

# CRISPR Democracy: Gene Editing and the Need for Inclusive Deliberation

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The 1975 Asilomar conference on the risks of recombinant DNA is a poor model for governing newly emerging gene-editing technologies.

Not since the early, heady days of recombinant DNA (rDNA) has a technique of molecular biology so gripped the scientific imagination as the CRISPR-Cas9 method of gene editing. Its promises are similar to those of rDNA, which radically transformed the economic and social practices of biotechnology in the mid-1970s. Ivory tower rDNA science morphed into a multibillion dollar technological enterprise built on individual entrepreneurship, venture capital, start-ups, and wide-ranging university-industry collaborations. But gene editing seems even more immediate and exciting in its promises. If rDNA techniques rewrote the book of life, making entire genomes readable, then CRISPR applies an editorial eye to the resulting book, searching for typos and other infelicities that mar the basic text. Gene editing shows many signs of being cheaper, faster, more accurate, and more widely applicable than older rDNA techniques because of its ability to cut and alter the DNA of any species at almost any genomic site with ease and precision.

Since their development, gene editing techniques have been used for many purposes: improving bacterial strains used in dairy products, making new animals for research, and experimenting with knocking out disease-inducing mutations in human genes. Some of these uses are already producing commercial benefits while others remain distinctly futuristic. Uncertainty, however, has not deterred speculation or hope. To many it appears all but certain that so precise and powerful a technique will revolutionize the treatment of genetically transmitted human disease, correcting defective genes within diseased bodies, and potentially banishing genetic errors from the germ-line by editing the DNA of human gametes and embryos. Some researchers have already initiated experiments on human gametes and embryos to develop techniques for this purpose.

Hope is understandable. Up to 10% of the U.S. population is estimated to carry traits for one or another rare genetic disease. The consequences for individuals and families may be tragic, as well as economically and psychologically devastating. Our moral intuition rebels against pointless suffering. Any discovery that serves medicine's ethical mandate to help the sick therefore generates immense pressure to move quickly from labs into bodies.

These established, socially approved ways of thinking explain the air of inevitability surrounding CRISPR's application to germline gene editing. In Craig Venter's words "the question is when, not if." Human curiosity and ingenuity have discovered a simple, effective means to snip out nature's mistakes from the grammar of the human genome, and to substitute correct sequences for incorrect ones. It seems only logical, then, that the technique should be applied as soon as possible to those dealt losing hands in life's lottery. Yet, as with all narratives of progress through science and technology, this one carries provisos and reservations. On closer inspection, it turns out to be anything but simple to decide how far we should go in researching and applying CRISPR to the human germline. CRISPR raises basic questions about the rightful place of science in governing the future in democratic societies.

Recapitulating the rDNA story, prominent biologists have been among the first to call for restraint. In March 2015, a group, including such luminaries as Nobel laureates David Baltimore of Caltech and Paul Berg of Stanford, proposed a worldwide moratorium on altering the genome to produce changes that could be passed on to future generations. In May, the U.S. National Academy of

Sciences (NAS) and National Academy of Medicine (NAM) announced their intention to hold an “international summit” later this year “to convene researchers and other experts to explore the scientific, ethical, legal, and policy issues associated with human gene-editing research.” The NAS-NAM plan also calls for a “multidisciplinary, international committee” to undertake a comprehensive study of gene editing’s scientific underpinnings and its ethical, legal, and social implications.

That leading scientists should call for responsible research is wholly laudable. But the human genome is not the property of any particular culture, nation, or region; still less is it the property of science alone. It belongs equally to every member of our species, and decisions about how far we should go in tinkering with it have to be accountable to humanity as a whole. How might a U.S. or international summit on gene editing attempt to meet that heavy responsibility?

Thus far, one historical experience has dominated scientists’ imaginations about the right way to proceed, an experience that takes its name like many ground-breaking diplomatic accords from a meeting place. The place is Asilomar, the famed California conference center where in 1975 some of the same biologists now proposing a moratorium on germline gene editing met to recommend guidelines for rDNA experimentation. In the eyes of Paul Berg, one of its chief organizers, this too was a meeting that changed the world. Writing in *Nature* in 2008, he portrayed Asilomar as a brilliant success that paved the way for “geneticists to push research to its limits without endangering public health.”

