Precaution and governance of emerging technologies

Precaution can be consistent with support of science

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Precautionary approaches to governance of emerging technology call for constraints on the use of technology whose outcomes include potential harms and are characterized by high levels of complexity and uncertainty. Although articulated in a variety of ways, proponents of precaution often argue that its essential feature is to require more evaluation of a technology before it is put to use, which increases the burden of proof that its overall effect is likely to be beneficial. Critics argue that precaution reflects irrational fears of unproven risks—“risk panics” (1)—and would paralyze development and use of beneficial new technologies (1, 2). Advocates give credence to this view when they suggest that precaution leads necessarily to moratoria (3). Progress in the debate over precaution is possible if we can reject the common assumption that precaution can be explained by a simple high-level principle and accept instead that what it requires must be worked out in particular contexts. The 2016 report from the U.S. National Academies of Science, Engineering, and Medicine (NASEM) on gene drive research (4) illustrates this position. The report shows both that precaution cannot be rejected out of hand as scaremongering and that meaningful precaution can be consistent with support for science.

Gene drives are a form of preferential inheritance that occur naturally and can be constructed in the laboratory using new genetic editing tools such as CRISPR-Cas9. Constructed drives could be used to alter, reduce, or eliminate populations of organisms in the environment; in principle, an entire species could be modified. Gene drives have considerable potential benefit, especially in the control of vector-borne diseases and the protection and restoration of environments threatened by nonindigenous organisms. Gene drives also might have harmful effects, especially to the environment. A drive designed to eliminate a non-native mouse population from an island to protect native species might pose threats to related species, to populations of the mouse elsewhere in the world, or to other species on the island that depend on the mouse population. The range of effects due to hybridization, geographic dispersal, and predator-prey interactions, for example, would need to be studied and the probabilities quantified. These are a few possible harms for one hypothetical use; given the present state of knowledge for gene drives, the outcomes and their probabilities are not yet well understood.

INTERPRETING PRECAUTION

At least four common objections to precaution underlie critics’ claims that precaution is irrational and paralyzing. First, precaution is said to be too vague and ambiguous to provide useful guidance. In response, some advocates hold that precaution is not meant to provide a decision-making algorithm that is able to identify appropriate precautionary measures for each and every technology. Precaution is better described at a high level not as a principle but as an attitude or approach that consists in sharpening or broadening the scrutiny of a proposed project (5, 6). Deciding whether precautionary measures are appropriate, and then determining what they are, depends on examining details of the technology and its potential impacts (2).

The NASEM report demonstrates this contextual approach to precaution. It starts from an understanding of the science, how the science might be used, and downstream effects of attempts to use it. Some general potential benefits and harms can be easily identified, but prospective uses involve multiple complex systems—genomic, environmental, and social—that add layers of uncertainty. For a given proposed gene drive, we may be uncertain about the probability of outcomes but also about how outcomes should be described and valued and about what all the possible outcomes are. The latter kinds of uncertainty can be distinguished from uncertainty about probability by referring to them as issues of ambiguity and ignorance (6).

The potential benefits of research on gene drives make prohibiting the research unjustifiable. The potential harms and uncertainties make a too-quick commitment to those uses unacceptable. The report therefore recommends research under four broad constraints:
SCIENCE AND VALUES

A fourth common objection to precaution, implicit in the idea of a risk panic (7), is that precaution is grounded on emotion—fear of the unknown—rather than reason. This objection is not wholly mistaken. Risk panics might explain some precautionary policy positions. We should, however, seek input from a wide range of stakeholders, and although the values that stakeholders embrace should be subject to the critical examination of public deliberation, we should be wary at the outset about rejecting some as less rational than others (10, 11).

There is another possible emotional response to new technologies: instead of a risk panic, an “innovation thrill.” As Oppenheimer said, “When you see something that is technically sweet, you go ahead and do it and you argue about what to do about it only after you have had your technical success” (12). Although the primary rationale for releasing a gene drive would be human or environmental benefit, the thrill of understanding and engineering biological systems would be part of the motivation to undertake the basic science. That thrill could also generate an impulse to move the science from the laboratory to the field. The NASEM report aims to counteract that impulse. An innovation thrill is no better than a risk panic as a basis for policy on when and how to use gene drives.

REFERENCES AND NOTES


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