Chapter 6
Conclusion and Future Directions

Abstract In the preceding chapters, we have presented the need for a science of public engagement, the reasons we focused on feature-process-outcome connections relating to deliberative engagement, and the basis for our targeting nanotechnology/synthetic biology as the policy area concentration of our research. In this chapter, we briefly summarize what we have learned and offer some suggestions for future studies that will further advance the science of engagement and deliberation. We also encourage the interested reader to access our data and other supplemental files in order to conduct additional analyses of the data we collected.

Keywords Biology · Deliberation · Engagement features · Genomics · Nanotechnology · Public engagement · Science and technology innovations · Science of public engagement · Synthetic biology

Anticipated advances in science led to the macabre creation of life portrayed in the nineteenth-century novel by Mary Shelly, *Frankenstein*, and to the fantastical technological advances depicted in the television cartoon series "The Jetsons." These popular cultural representations illustrate how developments in science and technology both excite and frighten society, often evoking the public's interest in being involved in decisions about whether to permit, regulate, or squelch scientific and technological innovations. For example, the recent announcement of the long-awaited breakthrough in editing human genes to remedy genetic anomalies that lead to disease again raised the specter of designing babies and led to calls for public deliberation about these emerging technologies (e.g., Belluck, 2017).

As we noted in the first chapter, public engagements regarding science and technology innovations allow many in society to provide input about what is accept-

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able and what is not (e.g., Delgado, Kjølberg, & Wickson, 2011). Such public involvements also can infuse public values into technology development discussions and are essential for a healthy democracy (e.g., Rip & Robinson, 2013; Wilsdon & Willis, 2004). Public engagement with science can increase the public understanding, appreciation, and opportunity to argue for or against acceptance of emerging science and technology advances (e.g., Gastil, 2017). There is, therefore, great hope for the value of public engagement.

In contrast to the great hope for engagement, there is a dearth of science about engagement. As we have argued previously (PytlikZillig & Tomkins, 2011), simply deploying listening sessions or other types of engagement with the public may not suffice: It is essential to ascertain what is a successful engagement, what works to ensure successful engagements, in what contexts, and why. As noted in Chap. 1, and as underscored by our own unwillingness to offer a hard-and-fast definition, the concept of "public engagement" itself is ill-defined. Currently, public engagement encompasses everything from opinion surveys to information campaigns, to interactive museum exhibits, to citizen science, to voting behavior, and to deliberative discussion. The definition of "public" is also broad and wide ranging. Consider, for example, that public engagement through deliberation can involve dialogues among or between peers, policymakers, technologists, scientists, and many other stakeholders. Furthermore, engagement methods and terminology used to describe those methods within studies of public engagement are widely varied; numerous dimensions of public engagement have been proposed without much consensus on which dimensions are most important to future research agendas; potential differences and opportunities for engaging marginalized populations for the most part have not been the target of theory or extended empirical focus (but see Young, 2002); and current categories of public engagement effectiveness criteria do not easily lend themselves to suggesting theories that would advance understanding of how various forms of public engagement work for different purposes and aims.

Given all these challenges, whatever is an aspiring public engagement researcher to do? Our work provides but one example of an approach forward. For our research, we functionally operationalized our engagements as deliberations about a target (learning about and assessing nanotechnology/synthetic biology) using accessible and appropriately thorough written materials as part of a class to inform students' decision-making as part of specifically designed tasks (see Chap. 2). We hope in the future much of what we need to know about public engagements we will know because experimental methods and valid assessments reveal what works to ensure engagements are successful according to clear criteria, under what circumstances, and why.

We hope that a science of public engagement will answer questions that go beyond our current data, such as whether, when, and why:

Face-to-face encounters are or are not preferable to online engagements.

Written materials are or are not a more effective way of providing background information than a brief video.

Engagement discussions are or are not more productive in small groups than in town hall formats.

Bringing people together in the real, versus the virtual, world enhances certain outcomes and so on.

In our series of studies, we were guided by affective, cognitive, and behavioral psychology to try to better understand the impacts of different *features* of engagement: Specifically, we looked at aspects of cognitive engagement (critical thinking, information organization), characteristics of background information (pro versus con perspectives of the topic, stronger versus weaker information), whether there was discussion, and active versus passive facilitation of the discussions (Chap. 2). We examined these matters in the context of college students—future scientists!—learning about the intersection of nanotechnology and genomics as part of an introductory biology course.

