Valuing Knowledge: a Reply to the Epistemological Perspective on the Value of Gain-of-Function Experiments

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The central ethical claim of Casadevall et al. in "An Epistemological Perspective on the Value of Gain-of-Function Experiments Involving Pathogens with Pandemic Potential" (1) is that, when conducting risk-benefit analyses on studies that use gain-of-function (GOF) methods to create potential pandemic pathogens (PPP), we ought to explicitly account for the value of the "epistemic gains" of the experiment. That is, the value of knowledge derived from GOF/PPP studies is informed by its contribution to the body of microbiological knowledge amassed in recent years. They conclude from this (1) that

> when one does a risk-benefit analysis of this issue, the epistemic gain from GOF experiments should be included in the bookkeeping: if one does that, the benefits of GOF experiments are potentially so great as to warrant our risking more than we otherwise might.

Unfortunately, the authors devote the majority of their paper to expounding on the epistemic merits of two paradigm GOF/PPP studies published in 2012 (2, 3) and on the general merits of GOF studies; they spend comparatively little time, however, on identifying the sense in which "epistemic gain" might be valuable in the context of decision making. Put another way, the authors spend little time on determining how gains in scientific knowledge, individually and collectively, should be understood to be valuable.

There is little doubt that there is epistemic value in GOF studies and other research posing a "dual-use dilemma." In point of fact, the epistemic gains posed by dual-use research are a strong contributor to the "dilemma" that we face; it is uncontroversial that scientific knowledge has value (4, 5). What is in question, however, is how we account for the significance of this value; how scientific knowledge relates to other important values; and how we weigh the value of epistemic gains against competing considerations, such as the risks posed by the accidental or intentional release of virulent pathogens.

There are four ways in which epistemic value might be conceived: (i) for its own sake, (ii) as it contributes to some body of (valuable) knowledge, (iii) as it contributes to the well-being of the knowers, or (iv) as instrumental to other important gains (e.g., human health). It is the second sense—epistemic value in terms of a contribution to a body of knowledge—on which the central argument of Casadevall et al. rests. However, this simply passes the buck on value; we now have to ask what is valuable about a body of knowledge. Much like instances of knowledge, bodies of knowledge are valuable for their own sake (as they contribute to the well-being of the knowers) and for instrumental reasons. (Bodies of knowledge can, of course, be valuable to other bodies of knowledge. I will not discuss this further; at some point, proponents of the value of knowledge either have to settle on one of the three other options, or commit themselves to a potentially endless chain of instrumental reasoning with no end in sight.)

Arguing that bodies of knowledge are valuable for their own sake says nothing about how we ought to weigh this value against other considerations. Even less clear is how we account for the marginal increases in value—of knowledge for its own sake—that we receive from GOP/PPP experiments. One inroad we can make, however, is that not all contributions are born equal. One of the claims of Lipsitch and Galvani's recent paper (6) is that PPP/GOF experiments do not provide information that allows us to reliably predict complex phenotypes. What is valuable is certainty in addressing important problems in a body of knowledge; mere certainty will not suffice. It has been argued, at length, that the specific subset of GOF/PPP studies does not achieve this end.

Knowledge, including the building of a robust body of knowledge, may be valuable as a component of our well-being (7, 8). That is, we are better off, all other things being equal, when we possess greater knowledge about the world. Things, however, are not always equal; moreover, on this account, the value of a body of knowledge is as much a factor of the number of knowers as it is a factor of epistemic merits. Questions of weighing knowledge against risk, then, are influenced by how many people know (and, presumably, understand) the results and significance of PPP/GOF experiments.

This has implications for science communication, science journalism, and science education that are too complex to enter into here. However, it is safe to say that if the value of knowledge is a function of the number of knowers, we have a lot of work to do. The disparity between the education of citizens and our rate of scientific advance is severe and widespread.

Finally, knowledge may be valuable because it leads to other, nonepistemic outcomes of value. Casadevall et al. (1) acknowledge and to an extent rest the value of GOF/PPP results on this:

> The emphasis on causation led to the identification of numerous microbes as etiological agents for specific disease, and these causative associations allowed humanity to control many infectious diseases through improved sanitation, vaccination, and eventual antimicrobial drug discovery. For example, such experimental rigor led to the rapid association of HIV with AIDS within 3 years after the report of a new deadly clinical syndrome.

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They link—historically, epistemologically, and normatively—causation in disease to the normative standards of microbiology. It is important to remember that their praise of these normative standards extends not just to the value of the knowledge for its own sake but to what we may one day do with this knowledge.

There is value in establishing causation, and the life sciences have produced incredible advances in human health and welfare. However, appeals to the value of "control[ling] infectious diseases" are instrumental relations, where the value of research derives from some other outcome. It would be a mistake to assume that the epistemic merits of GOF/PPP research add to the value of controlling infectious disease, rather than being instrumental in achieving that ultimate end.

The debate about PPP/GOF research often runs into this issue of "double counting" value, where the value derived from some outcome (human health) is also used to argue for the fundamental value of something that helps us achieve that outcome (scientific experiments). If it is human health that matters, then scientific research that helps us achieve human health facilitates our ends, but does not make our ends more valuable. Science is not merely a means to health, but its value as a tool in promoting health is captured by the value of health itself, and is not in addition to the value of health.

No one, I suspect, denies that scientific knowledge has value. What this debate turns on is how we value scientific knowledge and how we balance this value against competing considerations.

As a final note, while "an unaware public is often put at risk. . .as with research involving radioactive substances, where accidental release of radiation outside the laboratory is often a possibility" (1), mitigation of those risks is not always the purview of the field responsible for generating the risk in the first place. When it comes to the legacy of nuclear science, it is significant that the impact of the Trinity test on cancer rates in New Mexico is only now being studied, almost 70 years after the fact (9). Humans frequently fail to conduct risk-benefit assessments openly, or in a timely fashion. In biology's century, we ought to strive to do better.

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