

Experiments in engagement: Designing public engagement with science and technology for capacity building

Public Understanding of Science

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pus.sagepub.com**Cynthia Selin**

Arizona State University, USA

Kelly Campbell Rawlings

University of Southern California, USA

Kathryn de Ridder-Vignone

Duke Energy Center for Innovation, USA

Jathan Sadowski and Carlo Altamirano Allende

Arizona State University, USA

Gretchen Gano

University of California, Berkeley, USA

Sarah R. Davies

University of Copenhagen, Denmark

David H. Guston

Arizona State University, USA

Abstract

Public engagement with science and technology is now widely used in science policy and communication. Touted as a means of enhancing democratic discussion of science and technology, analysis of public engagement with science and technology has shown that it is often weakly tied to scientific governance. In this article, we suggest that the notion of *capacity building* might be a way of reframing the democratic

Corresponding author:

Cynthia Selin, School for the Future of Innovation in Society, Arizona State University, PO Box 875603, Tempe, AZ 85287-5603, USA.

Email: Cynthia.selin@asu.edu

potential of public engagement with science and technology activities. Drawing on literatures from public policy and administration, we outline how public engagement with science and technology might build citizen capacity, before using the notion of capacity building to develop five principles for the design of public engagement with science and technology. We demonstrate the use of these principles through a discussion of the development and realization of the pilot for a large-scale public engagement with science and technology activity, the Futurescape City Tours, which was carried out in Arizona in 2012.

Keywords

capacity building, material deliberation, public engagement with science and technology

Introducing a recent special issue of this journal on “Public Engagement in Science,” Stilgoe et al. (2014) reflect on the past 20 years of research and experiments in public engagement with science and technology (PEST). While they have a “normative commitment to the idea of democratic science policy” (Stilgoe et al., 2014: 5) and see public engagement as part of this, the account they offer is certainly not straightforwardly celebratory. Like others, they seek to move beyond uncritical excitement regarding the possibilities of public engagement (see Delgado et al., 2011; Irwin et al., 2013; Kerr et al., 2007). They suggest that scholars of Science and Technology Studies (STS) support for engagement activities now needs to be “qualified” (Stilgoe et al., 2014: 11) and that there have been flaws in both practice and analytical foci.¹ For these authors, one key lacuna has been a relative lack of attention to the political contexts of engagement activities, including the institutions within which they are embedded.

To these concerns, we might add a number of others. First, much of the scholarly discussion around public engagement has assumed that the central aim is to inform science policy and scientific decision-making. Thus, for example, Stilgoe et al. (2014) explicitly tie interest in public engagement to broader concerns regarding scientific governance—noting that “impact on governance” (p. 6) has been a central theme within critiques of various engagement processes. Indeed, concern regarding the impact of dialogue processes and the degree to which they may be implicated in legitimacy seeking without accountability has been a key question within the literature (Bickerstaff et al., 2010; Hagendijk and Irwin, 2006; Jones, 2007; Thorpe and Gregory, 2010; Wynne, 2006). But this interest tends to diminish forms of public engagement that have weak, or non-existent, ties to scientific governance (Davies et al., 2009)—forms such as science cafes, festivals, informal dialogue events, or online discussion.² The implications of this oversight are two-fold. Imagining engagement as needing to be somehow related to decision-making and science governance ignores the ways that lay publics mostly engage in dialogue on science: ultimately, more people go to science cafes than participate in consensus conferences (Grand et al., 2009). By positing a rather straightforward connection between deliberation and policy decisions, the more complex and long-term ways that PEST, citizenship, and political effects may intertwine are ignored (Powell and Colin, 2009).

Second, discussion of organized public engagement has largely relied on an essentially disembodied model of communication, in which discourse and information flow are key. Drawing on traditions in deliberative theory in which the production of reasoned argument is central to the process of multi-partner engagement (Chambers, 2003; Cohen, 1989), analysis has tended to focus on the role of talk or institutional text in constituting engagement. Prior work has, for example, discussed how expertise or power is negotiated within the practice of dialogue events (Davies, 2013; Kerr et al., 2007), analyzed information flows in citizen engagement (Horlick-Jones et al., 2007), and interviewed dialogue practitioners about their understandings of best practices (Chilvers,

2008). There has been relatively little reflection on non-language-based aspects of engagement, such as the role of emotions, embodiment, aesthetics, spaces, or objects (see Davies, 2014; Halpern, 2014; Marres, 2012; Vignone, 2013). This lack is significant because engagement with scientific issues is affected not only by cognitive values but also by affective and behavioral notions (Lorenzoni and Hulme, 2009). Context and locally relevant knowledge similarly play an important role in the way actors interact and build trust in experts (Finlay and Leggett, 2001; Parks and Theobald, 2013).