This sample consisted of participants who are comparatively bright and motivated and from a Midwestern, public university, so they may not generalize precisely to others across the American population. We do not think our materials always "worked" as well as our materials have when we have engaged residents on city budgeting issues. That is, in the city budgeting engagement we had both objective and subjective indications that participants learned a great deal about the way a city's finances worked and increased their trust in government after they engaged city officials about budgeting matters (Herian, Hamm, Tomkins, & PytlikZillig, 2012; PytlikZillig, Tomkins, Herian, Hamm, & Abdel-Monem, 2012; Tomkins et al., 2012; Tomkins, PytlikZillig, Herian, Abdel-Monem, & Hamm, 2010). Yet the lessons we learned from students in a much more controlled, laboratory-like setting are important first steps for beginning to understand what to do (and what not to do), despite the limitations of our program of research.

For example, we found that *reading* information related to nanogenomics had a positive impact on both objective and subjective knowledge, but *discussing* the information with other students was not important for factual knowledge gain (Chap. 3). The ways in which information was presented to students also did not make a significant difference, nor did our prompts for critical thinking directly influence knowledge. How students engaged with the nanogenomic materials they were provided impacted subjective knowledge: Students felt they learned more when they were paying closer, more conscientious, attention, when actively and metacognitively engaged with the information they received, and when thinking imaginatively about the materials. Moreover, students who were prompted to think critically and be conscientious about the science information reported less close-mindedness about the nanoscience as well as positive engagement with the materials. As a result, we found that critical thinking did in fact impact subjective knowledge through these increases in positive engagement and decreases in negative engagement. In general, we can say that our deliberative engagements, on the whole, increased knowledge, but scholars should pay closer attention to how participants cognitively engage to realize substantive knowledge gains.

Although an outcome often hoped for by deliberative theorists is increased attitude consensus, a concern that deliberation might lead to attitude polarization has been claimed, most prominently by scholars such as Cass Sunstein (e.g., Sunstein, 2000, 2002). Our analyses of the data (Chap. 4) revealed some degree of attitude change across studies but rarely in a matter that suggested polarization or extremitization of attitudes. There was some evidence of differences in extremitization when

students engaged in critical thinking (versus when they did not), but these effects were not affected by whether the students engaged in discussions and usually suggested students became more *moderate* when encouraged to think critically. Further, when we manipulated the homogeneity of attitudes within groups during discussion, we did not find any differences in attitude change or extremitization in the aggregate, but we did find that this was somewhat dependent on individual-level openness. Specifically, we found some evidence that students low in openness were the most likely to exhibit extremitization in heterogeneous groups, and students' high in openness were the most likely to exhibit extremitization in homogeneous groups. Our conclusion, partly reflecting others (for a review, see Delli Carpini, Cook, & Jacobs, 2004), is that attitude change via deliberation is dependent on context as well as personality, but we did not detect evidence of polarization related to discussing the ethical and policy implications of nanoscience materials (see also Gastil, 2017; Gastil, Kahan, & Braman, 2006).

Finally, we examined the students' policy acceptance, even when government selects a policy that is inconsistent with their own preferences (Chap. 5). Again, we did not find our experimental manipulations had many direct effects on this important outcome nor did they directly moderate the relationships between policy preferences and acceptance/support. Nonetheless, sometimes our manipulations did impact potential mediators such as perceptions of the process and of the information used. These mediators and moderators ended up being important for advancing understanding of why our manipulations may not have had effects. For example, one robust finding was that critical thinking prompts led participants to perceive the information materials more negatively. Somewhat less robustly, critical thinking prompts also sometimes led to greater conscientious (careful, thorough) engagement. Interestingly, this suggests multiple competing processes can be evoked by one feature of engagement: prompting critical thinking during deliberation evokes both conscientious engagement and negative assessments of the information provided. Note that for people to accept policies they do not prefer, it is required that the typically strong relationships between policy preferences and acceptance be reduced. Our analyses found conscientious engagement tended to *strengthen* the relationship between policy preferences and acceptance, while negative assessments of the information materials were associated with *weaker* policy preference-acceptance relationships. This suggests the reason critical thinking prompts appeared to have no overall effect on the policy preference-acceptance relationship is because the prompts evoked both processes simultaneously. It also suggests that some of the features that engagement practitioners attempt to promote (conscientious thinking and high-quality information) are likely to increase preference-acceptance relationships, thereby making it more difficult rather than less difficult for those who dislike policies to accept them.

