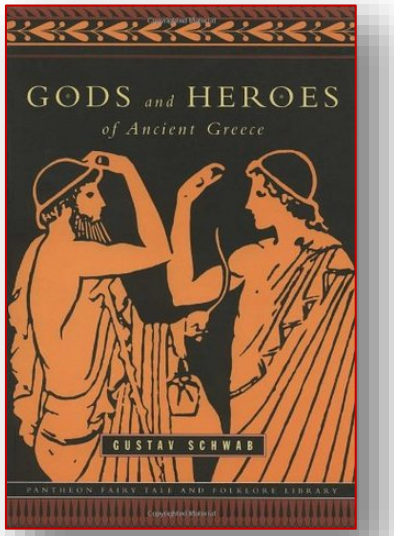
FROM GMOS TO CHIMERAS: UNDERSTANDING SCIENCE-SOCIETY INTERFACES

Dietram A. Scheufele

Taylor-Bascom Chair, and
Vilas Distinguished Achievement Professor
University of Wisconsin—Madison, and
Morgridge Institute for Research

@scheufele

TODAY… AN OVERVIEW



- From communication to engagement
- Words that matter: communicating science effectively
- The need for public engagement: Science as a necessary but not sufficient condition for good policy

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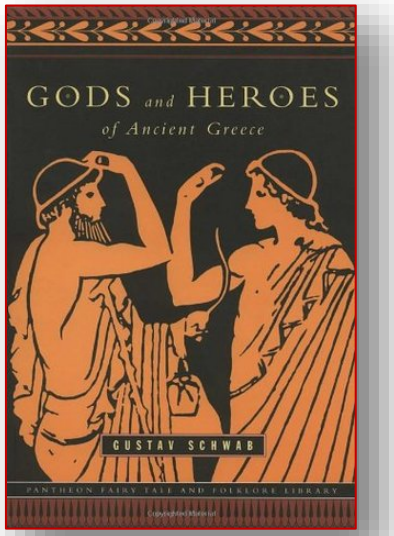

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WHY ENGAGE WITH PUBLICS ON EMERGING SCIENCE?

