 randomly selected U.S. adults, conducted by Knowledge Networks Inc. GKAP (the Survey on Genomics, Knowledge, and Policy) included 1,143 non-Hispanic whites and large oversamples of non-Hispanic African Americans (n = 1,031), non-Hispanic Asians (n = 337), self-defined non-Hispanic multiracials (n = 635), and Hispanics (n = 1,096). Each group of respondents is weighted to represent that group in the general population, and the whole set of respondents is separately weighted to represent the American population.

GKAP focused on four genomics arenas and one scientific arena outside genomics for comparison purposes. They are, in the words of the survey items: 1) research on inherited diseases especially likely to affect people of one race or ethnicity; 2) development of genetic tests to determine an individual’s likelihood of getting an inherited disease; 3) the use of DNA samples collected from patients or the general public for scientific research; 4) the use of DNA samples collected from people convicted of a serious crime for law enforcement purposes; and 5) efforts to slow or prevent global warming, sometimes termed climate change. For each arena, we asked respondents if research or activity would lead to “more good than harm,” “equal amounts of harm and good,” or “more harm than good” for society. Variants of this question have been used in surveys around the world, and it is our central focus in this article.

## **Technology Optimism, Trust in Elites, Policy Views, and Willingness to Participate**

GKAP respondents are more likely to say that research into all four genomics arenas will result in a net good for society than to say the reverse. Figure 1 shows the pattern:

Figure 1: Technology Optimism across Scientific Arenas, GKAP 2011



There can be tension between encouragement and monitoring – but Americans clearly do not see any such trade-off in genomic science or even in climate control.

Within the overall pattern, figure 1 shows two partial exceptions. Respondents are relatively pessimistic about research on efforts to mitigate global warming (green bars), and more than usually optimistic about the use of DNA samples for law enforcement purposes (purple bars). Not coincidentally, these are the two most politically charged of the five arenas.

Despite their overall technology optimism, GKAP respondents express mixed views about elites who generate or oversee genomic and other sciences. At least in these five arenas, roughly seven in ten Americans believe that scientists act in the public good; half say the same about government officials, but only two-fifths trust private companies “a lot” or “some” to act in the interests of society as a whole. Levels of trust vary a great deal according to the substantive arena under discussion. Reflecting the political controversy surrounding global warming, Americans are least likely to trust scientists, government officials, *and* private companies in that arena. Conversely, reflecting Americans’ concern about crime control and just punishment, they are most likely to trust police officers and judges and juries in the arena of forensic DNA use.

Americans’ optimism about genomic science and its uses is associated with backing for government involvement. At least three-fifths, and up to nine out of ten in the case of legal biobanks, endorse public funding for genomic science. Americans

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see no conflict between government support and government regulation, as people with strong ideological commitments on either the right or the left often do. Roughly three-fifths (four-fifths in the case of legal biobanks) want the government to regulate the same science that they also want it to fund. There can be tension between encouragement and monitoring – but most Americans do not see any such trade-off in genomic science or even in climate control.

Americans also seem willing to put their person where their mouth is. After (separately) explaining research biobanks and legal biobanks, and querying attitudes toward each, the GKAP survey asked if respondents would be “willing to contribute a DNA sample for use in current or future scientific or medical research?” or “. . . for use in current or future investigations to determine a person’s guilt or innocence of a particular crime.” Three-fifths reported being “somewhat willing” or “willing” to contribute in each case.