Through our multi-year research program, we learned that although it is possible to emulate some of the control features of laboratory science, the classroom does not necessarily emulate real-world deliberations environments (for a particularly interesting study of real-world deliberations, this in the legal system and the role of juries, see Gastil, Dees, Weiser, & Simmons, 2010). Research interests had to be subservient to the educational preferences, needs, and timings of the course

instructors, even if they were very flexible about our use of random assignment and the content of what we gave students. Students did receive participation grades for their involvement in our activities. They also could choose to withdraw their data from our analyses; however, the vast majority did not. Still, students distinguished between core course materials and the nanogenomic information we were providing them in recitation sections, and it was clear that nanogenomics was not as important to them as other biology they needed to know for the tests they were going to take. Nonetheless, we do think that there is promise in working with science teachers to learn about what works to increase engagement with science materials, to improve science communication to non-students, and especially to increase student interest in, skill for, and willingness to think through the ethical, legal, and social implications of the science they might practice and advance in the future.

In the future, the goals of deliberative engagements with science should be clearly articulated: Do we care about increases in science knowledge (Chap. 3), social conformity versus group polarization (Chap. 4), attitude change (Chap. 4), policy acceptance (Chap. 5), feelings of fairness and opportunities to be heard (Chap. 5), science-policy consensus, and so on? Which objectives should be prioritized, and why? What role should the reality of the costs involved in preparing and executing engagement activities play in decisions about their value for these outcomes?

As the numerous references in this book reflect, there is a lot of information already available and a lot of insights that already exist. Yet an overarching science of public engagement is not as well developed or coherent as the science of fairness or trust, or the science of attitude development and change, or the science of teaching and learning, or the science of various other pertinent elements of deliberative engagements (communication, decision-making, group processes, information sharing, and so on).

So, given where we are today, how do we get to a more developed science of engagement? We believe there is great promise in conducting theory-driven, experimental studies of public engagement utilizing randomized controls. We think that other social scientists can improve on what we did in our research. In our project, we focused on future scientists deliberating about nanotechnology and synthetic biology. Programs of research on these areas are still needed, as are other important areas of science and technology, such as workplace robotics and smart and connected communities, new genetic engineering tools such as CRISPR technology, and so on. We believe deliberations are also important for outcomes we did not investigate in our studies, such as understanding and promoting justice and clarifying values inherent in policy determinations of health care, education, finance and budgeting—really, virtually any public policy area.

For those who want to make use of our data set, we have provided our methods, materials, and measures, and substantial data as part of the supplemental materials. Additional analyses beyond those we have conducted certainly are warranted. We hope our materials will be useful for training of students and provide additional insights for public engagement researchers and practitioners. Much of our data also may contain insights we did not mine. Finally, we hope lessons from our research can enhance future studies of public engagement strategies used in different contexts and for varied purposes.

The most critical takeaway we can offer is to encourage social scientists to undertake theory-driven programs of systematic research on public engagement matters. We believe our colleagues will further develop what we have started. This seems especially salient in the current sociopolitical context. As the world's resources are increasingly depleted by an ever-growing human population, it is a near certainty that scarcity, unequal distributions of resources, and survival-relevant threats will increase the cognitive biases and psychological defenses used by key actors and the publics that follow them. This in turn will make a consensus around group efforts toward a sustainable future more and more difficult to obtain. Thus, it becomes increasingly important to promote the study of methods of public engagement (including the engagement of expert, lay, policymaking, and other publics) and to examine their impacts on outcomes such as learning (which can lead to informed decisions and attitudes), well-calibrated trust among parties involved in the decisions, polarization and conflict reduction, and willingness to accept policy decisions even when those decisions may not be personally optimal or preferred.

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