Third, at least some engagement activities continue to mobilize rather static notions of public opinion. There has, in other words, often been a focus on the findings of PEST and the ways in which these do or do not represent public opinion, values, or positions (Lezaun and Soneryd, 2007). The emphasis has been either on an idealized model of deliberation, in which “idiotic,” blank slate publics develop opinions which are then viewed as permanent, actionable, and static (Lezaun and Soneryd, 2007), or on stakeholder dialogue, in which actors with fixed interests negotiate between these (Welp et al., 2006). Engagement practices are thus often shielded from being seen as *emergent* and *produced*—as sites in which both publics and their views on technology are contingent, mobile, and ultimately intertwined. Relatively, little attention has been paid to the “back stage” (Hilgartner, 2000) of PEST: the ways in which its design, publics, and findings are co-produced.

These lacunae form the backdrop to the following discussion. How can designers of PEST respond both to Stilgoe et al.’s call to attend to the contexts of engagement and to what we might call the necessary messiness of engagement that incorporates multiple forms of knowledge? In the following sections, we outline one possible path for doing so, focusing on the notion of *capacity building* as a framework for designing, and valuing, PEST. We first draw on literature from public administration and political science to explain the notion of citizen capacity building. We then merge this concept with contemporary debates in STS on public engagement to develop five design principles for PEST and illustrate these through the Futurescape City Tours (FCT) project run by the Center for Nanotechnology in Society (CNS) at Arizona State University (ASU), piloted in 2012. In doing so, we draw on data collected through informal, semi-structured interviews with participants, observations, and field notes by the six-member pilot research team, recorded transcripts of workshop sessions and project de-briefs with participants, and a post-tour online survey. To conclude, we return to the notion of capacity building to reflect on the ways in which it was enabled or constrained by this particular experiment in PEST.

Capacity building as an end in PEST

STS and PEST have dedicated considerable energy over the last decades to developing processes to include the public in decision-making around science and technology, with three primary rationales: an *instrumental* desire for a particular result or end state; a *substantive* argument that engagement will result in better outcomes; and a *normative* position that engagement is the right thing to do based on democratic norms and values (Delgado et al., 2011; Fiorino, 1990; Stirling, 2008). We argue that insights from other domains of scholarship, particularly the literature on public administration, can offer additional perspectives on the value of engaging publics. Below we outline some of the key themes in this literature and suggest how they might be mobilized in STS thinking on PEST.

Brodie et al. (2009) suggest that citizen engagement can offer (1) increased legitimacy and accountability of governmental institutions, (2) empowered communities and increased social cohesion, (3) more efficient and effective public services and policies, and (4) personal benefits to participants. There is no shortage of public administration literature discussing these rationales for

public participation, and most research, as in STS, has focused on the organizational-, policy-, or societal-level outcomes. Even so, there has been a growing awareness in recent years that achieving successful organizational-, policy-, or societal-level outcomes requires a focus on what Gaventa and Valderrama (1999) call an individual's "participatory skills." In this vein, a smaller literature focused on Brodie et al's fourth point seeks to identify the individual benefits for citizens of participation and to explore the ways in which citizens' capacities for participation can be strengthened. Within this literature, there has been increased recognition of and justification for *citizen capacity building* as a worthwhile end.

The works of Rawlings (2012) and Powell and Kleinman (2008) offer an integrated notion of citizen capacity that involves the skills, tools, and knowledge needed for participation in civic life. Rawlings (2012) conducts a comprehensive review and assessment of the literature from the fields of public administration, political science, and psychology to provide a thematic content analysis of the potential outcomes and effects that constitute civic capacity building. Capacities were grouped into three categories—intrapersonal, political, and civic—acknowledging that there is overlap among the capacities.

Intrapersonal capacities

Intrapersonal capacities involve a person's sense of self and critical understanding of their own identity in relation to others. The degree to which an individual has a clear understanding of his or her preferences, strengths, biases, and abilities can shape the quality and substance of public engagement experiences. According to Rawlings (2012), studies typically use measures of empathy, empowerment, critical awareness, personal development, and maturity as indicators of intrapersonal capacity (Battistoni, 1997; Cooke, 2000; Couto, 1998; Finkelstein, 2008; Halvorsen, 2003; Hurtado et al., 2002; Peterson et al., 2002; Ryfe, 2002; Zimmerman, 1995) (p. 324).