That description, however, points to the dangers of using Asilomar as a model for dealing with CRISPR. It implies that geneticists have a right to “push research to its limits” and that restraint is warranted only where the research entails technically defined risks like “endangering public health.” But both notions are flawed. We argue here that an uncritical application of the Asilomar model to CRISPR would do a disservice to history as well as democracy.

Asilomar shows how under the guise of responsible self-regulation science steps in to shape the forms of governance that societies are allowed to consider. As a first step, questions are narrowed to the risks that scientists know best, thereby demanding that wider publics defer to scientists’ understandings of what is at stake. Even where there are calls for “broad public dialogue,” these are constrained by expert accounts of what is proper (and not proper) to talk about in ensuing deliberations. When larger questions arise, as they often do, dissent is dismissed as evidence that publics just do not get the science. But studies of technical controversies have repeatedly shown that public opposition reflects not technical misunderstanding but different ideas from those of experts about how to live well with emerging technologies. The impulse to dismiss public views as simply ill-informed is not only itself ill-informed, but is problematic because it deprives society of the freedom to decide what forms of progress are culturally and morally acceptable. Instead of looking backward to a mythic construct that we would call “Asilomar-in-memory,” future deliberations on CRISPR should actively rethink the relationship between science and democracy. That reflection, we suggest, should take note of four themes that would help steer study and deliberation in more democratic directions: envisioning futures, distribution, trust, and provisionality.

## Whose futures?

Science and technology not only improve lives but shape our expectations, and eventually our experiences, of how lives ought to be lived. In these respects, science and technology govern lives as surely as law does, empowering some forms of life and making them natural while others, by comparison, come to seem deficient or unnatural. For example, contraception and assisted reproduction liberated women from the natural cycles of childbirth and enabled a degree of economic and social independence unthinkable just a half-century ago. But increased autonomy in these domains necessarily changed the meaning and even the economic viability of some previously normal choices, such as decisions to have many children or simply “stay home.” Similarly, the

digital era vastly increased the number of “friends” one can call one’s own, but it curtailed leisure and privacy in ways that brought new demands for protection, such as employee rights not to answer email after hours, for instance in France and Germany, and the rights of individuals now recognized in European law to demand the erasure of their outdated digital footprints in search engines like Google. Prenatal genetic testing enabled parents to prevent the birth of seriously ill children but made disability rights groups anxious that members would be stigmatized as accidents who should never have been born.

The research community acknowledges the unfair distribution of health resources but tends to shrug it off as someone else’s business.

As in moments of lawmaking or constitutional change, the emergence of a far-reaching technology like CRISPR is a time when society takes stock of alternative imaginable futures and decides which ones are worth pursuing and which ones should be regulated, or even prevented. Asilomar represented for the molecular biology community just such a moment of envisioning. The eminent scientists who organized the meeting rightly recognized that at stake was the governance of genetic engineering. How should the balance be struck between science’s desire to push research to the limits on a new set of techniques with extraordinary potential, and society’s possibly countervailing interests in protecting public health, safety, and social values? Intelligence, expertise, a strong sense of social responsibility—all were amply represented at Asilomar. What was in shorter supply, however, was a diversity of viewpoints, both lay and expert.

To molecular biologists flushed with the excitement of snipping and splicing DNA, it seemed obvious that rDNA research should continue without what they saw as ill-advised political restrictions. Many scientists regarded this as “academic freedom,” a constitutionally guaranteed right to pursue research so long as inquiry harms no one. The primary risk, Asilomar participants believed, was that dangerous organisms might be accidentally released from the lab environment, injuring humans or ecosystems. What would happen, they asked, if a genetically engineered bacterium containing a cancer-causing gene escaped and colonized the human gut? To prevent such unwanted and potentially grave errors, the scientists adopted the principle of containment, a system of physical and biological controls to keep harmful organisms safely enclosed inside the experimental spaces where they were being made. Public health would not be risked and research would continue. The Reagan administration’s subsequent decision to use a coordinated framework of existing laws to regulate the products, but not the process, of genetic engineering reflected this end-of-pipe framing of risks. Upstream research remained virtually free from oversight beyond the narrow parameters of laboratory containment. This is the science-friendly settlement that Paul Berg celebrated in his *Nature* article and that the National Academies have invoked as a guiding precedent for the upcoming summit on gene editing.