## Technology Optimism among Types of Respondents

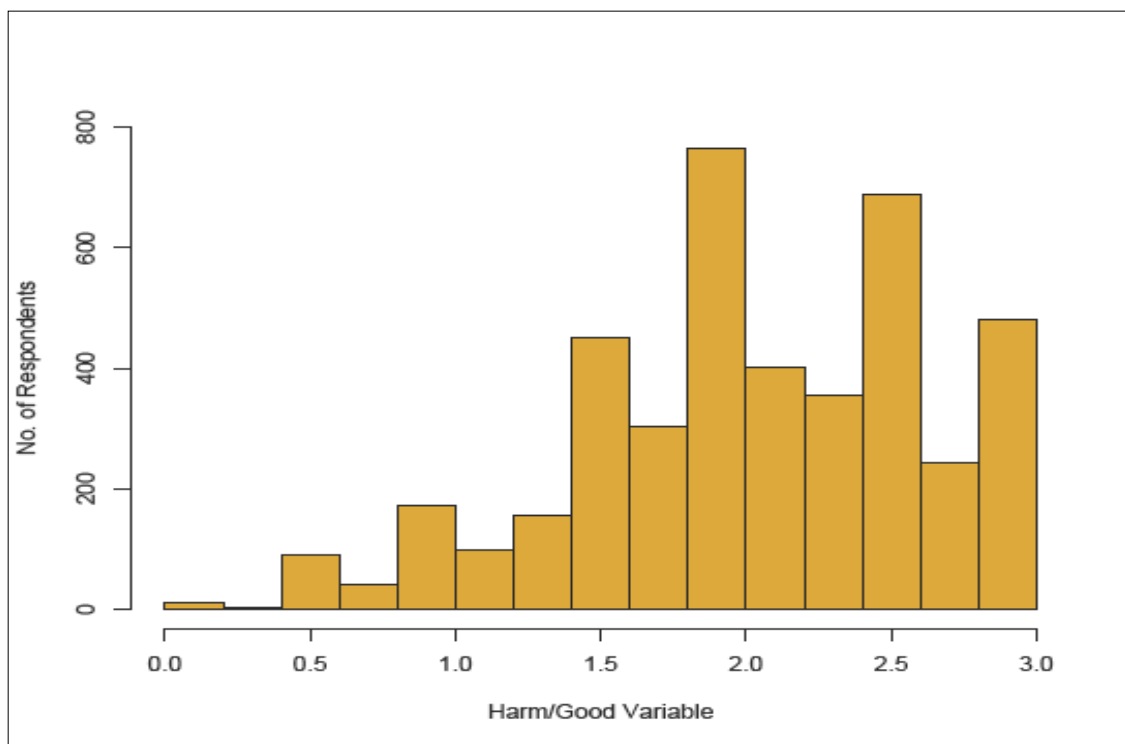
Figure 1 shows not only the central tendency toward “more good than harm” but also variation; some respondents do not share the views of most. In order to analyze distinctions among respondents’ views, we now collapse distinctions among arenas of genomic science. First, based on results from the statistical technique of factor analysis, we combined responses to the “harm/good” questions about three arenas in genomics with questions about trusting scientists in the same three arenas and the question about willingness to contribute to a medical biobank; those seven highly interrelated questions capture respondents’ overall latent level of optimism about genomics.<sup>2</sup> We then take the mean response to this combined variable to create for each respondent a single measure, identified as Optimism. Figure 2 presents the distribution of Optimism among all 4300 GKAP respondents:

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<sup>2</sup> We justify this particular combination through a factor analysis that groups similar, or highly correlated, responses in a given dataset. Technical details are discussed in Hochschild, Crabill and Sen (2012).



Figure 2: Levels of Technology Optimism, GKAP 2011



Note again that respondents tend more toward technology optimism than technology pessimism; the bars are much higher between 1.5 and 3 on the X-axis than between 0 and 1.5. Nevertheless, respondents appear at all levels of Optimism (or pessimism). That finding leads to questions such as “even controlling for different levels of education or religious beliefs, do *African Americans* or *Hispanics* view genomic science differently from *Caucasians*?” There are historical and empirical reasons both to think this might, or might not, be the case. On the one hand, blacks’ fraught history with American medical research (in, for example, the Tuskegee syphilis experiments) might imply technology pessimism and mistrust of scientific elites; on the other hand, the longstanding need for cures for sickle cell anemia and other racially inflected diseases suggests the opposite view.

Without any controls, we find that African Americans in GKAP strongly trust scientists only half as much as whites do (14 to 27 percent) with regard to research on inherited diseases especially likely to affect people of one group. They are more than twice as likely to strongly endorse regulation (22 to 10 percent). But blacks also want cures; African Americans are more likely than Anglos (34 to 25 percent) to strongly endorse government funding for research on group-inflected genetic diseases.

One might also expect blacks to differ from whites on forensic biobanks, even controlling for factors such as education or residence in high crime area. African Americans and Latinos, of course, have a long history of conflict with the criminal justice system that often overrides their need and desire for protection against

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[R]egardless of their race, gender, ideology, and so on, the more Optimism a respondent expresses, the more likely he or she is to endorse governmental funding *and* regulation of the three forms of medical or scientific genomics activity, to trust public officials *and* private companies to act in the public good, and to endorse legal biobanks.

