

Utilizing the Dynamic Role of Objects to Enhance Cross-Cultural Climate Change Collaborations

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ABSTRACT

Engagements between climate scientists and communities feature challenges but are also essential for successfully preparing for climate change. This is particularly true for indigenous peoples who are proactively responding to the threats that climate change poses by engaging in collaborations with climate decision-support organizations. The potential for risks and rewards associated with engagements like these makes developing tools for comprehensively, consistently, and equitably assessing cross-cultural climate collaborations a critical challenge. This paper describes a multicultural team's efforts to develop a survey that can assess collaborations between Native American tribes in the United States and climate science organizations. In the process, the developing survey's oscillations between acting as a boundary object and acting as an epistemic object in the project revealed common ground as well as existing differences across the cultural, disciplinary, and professional divides involved. Delphi expert elicitation was shown to be an effective approach for negotiating a cross-cultural research effort like this one because of its ability to establish consensus while delineating gaps. This experience highlights that assessing cross-cultural climate collaborations requires that both researchers and the tools that they use have the capacity to identify both common ground and distinctions between climate scientists and the communities with which they collaborate.

1. Introduction

Increasing understanding of engagement with communities affected by climate change is a pressing challenge (Bremer et al. 2017; Dilling et al. 2015; McNeeley and Lazrus 2014). Interactions between climate scientists and communities can help bring perceptions about the contextual relevance of climate science into alignment (Soares and Dessai 2016; Lemos and Morehouse 2005), but require participants to commit large amounts

of time and energy (Lemos et al. 2014) and can still produce negative results (Reo et al. 2017; Porter and Dessai 2017; Williams and Hardison 2013). Experience can enhance the capacity to successfully navigate these efforts (Briley et al. 2015; Kalafatis et al. 2015; Lemos et al. 2014), but more generalizable and systematic explorations of information exchange processes are needed to broadly address these concerns (Lemos et al. 2012).

Such explorations will require tools and strategies tailored to assess how well engagements meet the needs of specific decision-making contexts (Vaughan and Dessai 2014). These tools and strategies must be designed to identify and account for differences in how

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scientists and those they engage with approach their collaborations and communicate (Soares and Dessai 2016; Lemos and Rood 2010; Brownson et al. 2006; Choi et al. 2005). Failure to discern similarities and differences in the perspective of participants in these collaborations will ensure that existing cultural gaps undermining the successful application of climate science in policy decisions will continue (Porter and Dessai 2017). Not only might this limit the support that collaborations lend to efforts to address climate change, but neglecting to adequately acknowledge and balance the different worldviews of participants in these collaborations can constrain what strategies are considered and deepen inequalities (Klenk and Meehan 2015). Therefore, the ability to analyze differences across perspectives and the frictions these tensions produce is essential not only for understanding how these collaborations can produce valuable knowledge, but also for conducting them ethically (Klenk and Meehan 2015).

Studying the role of objects in projects can help shed light on interactions between scientists and nonscientists (Star and Griesemer 1989). However, more attention is needed on understanding what can be learned from the inability of objects to bridge between scientists and others in society (Star 2010). This paper explores how utilizing the changing role of objects in a project can enhance understanding of cross-cultural climate change collaborations between Native American tribes in the United States (tribes) and climate science organizations (CSOs)—governmental and nongovernmental organizations that provide decision support related to climate change planning. The challenges and opportunities associated with collaborations are heightened for indigenous peoples. Indigenous peoples are among the most affected by climate change (McNeeley 2017; Adger et al. 2014; Bennett et al. 2014). Indigenous testimonies and reports by diverse scientific organizations, from the IPCC to tribal governments, are converging on key factors for why indigenous peoples are, in many cases, negatively affected by climate change. The factors include how colonialism and other forms of political domination have rendered indigenous land bases less suitable for taking adaptive measures and how current laws and policies of nation states are not designed to be relevant to indigenous economies, cultures, and political situations (Whyte 2017; Bennett et al. 2014; Adger et al. 2014).

Tribes are engaged in efforts to enhance the quality of their collaborations with climate scientists (Maldonado et al. 2016; McNeeley et al. 2016; Mandaluyong Declaration 2011; Maynard 2003), creating spaces respecting cultural differences while drawing on longstanding indigenous traditions of collaboration to open communication channels (Reo et al. 2017). Indigenous peoples pursue

these efforts in spite of histories of being exploited by university and other researchers and having rarely had research efforts designed in support of their well-being (Smith 2013). While these efforts have represented important steps forward, tribes are often marginalized from climate change policy discussions in the United States (McNeeley 2017), despite legal requirements for cooperation between tribal and settler governments (Morishima 2014; Whyte 2013).