Political capacities

Political capacity involves the extent to which a person understands and can act upon political or public matters. Successful public engagement efforts depend upon participants who trust the process and are not only informed, but also willing, able, and motivated to engage. Drawing primarily from the political science literature, attitudes toward government and political efficacy, trust, and knowledge are indicators of political capacity (Emler and Frazer, 1999; Finkel, 1985; Jeffres et al., 2002; Pateman, 1970; Yang and Callahan, 2007) (Rawlings, 2012: 325).

Civic capacities

The idea of civic capacities is in many ways a catch-all term for the general skills and dispositions necessary for public engagement. These skills and dispositions can include (1) civic skills such as organization, communication, collective decision-making, and critical thinking; (2) civic judgment and imagination or the ability to think creatively about public problems; (3) an ability to critically engage with different points of view; (4) civic ownership and knowledge about place; and (5) a sense of responsibility to act and a belief in the efficacy to do so (Daubon and Saunders, 2002; Frumkin, 2002; Hooghe, 2003; Kirlin, 2003; Putnam, 2001; Warren, 2001; Rawlings, 2012: 326–327). It can be argued that civic capacities not only get people in the door but also increase the likelihood that individuals may constructively and actively participate in the work of public engagement once present.

Citizen capacity building is thus a process by which citizens are equipped, whether through personal maturity, political agility, or civic skills, to engage in public life. While individuals might start with a high level of citizen capacity, it has long been asserted that citizen capacities are in fact built and/or strengthened through participation in public engagement activities (Denhardt and Denhardt, 2011; Pateman, 1970). In other words, we learn to participate by participating. Therefore, we contend that development and practice of these skills should be considered worthwhile ends of PEST in and of themselves, rather than mere spillover effects (Brodie et al., 2009). As Talisse (2003) writes, “The formative task of a democratic community, then, is to cultivate, maintain, and nurture the conditions under which citizens can properly engage in cooperative inquiry” (p.10).

The aim of citizen capacity building through PEST is a more engaged citizenry, which in turn increases the potential for greater democratic control of technology. Enhancement of citizen capacities, and thus the potential for greater democratic engagement, is therefore a way in which “non-policy informing” engagement (Davies, 2009), which has weak links to science governance, can be understood as helping to build stronger links between science and citizens. Given the ubiquity of technology and the range of intervention points impacting a diverse citizenry, capacity building is a vital part of democratizing science–society interactions.

What relevance does this have for the practice of PEST? First, it allows us to reconceptualize “non-policy informing” processes, which may seem to lie outside of Fiorino’s (1990) three-part rationale for engagement (instrumental, substantive, and normative), as democratically relevant. Events and processes which have no impact on science policy or research practice can be understood as aiming to enhance citizen capacities and, perhaps, equip them to participate in democratic processes which do help shape scientific decision-making. Second, it emphasizes that the nature and quality of a participatory event, whether a science café or deliberative workshop, will shape the degree to which citizen capacities (skills, knowledge, and dispositions) are strengthened (or lessened). It is therefore critical to think about the way in which participatory opportunities are designed, structured, and delivered.

We move on, then, to reflect on how this notion of capacity building can be used to design PEST. The following five design principles were created as a result of our extensive work as both scholars and practitioners in the fields of civic and public engagement. Thus, the principles were derived in part from our theoretical reflections on the import of capacity building, but also in light of the desire to offer correctives to some of the well-known shortcomings of PEST as conducted by STS scholars. We identify the characteristics of public engagement that enable citizens’ capacities to be built through purposeful PEST. To illustrate the design principles and their practical implications, we use the example of a pilot engagement exercise carried out in 2012, as part of the FCT, which placed intentional focus on capacity building as a purpose, goal, and intended outcome. To close this section, we summarize this project.

The CNS at ASU, which led the FCT, carries out research on innovative forms of public engagement with emerging technologies. The FCT is a distributed, deliberative, embodied PEST methodology that draws on digital and analogue media and, in its large-scale iteration in 2013, involved over 100 members of the public in six cities in North America. The FCT pilot demonstrated these methods in an effort to apply notions of capacity building to PEST practices.

With an invitation to explore the future of emerging technologies and urban sustainability, the pilot recruited 16 participants and occurred in four phases, over 3 months in Phoenix, Arizona.³ The *first session* involved an orientation in which participants could discuss their “curiosities and concerns” focused particularly, but not exclusively, on nanotechnology and the urban environment. Based on the interests articulated by the participants, CNS researchers then designed the *second session*—a walking tour of the city—during which participants were asked to write reflections and take photographs to document, observe, question, and point out the places in their

city where they saw (1) the past persisting, (2) the present embodied, and (3) the future emerging. During the tour, they visited various locations, from strolling along a canal to touring a solar rooftop installation, and met with technical experts and civic stakeholders to discuss their curiosities and concerns with respect to the role of technology in the city. The tour was also designed to include both indoor and outdoor settings (e.g. a farmer's market, industrial zones, hidden infrastructures), as well as various modes of interaction (some active and energizing, some pensive and slow).