A full accounting of the Asilomar rDNA conference, however, highlights not the prescience of the scientists but the narrow imagination of risk that their “summit” adopted. The focus on containment within the lab failed to foresee the breadth and intensity of the debates that would erupt, especially outside the United States, when genetically modified (GM) crops were released for commercial use. U.S. policymakers came to accept as an article of faith that GM crops are safe, as proved by decades of widespread use in food and feed. Ecologists and farmers around in the world, however, observed that Asilomar did not even consider the question of deliberate release of GM organisms outside the lab because the assembled scientists felt they could not reliably assess or manage those risks. As a result, when agricultural introductions were approved in the United States, with little further deliberation or public notice, activists had to sue to secure compliance with existing legal mandates, such as the need for an environmental impact statement.

If the Asilomar scientists’ imagination of risk was circumscribed, so too were their views of the forms and modes of deliberation that are appropriate for the democratic governance of technology. Understandably, given the United States’ lead in rDNA work, American voices dominated at the scientists’ meeting, with a sprinkling of representatives from Europe and none from the developing

world. Questions about biosecurity and ethics were explicitly excluded from the agenda. Ecological questions, such as long-term effects on biodiversity or non-target species, received barely a nod. The differences between research at the lab scale and development at industrial scales did not enter the discussion, let alone questions about intellectual property or eventual impacts on farmers, consumers, crop diversity, and food security around the world. Yet, those emerged as points of bitter contestation, turning GM crops into a paradigm case of how not to handle the introduction of a revolutionary new technology. In retrospect, one can see the long, at times tragic, controversy over GM crops—marked by research plot destructions, boycotts and consumer rebellion, import restrictions against U.S. crops, a World Trade Organization case, a global movement against Monsanto—as a reopening by global citizens of all the dimensions of genetic engineering that Asilomar had excluded.

Biomedicine achieved greater political acceptance in the intervening decades than agricultural biotechnology, but even here the record is ambiguous. As we will discuss, the political economy of drug development, an issue that even scientists with substantial commercial interests typically regard as lying outside their remit, remains highly controversial. Specific public worries include the ethics of transnational clinical trials, access to essential medicines, and intellectual property laws that discriminate against generic drugs produced in developing countries.

Given these demonstrable gaps between what scientists deliberated in 1975 and what the world has seen fit to deliberate in the 40 years since, it is the myth of Asilomar as the “meeting that changed the world” that warrants revisiting.

## Whose risks?

In biomedical research, the notion that scientists should “push research to its limits” reflects not only the desire to satisfy curiosity but the hope that progress in knowledge will produce victories against disease. Given its power and versatility, there is plenty of speculation that CRISPR might be not just any therapy, with hit or miss qualities, but a magic bullet for generating customized gene and cell therapies, more targeted treatments, and, most provocatively, direct editing out of disease-causing genes in human embryos. These visions are not unlike several that preceded them, for instance with embryonic stem cell research, gene therapy, rDNA, and others. As with these precursors, imaginations of the technique’s therapeutic potential—and thus the imperative to proceed with research—eclipsed the complexities of biomedicine in practice. Although CRISPR might produce treatments, people will benefit from them only if their ailments are the ones treated and only if they have adequate access to therapies. Access, in turn, depends in important respects upon the political economy of innovation. Thirty-five years after Genentech produced recombinant insulin, the first major biomedical payoff of rDNA, insulin remains an expensive drug. Its cost keeps it out of reach for some Americans, with disastrous implications for their health. A therapeutic as complex as CRISPR gene therapy with multiple macromolecular components (protein, RNA, and delivery agents) is likely to be engineered and reformulated for decades to come to maximize safety and efficacy. That process, in turn, may generate a succession of “evergreening” patents and limit the immediate benefits to those with the resources to afford them.