GOALS

Avoid potential controversy

Educate the public

Build democratic capacity through deliberation

Widen representation of voices

Solicit input on value debates

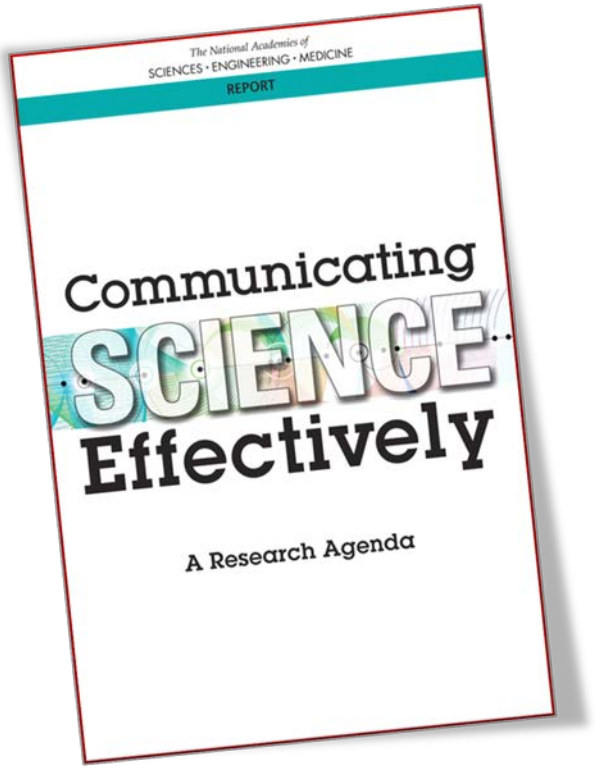
Enable responsible innovation

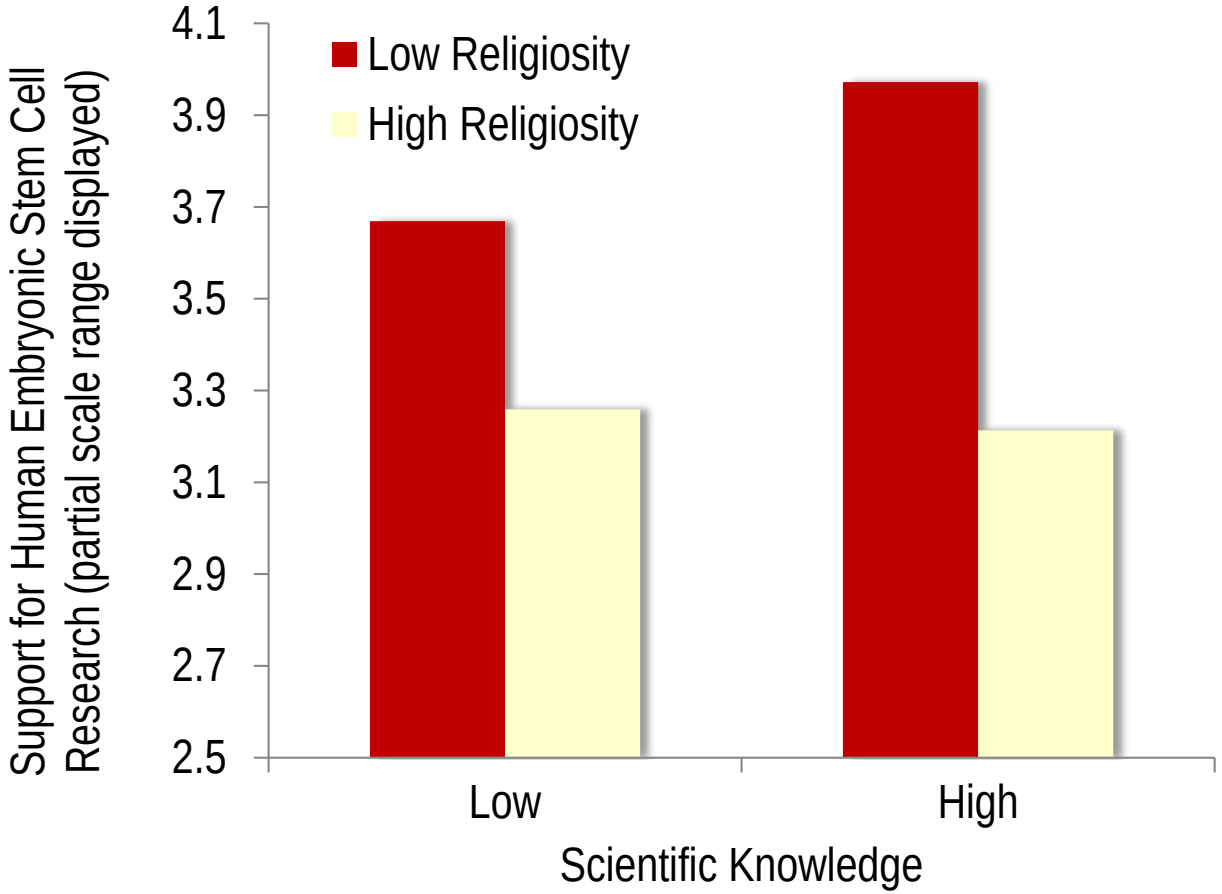
Shape policy

PRINCIPLES

Scheufele, D. A., Krause, N., Freiling, I., & Brossard, B. (in press). What we know about effective public engagement on CRISPR and beyond. *Proceedings of the National Academy of Sciences.*

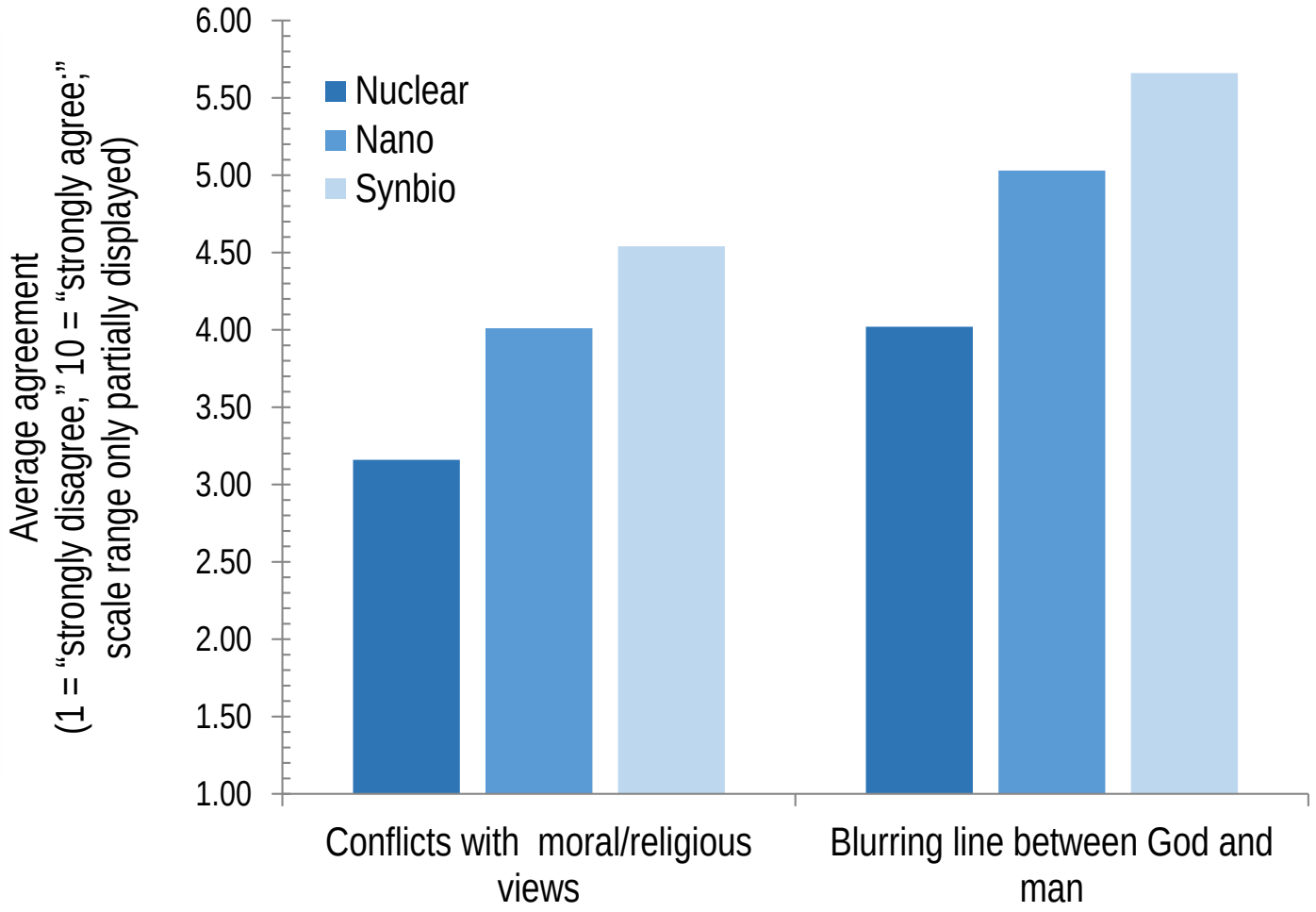
A REMINDER, FOR CONTROVERSIAL SCIENCE, LITERACY OFTEN DOESN'T TRANSLATE INTO PRO-SCIENCE ATTITUDES