During the *third session*, participants used a selection of their photographs in a series of deliberative exercises in which they negotiated the past, articulated the present, and envisioned the futures of their city. The FCT pilot concluded with a gallery show in downtown Phoenix (during the city's First Friday Art Walk), which displayed the participants' photography and writing in an interactive format, opening the process up to input from others.

Five design principles for PEST

In this section, we lay out the five design principles underpinning the FCT. These draw heavily on the notion of capacity building, and each, we believe, may be of wider use in designing PEST. To emphasize the ways in which these principles emerged from the process of experimenting with methods for engagement, we attend to the impetus behind each principle and how it manifests in practice (Table 1).

Design principle 1: Citizen-set agendas

When planning for public engagement, the collaborative governance literature emphasizes that it is critical to first consider the goal or purpose of the initiative before settling on an engagement technique; the *purpose* should drive the *process* (Nabatchi, 2012; Svava and Denhardt, 2010). Thus, engagement activities seeking to enhance citizen capacities need to be citizen-led, in terms of both substantive content explored and the process deployed. If a central aim of PEST is to develop and build the civic capacities of the participants, design should involve techniques that will maximize their opportunities to "practice" and sharpen their intrapersonal, political, and civic skills. Prioritizing citizen-set agendas also creates a sense of empowerment, relevance, and ownership of the process for all involved.

Grounding the FCT with a citizen-centered approach set the tone and thematic content for the entire FCT process and primed the design of each subsequent session. For example, through reflective dialogue in small and large groups in the first session, participants identified their core concerns related to the role of technology in the future of their city. In turn, these ideas informed the scope and foci of the city tour. This intentional process not only enabled participants' values to come to the fore but also expanded the scope for participants' influence and ensured participants had a clear stake and say in determining the overall focus of the deliberations.

Second, to create a citizen-centered process that fit our capacity building purpose, we aimed to design an atmosphere of safe, active, and honest dialogue that appreciated the contributions of each individual; throughout the FCT experience, each participant was given multiple opportunities to reflect and share, ranging from quiet solitary reflection and writing, to focused conversations in pairs, to energized plenary debate. Diverse modes of communication ensured that interactions neither presumed nor catered to certain personalities or cultural backgrounds. Participants were not expected or encouraged to come to a consensus; all reactions and concerns were valued. Importantly, participant input was valued equally to, if not more heavily than that of

Table 1. Design principles in practice.

	Design Principle	Goals	Methods
1	Citizen-set agendas	<p>Generate empowerment, relevance and ownership of the process</p> <p>Develop a sense of inclusion and shared group identity among participants</p> <p>Focus on and visit locations of interest to participants</p>	<p><i>Session 1:</i> Facilitated dialogues in small and large groups generate participants' concerns for and curiosities about technologies and the future of their city</p> <p><i>Sessions 2 and 3:</i> Different engagement modalities ensure inclusion</p> <p><i>Between sessions 1 and 2:</i> Tour development and design based on concerns identified in Session 1.</p>
2	Social constructivist framing of technology	<p>Enable discussion of technology as socially embedded</p>	<p><i>Pre-session 1:</i> Participants conduct introspective reflections on technological change in their lifetime</p> <p><i>Session 1:</i> Play and discuss equity in the Nano Around the World game (NISE Network (n.d.))</p> <p><i>Session 1:</i> Facilitators provide three social dimensions of technologies</p> <p><i>Between sessions 1 and 2:</i> Participants read background information</p> <p><i>Session 2:</i> Mini-lectures highlight characteristics of urban space that highlight the social dimensions of technologies</p>
3	Integration of expertise	<p>Create hybrid forms of knowledge and understanding</p>	<p><i>Session 2:</i> Participants (experts, stakeholders, and lay citizens) interact through a variety of modes throughout the tour and its stops</p>
4	Material deliberation	<p>Validate, value, and include material and affective knowledge that have been excluded from traditional public deliberations</p>	<p><i>Across all sessions:</i> Objects are used to elicit emotions, perspectives, and realizations</p> <p><i>Session 2:</i> Participants use cameras during a walking tour to identify the past persisting, the present embodied, and the future emerging in their community</p> <p><i>Between sessions 2 and 3:</i> Participants write critical reflections about the content of their photographs</p> <p><i>Session 3:</i> Using the collective bank of photographs from the tours, participants create three imaginations of the past, present, and future of their communities</p>
5	Tempered futures	<p>Highlight the limitations of shaping the future by acknowledging that the future is already populated with legislation, technologies, people, and (urban) infrastructures</p> <p>Introduce time as a means to understand challenges to producing and envisioning change</p>	<p><i>Across all sessions:</i> Conversations are structured to include the persistence of contemporary conditions and the momentum of the past on the present and future</p> <p><i>Session 1:</i> Participants identify and discuss the role of major technological changes in their lifetime</p> <p><i>Session 2:</i> Participants photograph technological change in the city</p> <p><i>Session 3:</i> Participants create a timeline of desirability for the future of their city</p>

invited experts and stakeholders. Thus, FCT embraced different modes and styles of deliberation and discussion and, as a result, provided participants a range of opportunities to practice their citizen capacities.