2. Boundaries and objects

Interactions between those considered inside and outside scientific communities have been fertile ground for examining the development (Riesch 2010), maintenance (Gieryn 1983), and crossing (Guston 2001; Star and Griesemer 1989) of social boundaries that demarcate distinctions between social groups like “climate scientists” and “tribes.” Going further back, intellectual traditions and practices of Menominee and other indigenous peoples often emphasize the relationship among social identities, their formation over time, and boundary setting and maintenance (Whyte et al. 2018). This is true contemporarily regarding tribal governments in boundary roles (Bruyneel 2007) and in intellectual traditions such as clan identity (Bohaker 2010). Indigenous science studies scholars, such as Megan Bang and her collaborators (Bang et al. 2007; Medin and Bang 2014), have investigated differences in how indigenous and nonindigenous scientists’ personal identities relate to boundary setting.

Figure 1 illustrates how this paper builds upon a model developed by Riesch (2010) based on discussions in the field of social psychology that is highly compatible with these indigenous intellectual traditions and areas of scholarship. Individuals cultivate and maintain a sense of social identity through their association with identifiable groups (e.g., geologist, American, or Shawnee). Figure 1 includes two such social groups (A and B). Social representations—shared interpretations of concepts (shown as arrows in Fig. 1)—are a key mechanism for delineating these identities, defining what is consistent and inconsistent with a particular social identity (Riesch 2010). These shared representations form self-reinforcing constellations surrounding each social identity, as the social representation of a particular identity (e.g., I am a scientist) carries common lenses through which group members will interpret other concepts in similar ways (e.g., many scientists share norms about data management that lead them to assume that traditional ecological knowledge held by indigenous peoples will be made available to the general public). Boundaries emerge between social identities as processes of defining the social representations that reflect or defy particular identities produce gaps between

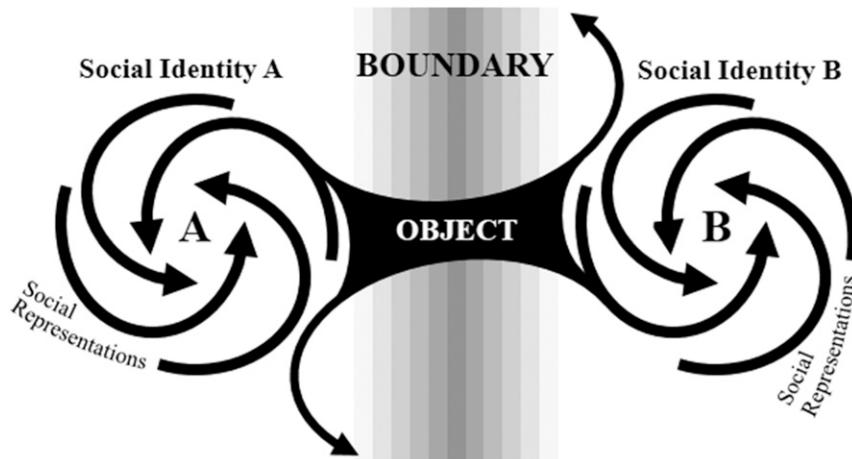


FIG. 1. Boundary emergence and the role of boundary objects.

the constellation of social representations they maintain and others (Riesch 2010).

Scientists do boundary work that differentiates their pursuit of science from other endeavors such as their public discussions about differences between science and religion (Gieryn 1983). However, the scientific process also features many interactions like those between tribes and CSOs that require scientists to cooperate without consensus across different perspectives (Star 2010). Star and Griesemer (1989) have highlighted the role of boundary objects—things acting as common ground for translating across participant perspectives—as a factor underlying the ability of science to coherently transfer across contexts. Boundary objects satisfy different communities' information requirements (Star and Griesemer 1989) and represent areas of shared meaning that provide a common language collaborators can use to cooperate (Carlile 2002). There has been considerable attention to boundary objects' potential to bridge between science and society (e.g., Hoppe 2005; Shackley and Wynne 1996). However, there is a need for more understanding of their “origin, development, and, sometimes, death and failure” (Star 2010, p. 613), such as the tension that arises from efforts to create common standards that can be applied across boundaries, inevitably producing residuals that fail to adhere to those standards (Star 2010). For example, Megan Bang and her colleagues have described how objects such as invasive species or scientific depictions of nature in classrooms can serve to mediate between indigenous and nonindigenous groups, such as students or scientists (Medin and Bang 2014). At the same time, residuals, such as how the term “invasive” erases the land-use changes that brought the species to a new place or how depictions of nature sometimes fail to show humans in them, can further entrench Native concerns that their experiences and cultures are