Ho, S. S., Brossard, D., & Scheufele, D. A. (2008). Effects of value predispositions, mass media use, and knowledge on public attitudes toward embryonic stem cell research. *International Journal of Public Opinion Research, 20*(2), 171-192.

MORE AND MORE TECHNOLOGIES SEEN THROUGH VALUE LENSES



Akin, H., Rose, K. M., Scheufele, D. A., Simis-Wilkinson, M., Brossard, D., Xenos, M. A., & Corley, E. A. (2017). Mapping the landscape of public attitudes on synthetic biology. *Bioscience, 67*(3), 290-300. doi:10.1093/biosci/biw171

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INTENTIONALLY OR NOT, THE SCIENTIFIC COMMUNITY OFTEN DOES NOT HELP ITS OWN CAUSE

Wealthier Nations Tend to Be Less Religious, But U.S. a Prominent Exception

lives (2011-2013)

Africa
Asia/Pacific
Europe

current international $)

pita and the percentage saying that religion plays
ng 2011; U.S., Japan % data from spring 2012.
capita (PPP) from IMF World Economic Outlook

PEW RESEARCH CENTER

Neil deGrasse Tyson ✓
@neiltyson
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On this day long ago, a child was born
by age 30, would transform the world.
Birthday Isaac Newton b. Dec 25, 1642

9:38 AM - 25 Dec 2

77,781 Retweets 8

2.5K 7

Michael E. Mann ✓
@MichaelEMann

This is why nobody with an "R
name is safe to have in congre

Jonathan Cohn ✓ @CitizenCohn
Murkowski says health care won't stop her from voting fo
huffingtonpost.com/entry/lisa-mur...

8:47 AM - 22 Nov 2017

54 Retweets **136** Likes

5 54 136

Richard Dawkins ✓
@RichardDawkins
Follow

With respect to those meanings of "human" that are relevant to the morality of abortion, any fetus is less human than an adult pig

4:42 AM - 13 Mar 2013

456 Retweets **246** Likes

205 456 246

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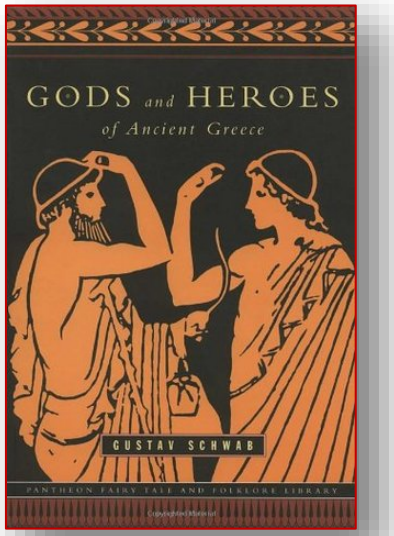