Design principle 2: Social constructivist framing of technology

Citizen capacity involves civic judgment and the ability to think creatively about public spaces, infrastructures, and systems, which involves exploring the multifaceted nature of technology. We argue for a design principle that seeks to establish a social constructivist framing of technology (Bijker et al., 1989), which problematizes and opens up the very idea of “technology.” This maneuver involves, for instance, enabling participants to move beyond thinking about technologies in terms of the risks and benefits of particular applications, and instead to consider bigger picture societal questions. By problematizing “technology,” it can be pluralized and expanded such that it is not seen as a singular force with inherent logics and independent ends (Marx, 2010) but as something shaped by a variety of social actors, including publics.

There are a variety of interactive platforms through which participants in PEST can hone their ideas about the nature and role of technologies in society. In the FCT, preparatory exercises and materials were used to ensure that conversations included the social dimensions of technology. For instance, before they gathered for the first session, we asked participants to reflect on and offer a few examples of technological changes they have witnessed during their lifetime and found significant. With this question, we hoped each participant would personalize and localize the changes they had witnessed—as well as be exposed to other participants’ examples and reflections. During the tour, we intentionally sought to broaden participants’ conceptions of what constituted technology by calling attention to objects in the landscape—such as sunscreen, graffiti, and crosswalks—as kinds of technology imbued with politics and social values. With this more pervasive idea of what constitutes “technology,” our goal was to develop, in conversation, a re-examination of base assumptions and perspectives about taken-for-granted categories such as technology, science, risk, and progress and in turn widen their capacities for critical thinking.

Design principle 3: Integration of expertise

Citizen capacity building involves the development of individual, intrapersonal capacities such as an increased sense of empowerment and critical awareness and a nuanced sense of identity. Additionally, it involves a heightened ability to interact and collaborate. In the context of PEST, the enhancement of these capacities can relate to the role and authority of public identities within participation and engagement. In particular, Callon’s (2004) notion of the hybrid forum can be used as a model for the way in which citizens are empowered to engage on their own terms, as equal partners; here, experts, lay people, and stakeholders convene to collectively discuss technical options surrounding an issue, each from their vantage point. The emphasis shifts to transform the traditional lay/expert divide, in which technical and scientific rhetoric (Goven, 2003) trumps non-expert forms of knowledge production to a hybrid forum enabling the forging of new identities and knowledge through experiential and mutual learning for all participants (Davies, 2009).

To accommodate a hybrid or heterogeneous public, the FCT design integrated different knowledge and modulated power dynamics to enable all participants to actively shape the evolving conversation. It convened a demographically diverse citizen panel, as well as professionals, scientists, and engineers who served as information resources and sparring partners both formally and informally during the walking tour. Generally, the “scientific expert” was a person who worked in the university conducting research related to the larger topic (e.g. nanotechnology for

water purification). “Stakeholders” included representatives from local corporations and civic and community leaders. For example, participants toured a solar panel installation and met with the principal and a student from a local biosciences high school, a photovoltaic researcher from ASU, and a representative from the company that made the panel. At each tour stop, invited experts illuminated unseen or prospective technological issues by bringing their specialist knowledge to bear. However, their presentations were intentionally set up as conversational, devoid of traditional presentation props such as PowerPoint slides. The exchanges thus avoided the formal trappings of debate common to many deliberative processes, where rational problem solving is the dominant mode of discourse, and expert roles are clearly delineated and enforced. We varied the ways that citizens interacted with invited guests: one social scientist, Dave Conz, demonstrated home-brewed biofuels, while another group of stakeholders gave brief statements and then responded to participants’ questions in a lively panel on the future of transportation infrastructure. Ultimately, this style of *in situ* back-and-forth conversation afforded participants opportunities to integrate their own expertise with those of the invited experts and stakeholders, attempting to disrupt the lay-expert divide that plagues much of PEST.