The research community acknowledges the unfair distribution of health resources but tends to shrug it off as someone else’s business. Science, after all, should not be burdened with solving complex political and economic problems. The social contract between society and science, as encapsulated in Vannevar Bush’s metaphor of the endless frontier, calls on science only to deliver new knowledge. Yet the commercial aspirations of twenty-first century normal science play no small part in sustaining the very political economy of invention that gives rise to distributive inequity. These days it is expected (and indeed required by law) that publicly funded discoveries with economic potential should be commercialized: science, in this view, best serves the public good by bringing goods to market. CRISPR is no exception. A patent battle is taking shape between the University of California, Berkeley and the Broad Institute, with predictions that upward of a billion

dollars in royalties are at stake. With such forces in play, “pushing research to its limits” easily translates into pushing biomedicine’s commercial potential to its limits, meaning, in practice, that urgent needs of poor patients and overall public health may get sidelined in favor of developing non-essential treatments for affluent patients. Under these circumstances, it is hard not to read defenses of scientific autonomy and academic freedom as defenses of the freedom of the marketplace. Both freedoms are rooted in the same disparities of wealth and resources that separate the health expectations of the poor from those of the rich.

The apparent inevitability of CRISPR applications to editing embryos takes for granted the entire economics of biomedical innovation, with the assumption that the push to commercialize is by definition a universal good. These arrangements, however, are not natural expressions of the market’s invisible hand. They grow out of specific political and legal choices whose consequences have typically not been revisited in the decades since they were made, even where mechanisms exist to do so. The National Institutes of Health (NIH), for instance, retains march-in rights for intellectual property produced with its support, but it has never seen fit to exercise them, even where pushing profits to the limit has compromised access to therapeutics with detrimental effects on public health. In contrast, many developing countries initially exempted pharmaceutical drugs from patent protection on the belief that access to health should not be limited by commercial interests—an exemption eliminated by the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

Good governance in a complex world does require accommodation of private interests, and democracies have struggled to insulate governance from undue influence by the power of money. CRISPR and its biotechnological predecessors exemplify cases where it is especially hard for democratic processes to strike the balance between public good and private benefit. For here, as already noted, delegating to experts the right to assess risk strips away many features of the social context that shape technologies and eventually give rise to disparities in health and health care access. Scientists at the frontiers of invention do not see it as their responsibility to address even the most obvious equity issues, such as whose illnesses are targeted for intervention or when money should be directed from high-cost individualized treatment to lower-cost public health interventions. As technologies come to market without prior collective assessment of their distributive implications, it is the potential users of those technologies who will have to confront these questions. Limiting early deliberation to narrowly technical constructions of risk permits science to define the harms and benefits of interest, leaving little opportunity for publics to deliberate on which imaginations need widening, and which patterns of winning and losing must be brought into view.

## Trust

The leaders of the research community recognize that trust is essential in securing public support for any recommendations on how to handle CRISPR, including rules for the manipulation of germline cells. The NAS-NAM proposal seeks to build trust on three levels: (1) by invoking the National Academies’, and more generally science’s, prior achievements in consensus-building; (2) by reaching out to stakeholders in accordance with principles of pluralist democracy; and (3) by constructing a multilayered institutional structure for decision making. In important ways, however, these proposals misremember history, misconceive the role of participation, and misunderstand the relationship between expertise and democracy.

Looking back on the history of rDNA policy, it is crucial to remember that public trust was not cemented at Asilomar. It took years, even decades, to build anything like a consensus on how genetic and genomic developments affecting biomedicine should be governed, even in the United States. Indeed, many would say that trust-building is still a work in progress. Democratic demands soon forced the scientific community to open up its deliberations on rDNA to a wider public than had been invited to Asilomar. Publics and policymakers responded to Asilomar with skepticism for

having neglected their concerns. As Senator Edward M. Kennedy put it, the Asilomar scientists “were making public policy. And they were making it in private.” Not only were the recommendations produced by those who stood to gain the most from a permissive regime, but the conference failed to entertain questions that mattered most to the wider public. Facing the threat of legislation, the scientific community sought to appease such criticisms, for instance, by adding a handful of public interest representatives to the Recombinant DNA Advisory Committee (RAC) of the NIH. Whether such token representation had effects on policy remains questionable.