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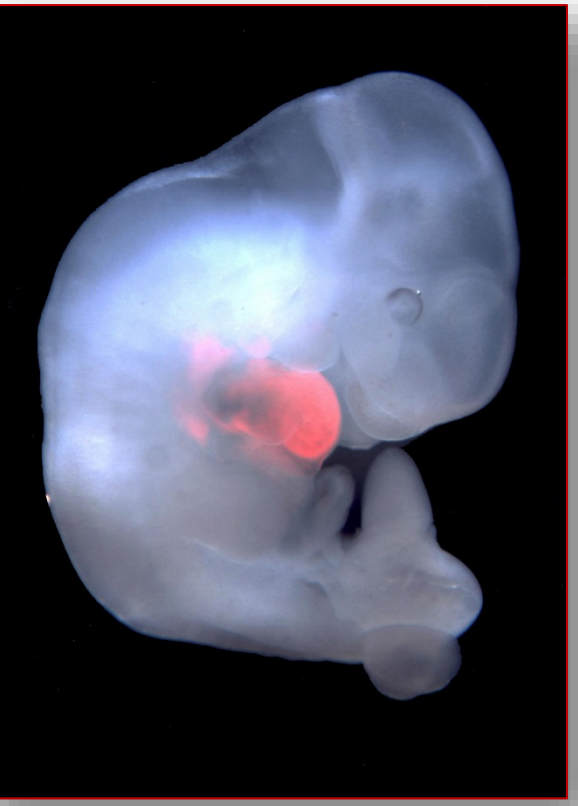
WHY LANGUAGE SETS OUR FRAMES OF REFERENCE

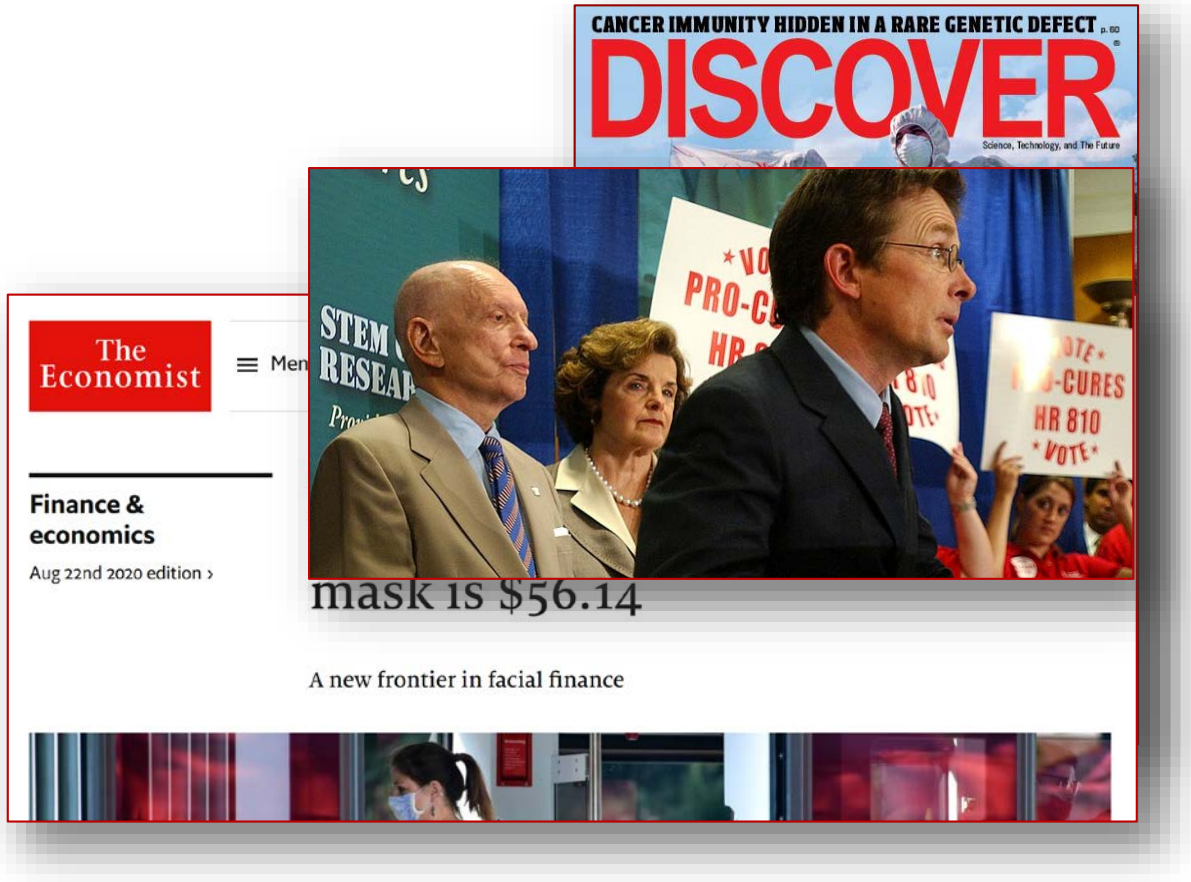


- Daniel Kahneman and Amos Tversky:
  "Perception [of ambiguous stimuli] is reference-dependent."

Scheufele, D. A. (2006). Messages and heuristics: How audiences form attitudes about emerging technologies. In J. Turney (Ed.), *Engaging science: Thoughts, deeds, analysis and action (pp. 20-25). London: The Wellcome Trust.*

FRAMING

Tewksbury, D., & Scheufele, D. A. (2009). News framing theory and research. In J. Bryant & M. B. Oliver (Eds.), Media effects: Advances in theory and research (3rd ed., pp. 17-33). Hillsdale, NJ: Erlbaum.