Design principle 4: Material deliberation

Public deliberations and engagement activities have traditionally relied on discourse-based interaction. Sanders (1997), Campbell (2005), and Young (2001) suggest, in somewhat different ways, that these forms of speech-based deliberation are exclusive and undemocratic because they rely on a notion of “reasoned argument” privileging particular voices, knowledge, and modes of interaction. Citizen empowerment and capacity building might instead practice “material deliberation” —formats which value, include, and validate material and affective knowledge difficult to represent in more traditional public engagement activities. Davies et al. (2002) use material deliberation

as a shorthand for processes of deliberation and citizen engagement which incorporate an awareness, openness or sensitivity to nontraditional modes of deliberative interaction, including, but not confined to, the sonorous (music, singing, laughter, noise), the discursive (gossip, storytelling, anecdote, polemic, drama), the material (objects, bodies, sites, places) and the affective (hate, love, fear, attachment, nostalgia, intuition, pleasure). Such engagements show a sensitivity to the situated nature of all encounters, deliberative or not, as embedded in particular spaces, material configurations and temporalities. (p. 353)

PEST can seek to value and validate these alternative forms of knowing and interacting. A more inclusive practice of valuing alternative epistemologies may allow for better intrapersonal outcomes for participants, including building capacity for personal empowerment, skill in interaction and discussion, and the ability to critically engage with others who have different perspectives or backgrounds.

In the FCT pilot, this emphasis on material deliberation resulted in the use of photography as both a stimulus and a tool to enable a different way of seeing (Altamirano and Selin, 2015). During the tour, participants were asked to identify places where they saw the past persisting, the present represented, and the future emerging with respect to technologies, new and old, in their communities. Using a camera helped participants notice qualities of their environment often taken for granted: more than one participant told us that by walking and photographing, they found themselves “seeing” aspects of their community they had never noticed before or found significant.

The photographs themselves served as material artifacts that supported further deliberation and reflection (see Pink, 2008). In effect, the photos kept the experiential aspects close at hand and fresh

for participants to use in group reflection. This accessibility was important because, after the tour, participants were asked to work with their images in several ways: first, to (individually) select twenty images and add a descriptive tag to each, explaining its significance. Second, participants used their images to discuss aspects of the past that should persist in their community, identify negative and positive characteristics of the present, and create a time-line collage reflecting their imagined futures. The use of photography thus enabled deliberation to be grounded in lived experiences and in participants' evolving perspectives, creating spaces for them to tell their stories.

Design principle 5: Tempered futures

Civic capacities include the ability to reimagine local environments and chart a sense of responsibility for action. Such capacities are inevitably tied to an awareness of temporality: citizens act with regard to potential futures, based on contemporary observations, buttressed by past experiences. However the temporal dimension has often been handled superficially in public engagement exercises. The future is either glossed over entirely or treated as a blank slate to be filled with participants' visions and desires. In the context of the FCT, we as researchers believe that equipping citizens to work toward a desirable future means first understanding the ways that technologies become resistant to change and place restrictions on human choice (Kirkman, 2009). There is little value in offering a laundry list of public desires, untempered by an appreciation of obduracy or the way the past persists. Such obduracies arise through a variety of mechanisms: deep embeddedness in a tangled network of sociotechnical systems, clashes in the ways that different actors view the world, and the persistence of structural contexts, traditions, and values (Hommels, 2005, 2010; Kirkman, 2009). PEST should therefore approach the future in an intentionally tempered mode, creatively imagining while acknowledging obduracy and the ways in which certain dreams may already be foreclosed.

In the FCT, the emphasis was thus on seeing the future not as empty but as already populated with obdurate legislation, technologies, mental models, and infrastructures (Selin and Sadowski, 2015). In the orientation session, we introduced ideas about technology and time, augmented through participants playing a card game that situated nanotechnologies in both historical and futuristic lights. We also sought to incorporate layered temporalities by asking participants to tag their tour photos as "past" and "present" to focus attention not only to contemporary conditions but also to the momentum of the past. To round out continuity in time, we asked participants to tag photos "future" to call out the ways in which hints of new technologies can be witnessed today as whispers of what is to come. Such articulations of technologies in time also carried through to structure the deliberative session. Thus, time was tempered throughout the engagement to nurture a more critical and complicated appreciation of "the future" of the city.