For many U.S. biomedical scientists, demonstration of successful self-regulation was a tactic for avoiding premature legislative intervention—and in this they were consistently and eminently successful. The absence of national legislation, however, is not a good measure of Asilomar’s success or, more broadly, of trust in science. Indeed, it has proved necessary to add layers of institutional oversight at critical junctures in the development of genetic sciences and technologies, showing that the *laissez faire* approach did not sufficiently produce trust. One of these occurred at the start of the Human Genome Project (HGP), when James Watson, the HGP’s first director, set aside funds for research on the ethical, legal, and social implications (ELSI) of research. Regardless how one draws up the balance sheet with respect to ELSI (and it is not straightforward), the point is that the program was conceived as a defensive move by big biology to demonstrate enough ethical and social responsibility to deserve public funding and the trust that such funding implies. As Watson himself explained, “My not forming a genome ethics program quickly might be falsely used as evidence that I was a closet eugenicist.”

Limiting risk to accidental releases of pathogens left untouched the economic, social, and political implications of biotechnology.

Similarly, debates around human embryonic stem cell (hESC) research at the turn of the century show that claims of self-regulation were not alone enough to satisfy public concerns and silence politics. U.S. biomedical science had to publicly demonstrate its commitment to ethical norms. The National Academies issued guidelines for work with stem cells, in conformity with the congressional mandate not to use public funds for deriving hESCs, but going well beyond that minimum requirement. These included a new layer of formal supervision, comprising (Embryonic) Stem Cell Research Oversight (SCRO or ESCRO) committees, established at each institution working with these potentially controversial materials. In practice, therefore, the price of avoiding congressional oversight was a new, more visible, display of self-regulation that stem cell scientists accepted to shore up their claim on public trust.

Challenges to trust and legitimacy, moreover, may resurface at any moment, as NIH learned in 2010-11 through a protracted, though ultimately unsuccessful, legal challenge to its authority to fund downstream research on lawfully derived stem cell lines. The point is not so much that federally funded stem cell research survived the attack. It is that, in a robust, decentralized democracy, there is no one-shot silver bullet for building trust. Political power, as every citizen knows, demands continual regeneration at the polls and elsewhere to maintain its legitimacy. Trust in science is just as fragile and just as much in need of regeneration when science, in effect, takes on the tasks of governance by shaping society’s visions of the future. Decades of experience with the genetic revolution make it clear that narrowing the debatable questions, as at Asilomar, is not a strategy for maintaining trust over the long haul or for living up to the forms of responsibility that democracy rightfully demands from science.

## **Provisionality**

Revolutionary moments do not reveal the future with map-like clarity. Far more, they are moments of provisionality, in which new horizons and previously foreclosed pathways become visible. The challenge for democracy and governance is to confront the unscripted future presented by technological advances and to guide it in ways that synchronize with democratically articulated

visions of the good. This demands thoughtful conversations about alternatives for as long as it takes to build new norms for the new futures in view. Conversations are compromised if they are limited to narrow constructions of near-term risk, thereby foreclosing opportunities to build such norms.

Worldwide controversies about the limits of genetic modification, whether in agriculture or biomedicine, signal that Asilomar's framing of the risks, the stakes, and the scope of deliberation was too narrow to encompass the wide range of ethical, legal, and social issues that accompany a scientific revolution and the forms of collective deliberation they demand. The history of half-measures and repeated eruptions of public distrust around rDNA reveals weaknesses in the NAS-NAM conception of an expert summit as the right instrument of democratic deliberation on gene editing. The very notion of a summit suggests that a view from the mountaintop will provide an authoritative image of the lay of the land, to be charted once and for all through ethics or regulation. Past experiences indicate, however, that good deliberative processes need to be recursive as well as inclusive. The initial framing of an issue shapes the analysis of alternatives, whether scientific, ethical, or political. This is one reason inclusivity at the agenda-setting table is so valuable: it helps to ensure that important perspectives are not left out at the start, only to surface after possibly unjust judgments and decisions have been taken.