- Integral part of how we all process information
  - why we should pay attention
  - why new technologies are worth investment or risk (or not)
  - connect emerging science to what we know and what matters to us (values, beliefs, priorities, etc.)

LABELS MATTER FOR APPLICATIONS MORE SO THAN BASIC RESEARCH

Scheufele, D. A. (1999). Framing as a theory of media effects. *Journal of Communication, 49*(1), 103-122.

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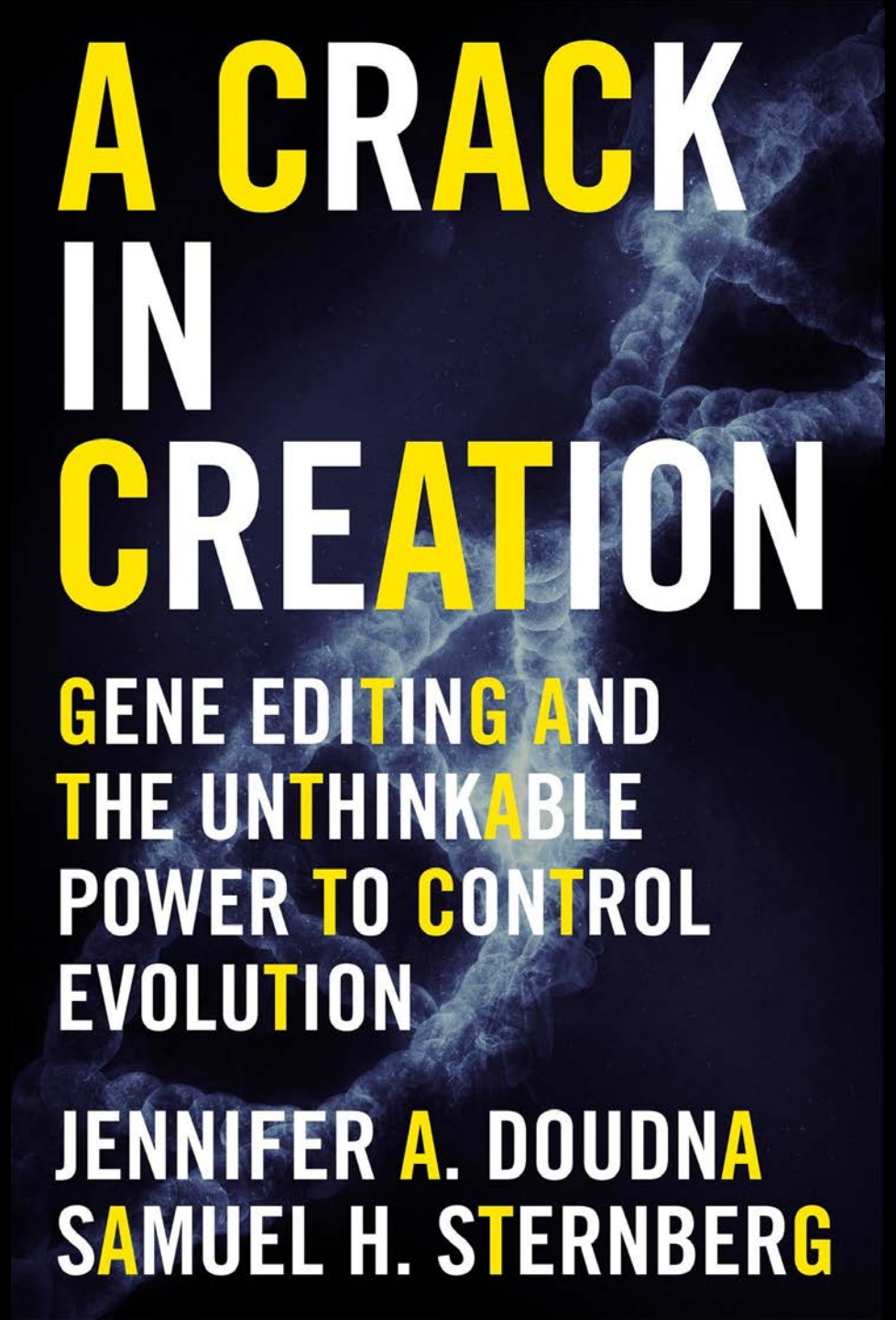
LANGUAGE IS SOMETHING TO THINK ABOUT EARLY IN THE R&D PROCESS

- Language matters ... early on
- Once a frame is established in public discourse, it's virtually impossible to change

- And sometimes we activate mental stories inadvertently …


A CRACK IN CREATION
GENE EDITING AND THE UNTHINKABLE POWER TO CONTROL EVOLUTION
JENNIFER A. DOUDNA
SAMUEL H. STERNBERG

FRAMES THAT CORRELATE WITH PUBLIC SUPPORT FOR SCIENCE

- *Social progress* ... improving quality of life, or solution to problems. Alternative interpretation as harmony with nature instead of mastery, "sustainability“