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criminal activity. And in fact, GKAP results do show that non-Anglos are wary of forensic biobanks. Whereas two-thirds of non-Hispanic whites see more good than harm to society in using DNA in the criminal justice system, only half of Asians and Hispanics and just two-fifths of blacks concur. More blacks and Hispanics than whites and Asian Americans strongly endorse regulation in this arena. Roughly twice as many whites and Asians as blacks trust police officers or judges and juries to act for the public good with regard to legal biobanks (Hispanics are in between). Whites, Hispanics, and Asians are all more willing than blacks to contribute DNA to forensic biobanks. But wariness is not opposition: as many blacks as whites and even more Asians and Hispanics strongly support government funding for forensic biobanks (roughly two-fifths of all groups, with most of the rest supporting funding “somewhat.”)

One might also ask, “even controlling for different levels of education or religious beliefs, do *women* view genomic science differently from men?” Some research shows women to be more technologically pessimistic than men or to have less confidence in science (Gauchat 2012; Hayes and Tariq 2000; Siegrist 2000). But due to their sense of vulnerability to crime, women may be unusually supportive of forensic biobanks. Unlike with African Americans, the simple percentages in GKAP do not show differences by gender in Optimism, so we do not expect gender differences to parallel racial ones even when other respondent characteristics are controlled for.

*Religious convictions*, or the intensity of *religious practices* might separate technology optimists from pessimists, even when education, race, or other factors are controlled. Public discourse and some scholarship suggests that highly religious Americans, or adherents of conservative religious traditions, are especially skeptical of science in general and concerned about genomic science in particular (Gauchat 2012; Hayes and Tariq 2000; Sturgis and Allum 2004; Muñoz et al. 2012). However, basic percentages in GKAP are more like those for gender than for race; they do not show people who often attend religious services to be more skeptical of genomic science than those who attend infrequently or never. (In fact, the nonreligious are more likely to see harm in genetic medical tests and less likely to see good in research biobanks.)

Next, we consider *ideology*. Conservatives disproportionately and perhaps increasingly mistrust science and scientists (Binder 2002; Mooney 2005; Gauchat 2012), while self-defined leftists support more government funding of science (Muñoz et al. 2012). President Obama sponsored a bill to enhance genomics research while he was a senator, and Democrats were primary sponsors of GINA, the only federal law addressing genomics. Nevertheless, even with controls for education or technology optimism, conservatives or Republicans may be more likely than liberals to trust private companies to act in the public interest, and may be disproportionately optimistic about legal biobanks.

Initial results in the GKAP survey reinforce those expectations. Compared with Democrats, Republicans are less likely to see more good than harm in three of the four genomics arenas (the exception is forensic biobanks). Fewer Republicans endorse and more oppose government funding – even, to a lesser degree, with regard to

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forensic biobanks. Interestingly, perhaps reflecting opposition to any form of governmental action, Republicans are also less likely to endorse and more likely to oppose government regulation in all four arenas.

We then examine associations between *scientific literacy*, or *awareness* of genomic science, and views about the practice and use of genomic science. Controlling for education and other factors, we expect people with more knowledge about or engagement with genetics to be more supportive and trusting (Allum et al. 2008; Bodmer 1985; Miller 2004). The direction of causation is not clear here; scientific knowledge or awareness may lead to support, or support to knowledge and awareness. But whatever way the causal arrow goes, we anticipate links between knowledge and attitudes.

Finally, we examine *self- (or family-) interest*. Political scientists have a surprisingly difficult time showing that the pursuit of personal goals is connected with views about or activity within the public arena (Kinder 1998). Nevertheless, it is too important a possibility to ignore. Therefore we look first at medical self-interest: people with a genetic disease or with a family member suffering from a genetic disease may be distinctive on Optimism, may endorse more government funding, and may trust both private companies and public officials to act in the public good with regard to medical genomics. Second, we examine people living in high-crime neighborhoods, who are likely to be especially anxious about criminal victimization and supportive of a strong criminal justice system. One might therefore anticipate that they see more good than harm in legal biobanks, trust police officers and judges and juries, support government funding, oppose strong regulation, and are willing to contribute their own DNA to a forensic biobank.

Overall, we examined these six differences among individuals—race, gender, religious convictions or practices, political ideology, scientific literacy or awareness, and medical or legal self-interest – to see which, when other factors are controlled, was associated with different levels of Optimism and policy preferences around genomic science. We also analyzed our central thesis, that Optimism itself is associated with views toward genomic science, even when controlling for the respondent’s characteristics. The regression analysis is available in Hochschild, Crabill, and Sen 2012; here we report the results.