The Asilomar meeting on rDNA framed the risks to society in terms of physical hazards to people and, to a limited extent, ecosystems. The solution provided was equally narrow: four levels of physical and three of biological containment of engineered organisms. But as noted above, limiting risk to accidental releases of pathogens left untouched the economic, social, and political implications of biotechnology, and consensus has not yet been achieved on those initially excluded issues. By treating risks as resolvable by technical experts and the responsibilities of governance as settled, Asilomar failed to recognize the virtues of social ambivalence as a resource for building and rebuilding solidarity between science and society by continually rearticulating norms and aspirations to guide an unfolding technological future.

Many experiments have been tried in recent years to involve publics in deliberating on emerging sciences and technologies before their course is set in stone. These "public engagement" exercises include focus groups, citizen juries, consensus panels, public consultations, and technology assessment processes. Initially such efforts presumed that the main reason for public hostility to technological innovation was lack of information. Although public engagement efforts have grown more sophisticated, they remain one-shot consultations whose agenda and terms of debate are still narrowly defined.

Approaching public engagement in this manner misses the point that living well with technology involves more than reacting to information about it. Changes in social interactions and relationships with technology are unpredictable and emerge only through long-term experiences in varied settings. The stakes cannot be accessed, let alone addressed, in highly scripted deliberations that "engage" a limited range of citizens in terms that are defined in advance. Though such exercises purport to satisfy the need for public engagement, they fail to reach the poor, the marginal, and the socially excluded in meaningful ways. They afford little opportunity for the emergence of dissenting voices and perspectives that challenge experts' imaginations. Consequently, they are more likely to perpetuate than correct Asilomar's legacy of exclusion. They are, at best, ineffectual in assessing ambivalence and doubt, and still worse at inviting sustained deliberation on humanity's collective ownership of its technological future.

A 1996 report of the National Research Council proposed an alternative approach to understanding risk that would build in mechanisms for taking the provisionality of people's judgments into account. This was the analytic-deliberative model, a recursive decision-making paradigm aimed at revisiting early framing choices in light of later experience. In this model, the movement from fact-finding to incorporating value judgments is not linear, as in the conventional risk assessment-risk management approach. Instead, the analytic-deliberative model presumes that, in democracies, the process of understanding risk requires constant revisiting, through deliberation, of the risks framed

and the questions asked. Reframed questions in turn lay the ground for meaningful further analysis and keep publics engaged in the process of governance.

Ongoing debates on privacy and civility in the era of digital communication and social media illustrate this need to revisit apparently settled issues in light of lived experience. Facebook users only gradually discovered the need to filter their postings so that messages intended for friends would not be unintentionally disclosed to parents or prospective employers. Twitter users learned the devastating effects of casual messaging and careless jokes only after many episodes of such postings going destructively viral. In a celebrated and still not fully resolved development, European law has diverged from that of the United States in asking Google and other Internet search engines to remove links to excessive or irrelevant information. This controversial “right to be forgotten” emerged only after 20 years of rising information traffic on the Internet. Users could not have foreseen the potentially perverse consequences of a permanent digital memory bank, recording the most trivial aspects of daily lives, when they discovered the informational wealth of the Internet in the 1990s.

Provisionality in the face of new technologies includes, at the limit, the choice to say no to particular visions of progress. In 2011, Germany’s national Ethics Council issued a report on preimplantation genetic diagnosis (PGD) with a substantial minority of 11 members recommending that the procedure should not be permitted in Germany under any circumstances. Even the 13-member majority, followed by the German Parliament, only approved PGD under highly restrictive conditions, including prior ethical review and informed consent by the mother-to-be. These arguments and actions deserve attention as an affirmation that technology’s unimpeded progress is not the only collective good recognized by free societies: as the minority opinion stated, “an enlightened and emancipated relationship to technology is the decision not to use it if it violates fundamental norms or rights.” A regime of assessment that forecloses in advance the very possibility of rendering such enlightened and emancipated judgments opens the way to a politics of dissent and frustration rather than to shared democratic custodianship of the technological future. Perhaps this is Asilomar’s true legacy.