- *Economic development/competitiveness* ... economic investment, market benefits or risks; local, national, or global competitiveness

Nisbet, M. C., & Scheufele, D. A. (2007). The future public engagement. *Scientist, 21(10), 38-44.*

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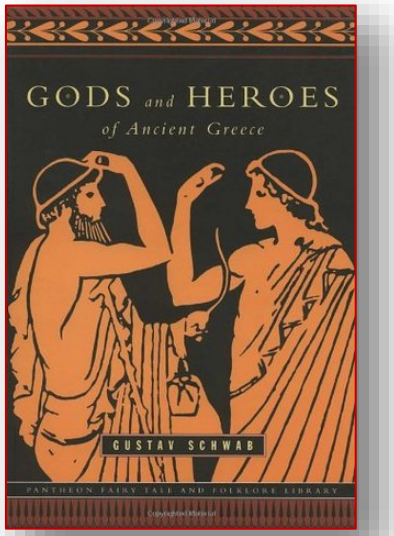

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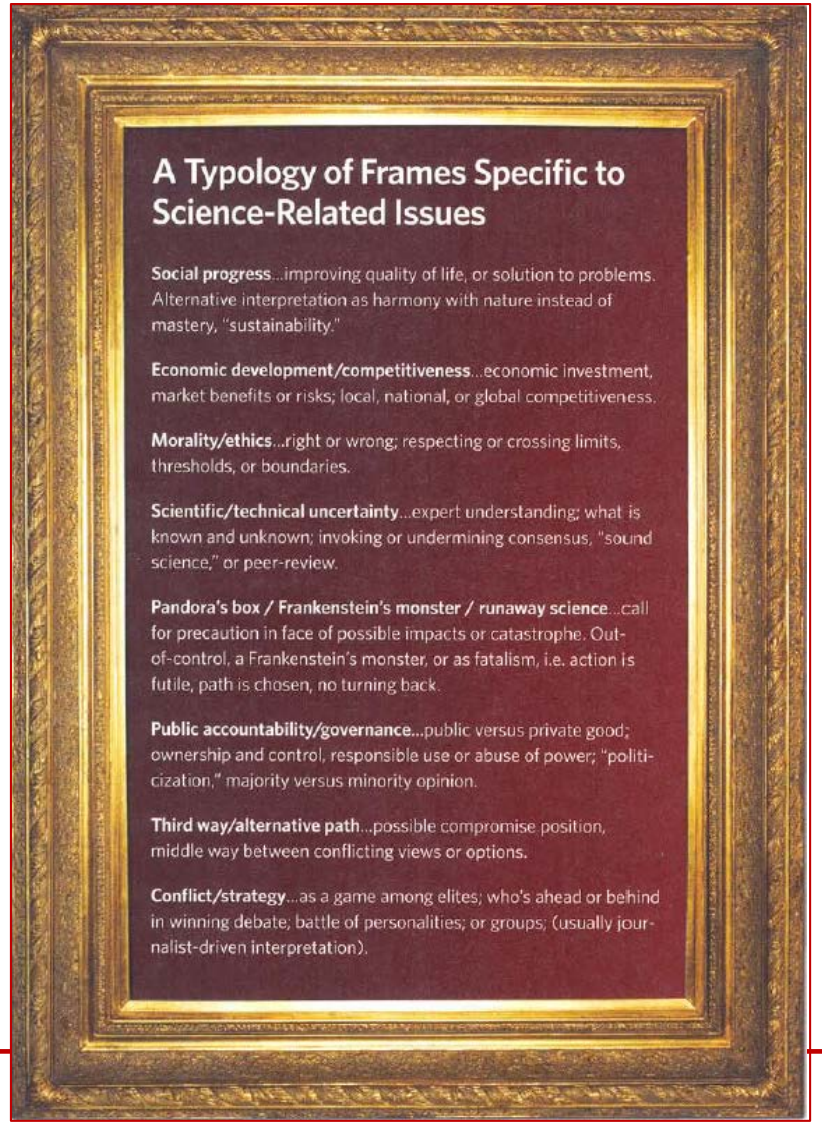
BUT OTHER FRAMES *WILL* (JUSTIFIABLY) EMERGE IN PUBLIC DISCOURSE



A Typology of Frames Specific to Science-Related Issues

Social progress...improving quality of life, or solution to problems. Alternative interpretation as harmony with nature instead of mastery, "sustainability."

Economic development/competitiveness...economic investment, market benefits or risks; local, national, or global competitiveness.

Morality/ethics...right or wrong; respecting or crossing limits, thresholds, or boundaries.

Scientific/technical uncertainty...expert understanding; what is known and unknown; invoking or undermining consensus, "sound science," or peer-review.

Pandora's box / Frankenstein's monster / runaway science...call for precaution in face of possible impacts or catastrophe. Out-of-control, a Frankenstein's monster, or as fatalism, i.e. action is futile, path is chosen, no turning back.

Public accountability/governance...public versus private good; ownership and control, responsible use or abuse of power; "politicization," majority versus minority opinion.