Presenting our five design principles, we have strived to be transparent and reflexive about the choices that we made as researchers in setting up the interactions, activities, movements, and conversations during the FCTs, understanding that we could have made different choices (Table 1). Throughout, we have made explicit our intentions and commitments and how they manifest in the workings of the FCTs. For instance, we reference the importance of facilitation and recognize that facilitation is not some neutral technique, but rather a modality through which we structured and framed conversation. As we relayed to participants during the orientation session, the FCTs are a research project and, as researchers, we are testing methodologies designed to cultivate a critical approach to emerging technologies, through engagement methods meant to inclusively incorporate diverse ways of knowing, affording interactions with experts and stakeholders in such a way to give primacy to citizens' concerns. When we as researchers took on a facilitator role, we sought to enforce these intellectual commitments, for instance, by supporting inclusivity, developing ways for quiet people to be heard, offering opportunities for multiple

modes of expression (writing, photography, speaking), or directly asking experts to deliver information accessibly and listen carefully to participants' questions. As facilitators, we were sensitive to the group dynamics, for example, by checking in with individuals to see whether they were able to express their views. There were also ways in which we, as facilitators, influenced the conversation based upon our position as researchers, as women, as men, as graduate students, as extroverts, as introverts, and so on. We recognized that we are never neutral technicians but instead held sway over the interactions in both intentional, and inevitably, unintentional ways.

Discussion: Relationship between the FCTs and capacity building

We have argued that citizen capacity building can be understood as a valid aim of PEST and outlined capacities that it might be seen to enhance. We used this discussion of the literature on capacity building to suggest five design principles for PEST, including some of the ways these principles might be applied in practice, as demonstrated in the FCT. As we conclude, we want to reflect on the degree to which the FCT connected with the idea of capacity building. Given the pilot nature of this study, our data collection was geared toward broadly assessing the design and delivery of the FCT's tools and techniques with a modest attempt to document and capture its specific impact on citizen capacity. Although we cannot prove empirically that the FCT built citizen capacity, through participant observation, informal interviews, workshop transcripts, and evaluation data, we see early evidence that indicates its potential to do just that. What follows is a brief discussion of the specific kinds of capacities identified as potentially developed or enhanced as a result of individuals' participation in FCT.

With regard to *intrapersonal capacities*, outcomes of FCT include an increased understanding of the interconnections between issues and people, enhanced empathy, and the building of networks and relationships among participants. At the tour's conclusion, participants were asked to reflect on what they most appreciated about the FCT. This open-ended question elicited responses that helped illustrate the potential that events such as FCT have for building intrapersonal civic capacities. One participant explained that the project helped him or her "to be able to see the interconnectivity of all the systems—to connect them visually and physically." This response exemplified an increase in both critical awareness and the ability to see how issues and systems are interrelated. Survey data support this assessment, with 92% agreeing or strongly agreeing that their participation enabled them "to appreciate different trends and envision alternate futures."

In terms of enhancing empathy and building networks and relationships, several participants explicitly stated that they appreciated seeing "how much we all have in common" and realized that "we all have different perspectives—we need to come together to talk." This improved ability to see and appreciate other points of view is indicative of intrapersonal capacity building. When asked what was most inspiring or interesting about their tour experience, two participants mentioned that it was really "about the people and not the technology." This notion was supported through the survey data that revealed 100% of respondents agreed or strongly agreed that the FCT "provided me access to new ideas, people, and places." Although not captured in the evaluation data, some invited technical experts discussed with FCT researchers that they valued the opportunity to talk casually with participants, giving them the chance to learn more about public concerns. It was observed that one of the experts voluntarily exchanged contact information to pursue a collaboration with two participants.

The second category of capacity building observed in the FCT was *political capacities*. Participants were provided with opportunities to engage with subject matter and policy experts related to the technological priorities they identified. Formal observations and survey data reveal that this may contribute to a potential increase in participants' political efficacy. During the FCT

debrief, one participant said that she or he was now more aware of how “our policymaking processes are remarkably slow in comparison to the processes for technology and innovation.” A concern for whether government is able to handle these kinds of policy issues alone was raised throughout the deliberative sessions, with one participant stating, “I’m optimistic for us as citizens to solve problems, but I’m pessimistic about government’s ability to solve them.” Along with changes in awareness, participants expressed an increased understanding of the importance of citizens getting involved in policy decisions and public engagement, which are two indicators of political efficacy. For example, 83% of survey respondents agreed or strongly agreed that their involvement with FCT “empowered me as a citizen to take an active role in issues related to science and technology.” Moreover, 75% of respondents indicated an interest to continue participation via a CNS citizen advisory committee. Similar indicators of political efficacy were seen in the qualitative interview data. When asked about the most important thing learned from the FCT experience, one respondent stated, “There are many ways in which a city can develop, and lots of different opinions of priorities. People have to get involved in order to keep a diverse and inclusive approach to growth.” Another respondent stated, “the information is out there for me to do things myself ... and I should be more active in my community.”