## **Coming down from the summit**

CRISPR-Cas9 offers, at first sight, a technological turn that seems too good for humankind to refuse. It is a quick, cheap, and surprisingly precise way to get at nature’s genetic mistakes and make sure that the accidentally afflicted will get a fair deal, with medical interventions specifically tailored to their conditions. Not surprisingly, these are exhilarating prospects for science and they bring promises of salvation to patients suffering from incurable conditions. But excitement should not overwhelm society’s need to deliberate well on intervening into some of nature’s most basic functions. That deliberation, in our view, demands a more sophisticated model than “Asilomar-in-memory,” a flawed and simplistic approach to evaluating alternative technological futures in a global society.

Summitry organized by science, in particular, needs to be handled with care. Such events, as we have seen, start with the almost unquestionable presumptions that scientists should “push research to its limits,” and that risks worth considering are typically reduced to those foreseeable by science. Physical and biological risks therefore receive more attention than risks to social relationships or cultural values. Such narrowing is inconsistent with democratic ideals and has proved counterproductive in societal debates about genetic engineering. The planned NAS-NAM event would better serve science and society by moving down from the “summit” to engage with wider, more inclusive framings of what is at stake. Good governance depends on visions of progress that are collectively defined, drawing on the full richness of the democratic imagination. Opportunities for deliberation should not be reduced, in our view, to choreographed conversations on issues experts have predetermined to warrant debate. Confining public engagement exercises to such constrained parameters too easily presumes that the entry card for engendering deliberative



democracy is speaking the right language, that of scientific rationality.

In the musical *My Fair Lady*, based on George Bernard Shaw's *Pygmalion*, Eliza Doolittle, a Cockney flower girl, takes speech lessons from Professor Henry Higgins, a phoneticist, so that she may pass as a lady. Having transformed Eliza, the professor wishes to control not just how she speaks, but how she thinks. The authors of the NAS-NAM proposal run the risk of acting like Henry Higginses of CRISPR democracy. Having taught the Eliza Doolittles of the world how to articulate their concerns properly, they may be inclined to think that judgment should follow suit, because right language must lead to right reason about the need for research. Yet, the audience's sympathy rests with Eliza, not Henry, when he sings, "Why can't a woman be like me?" The rarefied reasons of science are essential to any good deliberation on gene editing, but it is to be hoped that the deliberative processes we design will be expansive enough to let the unbridled Cockney in the rest of humanity also sing and speak.

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#### *Recommended reading*

David Baltimore, et al., "A prudent path forward for genomic engineering and germline gene modification," *Science* 348 (2015): 36-38.

Paul Berg, "Meetings that changed the world: Asilomar 1975: DNA modification secured." *Nature* 455 (2008): 290-291.

German Ethics Council (GEC), *Preimplantation Genetic Diagnosis (Präimplantationsdiagnostik)* (Berlin: Deutscher Ethikrat, 2012 [2011]).

J. Benjamin Hurlbut, "Remembering the Future: Science, Law and the Legacy of Asilomar," in *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, edited by Sheila Jasanoff and Sang-Hyun Kim (Chicago: University of Chicago Press, 2015).

Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton, NJ: Princeton University Press, 2005).

Sheila Jasanoff, ed., *Reframing Rights: Bioconstitutionalism in the Genetic Age* (Cambridge, MA: MIT Press, 2011).

Gene Rowe and Lynn J. Frewer, "A Typology of Public Engagement Mechanisms," *Science, Technology & Human Values* 30, no. 2 (April 1, 2005): 251-90.

Paul C. Stern and Harvey V. Fineberg, ed., *Understanding Risk: Informing Decisions in a Democratic Society* (Washington, DC: National Academies Press, 1996).

Judith P. Swazey, James R. Sorenson, and Cynthia B. Wong, "Risks and Benefits, Rights and Responsibilities: A History of the Recombinant DNA Research Controversy." *Southern California Law Review* 51, no. 6 (1978): 1019-1078.

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