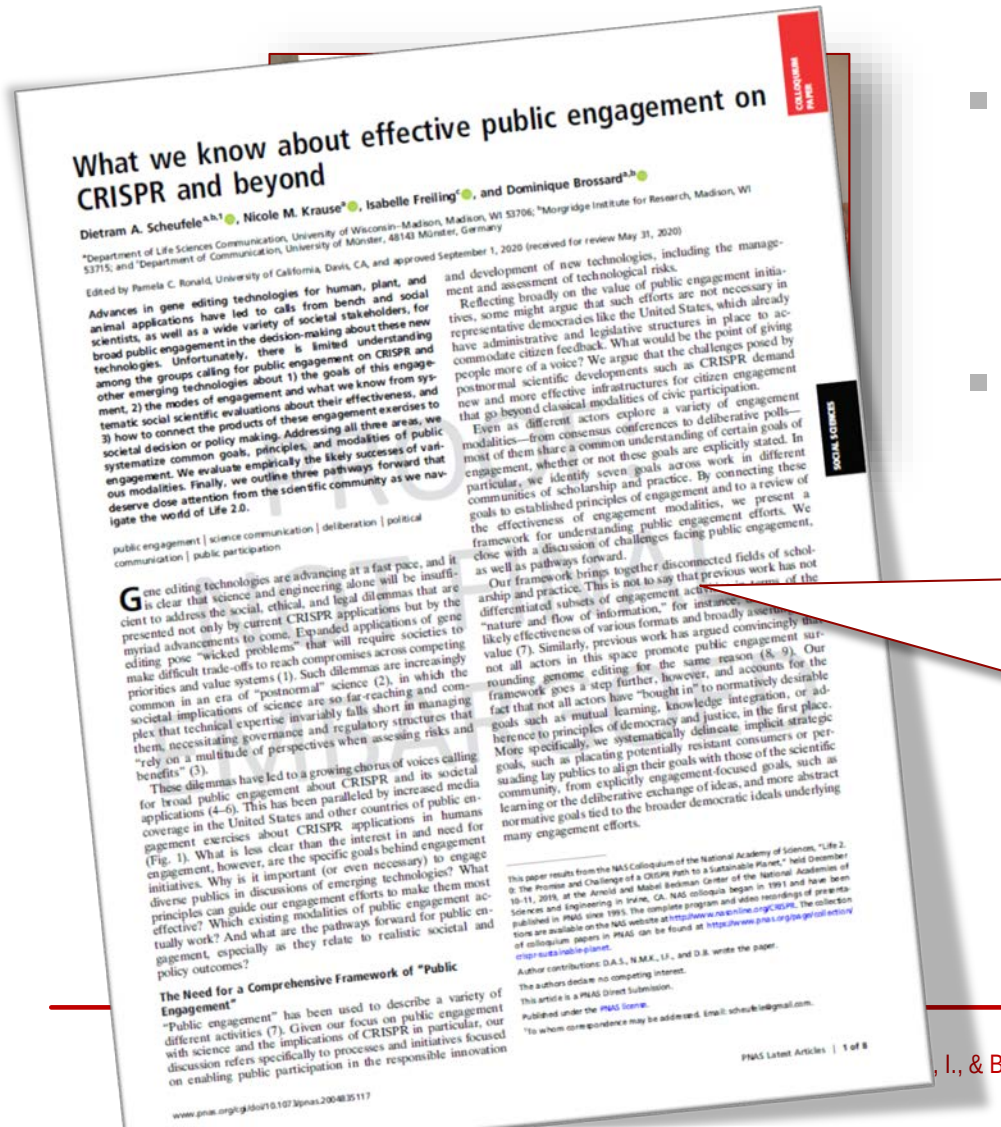
Third way/alternative path...possible compromise position, middle way between conflicting views or options.

Conflict/strategy...as a game among elites; who's ahead or behind in winning debate; battle of personalities; or groups; (usually journalist-driven interpretation).

- Morality / ethics / DEI
- Scientific/technical uncertainty
- Pandora's box / runaway science
- Public accountability / governance
- Third way / alternative path
- Conflict/strategy (usually journalist-driven interpretation)

Nisbet, M. C., & Scheufele, D. A. (2007). The future of public engagement. *Scientist, 21(10), 38-44.*

OUR VULNERABILITY: AN INADEQUATE CAPACITY FOR MEANIGFUL ENGAGEMENT



What we know about effective public engagement on CRISPR and beyond

Dietram A. Scheufele[a,b,1], Nicole M. Krause[a], Isabelle Freiling[c], and Dominique Brossard[a,b]

[a]Department of Life Sciences Communication, University of Wisconsin–Madison, Madison, WI 53706; [b]Morgridge Institute for Research, Madison, WI 53715; and [c]Department of Communication, University of Münster, 48143 Münster, Germany