One of the key *civic capacities* discussed in the literature involves civic ownership and one’s level of knowledge about, and commitment to, a particular place or community.⁴ When asked, FCT participants discussed how their participation had changed their attitudes toward the place where they live and caused them to think differently about their communities. For example, during the debrief one participant mentioned, “I was surprised about what I didn’t know about the things I see every day.” Another said, “I was a tourist in my own city, I was born here, lived here, and yet I haven’t seen a lot of these things.”

Participants often spoke about an enhanced sense of civic ownership, civic commitment, and civic awareness, while 50% of survey respondents stated that as a result of their FCT experience they felt much more concerned about the potential impacts of emerging technologies in the city. In a different vein, walking through the city provided participants an opportunity to observe what one participant called the “hierarchy of values” that are apparent in the way we organize space. For many participants, the FCT helped identify “what’s important and how it manifests itself in our environment.” These kinds of statements begin to show us how efforts like FCT can impact citizens’ capacity to critically reflect on the places and spaces around them (see Selin and Gano, 2015).

The FCT was, of course, far from a perfect engagement exercise. Participants were largely self-selected; power dynamics were not entirely disrupted; and the extent to which capacity building took place is ultimately difficult to measure (Rawlings, 2012). Our broader argument is that capacity building—the development of the skills and habits necessary to successfully participate in public life—requires practice and opportunities to engage. One-shot events are much less likely to have measurable effects in terms of capacity building. But it is not a stretch to imagine that individuals living in a space where there are frequent, overlapping, and interconnected opportunities to publicly engage will continue to build their capacity for future efforts (Powell and Kleinman, 2008). This possibility speaks to the importance of creating an intentional civic infrastructure maintaining commitment to citizen inclusion and supporting multiple opportunities for PEST. The more that opportunities like FCT are available, the more likely it is that individuals will continue to develop, build, and use their intrapersonal, political, and civic skills.

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Notes

1. An increasingly substantial literature focuses on analyzing—and critiquing—the way that public engagement has been framed and practiced. Key themes include the way the public is constructed and imagined (Lezaun and Soneryd, 2007; Sturgis, 2014) and the (implicit or explicit) purposes of engagement: Is it to enhance democracy or defuse public opposition (Jones, 2007; Wynne 2007)? See Stilgoe et al. (2014) and Davies (2014) for reviews.
2. Furthermore, as Guston (1999) found in his review of consensus conferences, searching for policy impact can be an incomplete measure of evaluation for participatory activities because (1) even formal institutional technology assessments rarely succeed on those ill-conceived silver bullet models and (2) learning that occurs on the part of participants, organizers, and other elites constitutes an important outcome, although neglected by most policy-oriented measures.
3. To recruit participants for the pilot, Center for Nanotechnology in Society (CNS) delivered flyers to community centers, public libraries, museums, maker spaces, and neighborhood associations in the Phoenix Metropolitan Area. In total, 70 applications were received, from which 16 participants were selected based on criteria ensuring the most diverse group in terms of age, gender, income, educational level, race, interest in issues related to Science and Technology (S&T), and degree of civic engagement.
4. To further enhance this capacity building effect, after the project close, we provided participants with resources about how to get involved in local politics, community groups, and other engagement activities.

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Author biographies

Cynthia Selin studies sociotechnical change, responsible innovation, and foresight methodologies with an emphasis on novel scenario practices. She is a Marie Curie Fellow at the Technical University of Denmark (2014–2015) and an Assistant Professor in the School for the Future of Innovation in Society and the School of Sustainability at Arizona State University.

Kelly Campbell Rawlings is an Assistant Professor with the Sol Price School of Public Policy at the University of Southern California with research focusing on identifying innovative approaches to public participation and civic engagement.

Kathryn de Ridder-Vignone is the Director of the Duke Energy Center for Innovation where she focuses on the social, ethical, economic, and political issues associated with developing and applying new technologies.

Jathan Sadowski is a PhD student in the Human and Social Dimensions of Science and Technology (HSD) program at Arizona State University researching political social theory/justice and the political economy of information communication technology.

Carlo Altamirano Allende is a PhD student in the Human and Social Dimensions of Science and Technology program at Arizona State University investigating the nexus between energy, democracy, and society by studying stakeholder engagement in energy transition projects using renewable sources.

Gretchen Gano is the Associate Director of Research at the Center for Science, Technology, Medicine & Society, University of California/Berkeley, who seeks to understand the practices, dynamics, and structures of sociotechnical innovation systems.

Sarah R. Davies is Marie Curie Research Fellow in the Department of Media, Cognition, and Communication at the University of Copenhagen, where her work focuses on science communication and public engagement with science.

David H. Guston is the Founding Director of the School for the Future of Innovation in Society and Director of the National Science Foundation (NSF)-funded Center for Nanotechnology in Society at Arizona State University.