The most prominent result addresses our central thesis: regardless of their race, gender, ideology, and so on, the more Optimism about genomics a respondent expresses, the more likely he or she is to endorse governmental funding *and* regulation of the three forms of medical or scientific genomics activity, to trust public officials *and* private companies to act in the public good, and to endorse legal biobanks. (For this analysis, we are ignoring climate change.) These associations show that public attitudes about genomics are coherent and intelligible – especially interesting given how little people know about this new science and how much evidence we have about disjunctions within public opinion on a variety of topics.

Beyond that key finding, our other expectations showed mixed results. Three of the six variables of interest are linked to Optimism and views on genomics. First, *race*: even with controls, African Americans express less Optimism than do whites, and

even controlling for Optimism, blacks are less supportive of legal biobanks. Compared with whites, however, blacks, Hispanics, and Asians all support more governmental funding and regulation, and trust both public and private officials more. Overall, Anglos are the most optimistic in general about genomic science but are the least eager to develop it through public action, except in the legal arena.

Second, *ideology*: with controls, Republicans express slightly less Optimism about genomic science than Democrats do. Even controlling for Optimism, Republicans seek less government activism (both funding and regulation) and trust government officials less. They do, however, trust private companies more and show more support for forensic biobanks than do Democrats.

Third, *knowledge and awareness*: with controls, those who know the most about genetics and those who claim the most awareness of genomics express more Optimism. Interestingly, knowledgeable individuals trust both public officials and private companies less than do those who know less; relative expertise among the lay public has mixed and inconsistent associations with trust in public and private actors and with views on legal biobanks.

Despite plausible predictions, the other three variables were not linked to Optimism or to any other features of genomic science surveyed in GKAP. *Women* do not systematically differ from men; people with particular *religious convictions or religious practice* do not systematically differ from others. People living in *high crime areas* do not support legal biobanks more than others, and respondents with *personal or family genetic diseases* do not differ consistently from people or families without. Social divides, such as gender or faith, that matter in other political arenas have no bite in genomics -- and once again, self-interest is surprisingly invisible in political attitudes.

## Conclusion

The patterns in the 2011 GKAP survey show the foundation from which public opinion about genomic science may consolidate over the next few decades. If current configurations deepen and solidify, we could expect:

- Division between the optimistic views of the American public and the pessimistic views of many if not most social scientists, legal scholars, and policy advocates. Such a division will not be new; it will resemble beliefs about evolution, attitudes toward undocumented immigrants, and anxiety about climate change. But a split between technology optimism and pessimism could reinforce elites' mistrust of the mass public and the public's reciprocal mistrust;
- Division between people of color and non-Hispanic whites, especially but not uniquely with regard to forensic DNA databases. That split too will hardly be new, but it could add to already severe racial and ethnic tensions within the criminal justice system. It could even retard development of genomics techniques that might lessen, rather than exacerbate, racial discrimination

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around the issue of crime control;

- Division between those knowledgeable about genetics and aware of genomic developments, and others. If biology indeed plays the role in this century that physics did in the last one, a democratic polity can ill afford for many citizens to receive little education about or have little engagement with this new science, especially if the less aware tend toward unwarranted technology pessimism; and
- Possibly division between conservatives and liberals. Again hardly new – in fact, what is novel at this point is that genomic science largely escapes the polarization characterizing stem cell research, the science of climate change, or evolutionary science. Even in this highly polarized political environment, in 2008 GINA passed the House of Representatives with only one dissent and the Senate unanimously. GKAP respondents are more divided, slightly but consistently, than Congress was. Conservatives are not totally hostile or liberals totally enthusiastic, but they differ in the objects of their concern or enthusiasm. So partisan separation may yet emerge in the arena of genomics optimism or pessimism.

Despite these potentially growing divisions, a projection of GKAP results into the future encourages hopefulness (about the citizenry, if not the science). Americans' attitudes are coherent, intelligible, and largely favorable; we do not see a fearful or defensively pessimistic population in this arena. Even blacks' well-founded anxieties about forensic biobanks and mistrust of elites do not prevent 83 percent from endorsing more government funding. As one black GKAP respondent put it, "[a legal biobank] is a good instrument and tool for proving innocence or guilt." Whether that view proves naïve or prescient will take years, if not decades, to determine; in the meantime, Americans are reasonably sanguine.

We welcome comments and suggestions for further research, sent to [hochschild@gov.harvard.edu](mailto:hochschild@gov.harvard.edu) or [msen@ur.rochester.edu](mailto:msen@ur.rochester.edu).

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