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Advances in gene editing technologies for human, plant, and animal applications have led to calls from bench and social scientists, as well as a wide variety of societal stakeholders, for broad public engagement in the decision-making about these new technologies. Unfortunately, there is limited understanding among the groups calling for public engagement on CRISPR and other emerging technologies about 1) the goals of this engagement, 2) the modes of engagement and what we know from systematic social scientific evaluations about their effectiveness, and 3) how to connect the products of these engagement exercises to societal decision or policy making. Addressing all three areas, we systematize common goals, principles, and modalities of public engagement. We evaluate empirically the likely successes of various modalities. Finally, we outline three pathways forward that deserve close attention from the scientific community as we navigate the world of Life 2.0.

public engagement | science communication | deliberation | political communication | public participation

Gene editing technologies are advancing at a fast pace, and it is clear that science and engineering alone will be insufficient to address the social, ethical, and legal dilemmas that are presented not only by current CRISPR applications but by the myriad advancements to come. Expanded applications of gene editing pose "wicked problems" that will require societies to make difficult trade-offs to reach compromises across competing priorities and value systems (1). Such dilemmas are increasingly common in an era of "postnormal" science (2), in which the societal implications of science are so far-reaching and complex that technical expertise invariably falls short in managing them, necessitating governance and regulatory structures that "rely on a multitude of perspectives when assessing risks and benefits" (3).

These dilemmas have led to a growing chorus of voices calling for broad public engagement about CRISPR and its societal applications (4–6). This has been paralleled by increased media coverage in the United States and other countries of public engagement exercises about CRISPR applications in humans (Fig. 1). What is less clear than the interest in and need for engagement, however, are the specific goals behind engagement initiatives. Why is it important (or even necessary) to engage diverse publics in discussions of emerging technologies? What principles can guide our engagement efforts to make them most effective? Which existing modalities of public engagement actually work? And what are the pathways forward for public engagement, especially as they relate to realistic societal and policy outcomes?

The Need for a Comprehensive Framework of "Public Engagement"

"Public engagement" has been used to describe a variety of different activities (7). Given our focus on public engagement with science and the implications of CRISPR in particular, our discussion refers specifically to processes and initiatives focused on enabling public participation in the responsible innovation and development of new technologies, including the management and assessment of technological risks.

Reflecting broadly on the value of public engagement initiatives, some might argue that such efforts are not necessary in representative democracies like the United States, which already have administrative and legislative structures in place to accommodate citizen feedback. What would be the point of giving people more of a voice? We argue that the challenges posed by postnormal scientific developments such as CRISPR demand new and more effective infrastructures for citizen engagement that go beyond classical modalities of civic participation.

Even as different actors explore a variety of engagement modalities—from consensus conferences to deliberative polls—most of them share a common understanding of certain goals of engagement, whether or not these goals are explicitly stated. In particular, we identify seven goals across work in different communities of scholarship and practice. By connecting these goals to established principles of engagement and to a review of the effectiveness of engagement modalities, we present a framework for understanding public engagement efforts. We close with a discussion of challenges facing public engagement, as well as pathways forward.

Our framework brings together disconnected fields of scholarship and practice. This is not to say that previous work has not differentiated subsets of engagement activities [illegible] terms of the "nature and flow of information," for instance, [illegible] likely effectiveness of various formats and broadly assessed their value (7). Similarly, previous work has argued convincingly that not all actors in this space promote public engagement surrounding genome editing for the same reason (8, 9). Our framework goes a step further, however, and accounts for the fact that not all actors have "bought in" to normatively desirable goals such as mutual learning, knowledge integration, or adherence to principles of democracy and justice, in the first place. More specifically, we systematically delineate implicit strategic goals, such as placating potentially resistant consumers or persuading lay publics to align their goals with those of the scientific community, from explicitly engagement-focused goals, such as learning or the deliberative exchange of ideas, and more abstract normative goals tied to the broader democratic ideals underlying many engagement efforts.

This paper results from the NAS Colloquium of the National Academy of Sciences, "Life 2.0: The Promise and Challenge of a CRISPR Path to a Sustainable Planet," held December 10–11, 2019, at the Arnold and Mabel Beckman Center of the National Academies of Sciences and Engineering in Irvine, CA. NAS colloquia began in 1991 and have been published in PNAS since 1995. The complete program and video recordings of presentations are available on the NAS website at http://www.nasonline.org/CRISPR. The collection of colloquium papers in PNAS can be found at https://www.pnas.org/page/collection/crispr-sustainable-planet.

Author contributions: D.A.S., N.M.K., I.F., and D.B. wrote the paper.

The authors declare no competing interest.

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[1]To whom correspondence may be addressed. Email: scheufele@gmail.com.

www.pnas.org/cgi/doi/10.1073/pnas.2004835117

- Neither RAC nor NExTRAC are designed to have
  - necessary expertise, or
  - charge for meaningful public engagement
- What m
  - ava
  - inc

res for

> "Either way, future science policy should be informed at least as much by broad public engagement … as it is informed by the science itself."

, I., & Brossard, B. (in press). What we know about effective public engagement on CRISPR and beyond. *Proceedings of the National Academy of Sciences.*

THANK YOU

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