being excluded (Bang et al. 2014). In Fig. 1, an object spans the gap between social identities A and B, but while some aspects of this object cross the boundary effectively and result in translated social representations taken up by both A and B, some aspects are not. The social representations that are not taken up effectively by both groups contribute to the reinforcement of the boundary between the two identities because they illustrate ways in which these perspectives remain distinctive from one another.

That an object can both transcend and reify an existing boundary underscores that objects' perceived character and value shift based on changes in how humans relate to them (Brown 2001; Borgmann 1984). Objects play varying roles as collaborative projects develop (Nicolini et al. 2012; Ewenstein and Whyte 2009). These roles are fluid because they are not based simply on an object's content, but on how the object relates to the project itself at any given moment (Nicolini et al. 2012; Ewenstein and Whyte 2009). While there are times when an object can act as a boundary object as described above, it can also act as an *epistemic object* (Knorr Cetina 2001; Rheinberger 1997). Objects act as epistemic objects when they drive inquiry through embodying what is not known or is incomplete (Knorr Cetina 2001). Objects are often invisible to those using them when they operate as intended, but their particular characteristics become more apparent when they fail to perform as expected (Brown 2001; Borgmann 1984). Viewing an object as an epistemic object turns these gaps into opportunities for enhancing understanding about the larger processes in which the object is involved. This incompleteness stimulates actions that may fill in gaps in understanding or resolve existing differences between those working together (Nicolini et al. 2012; Ewenstein and Whyte 2009; Knorr Cetina 2001).

Kuhn's (1970) discussion of paradigm shifts can illustrate what episodic oscillations in roles from boundary to epistemic objects look like in practice and how such oscillations can push understanding forward. For centuries, a Newtonian perspective on physics acted as a boundary object forming common ground that connected the physics community—in Kuhn's terms, it operated as a paradigm that encompassed a shared worldview. Over time, though, anomalies accumulated that called this shared understanding into question, leading to debate within the physics community in the form of competing theories that was eventually resolved by Einstein's special theory of relativity becoming established as a new paradigm (Kuhn 1970, 72–74). Anomalies that undermined the perceived usefulness of the Newtonian perspective increasingly led it to act more and more like an epistemic object whose failures to explain observed phenomena created the conditions for a shift to a new prevailing understanding of physics.

3. Building a boundary object, utilizing an epistemic one

This paper argues that tracking the changing roles that objects play in relation to cross-cultural collaborations in climate change projects can provide insights into the social representations and identities of participants, illustrating areas for connection as well as critical differences between them. It demonstrates this potential by tracing the development of a particular object—a survey created by the project team that aimed to explore and compare the experiences of tribes and CSOs in cross-cultural climate change collaborations. To achieve these goals, the project team needed to reconcile the different social representations that tribes and CSOs possess about issues surrounding these collaborations into a common set of standards—measures used for comparative evaluations. To the extent that this set of social representations successfully served as standards interpreted consistently by participants with different social identities, the survey would act as a boundary object bridging these identities. However, this process also produced residuals (Star 2010) that could not be readily incorporated into standards for comparative evaluation. Such shortcomings offer opportunities for insight if the survey's potential role as an epistemic object is embraced and gaps in its performance as a boundary object are treated as opportunities for analysis of difference and the pursuit of clarification.

a. The research project

This research project presented an opportunity to explore the changing role of objects in cross-cultural

climate change projects featuring exchanges across social, cultural, and professional boundaries, as well as the opportunities associated with these changes. The research team itself represents an equal partnership between a tribal organization of a federally recognized tribe and a public, land grant research university exploring collaborations between those affiliated with tribes and CSOs. The project seeks to produce recommendations and evaluation criteria for assessing approaches cultivating ethical interactions between research and tribal communities in the United States. Ultimately, the goal was to develop a survey that could quantitatively assess and compare the concerns of participants; identify the types of approaches they use to cultivate ethical science, technology, engineering, and mathematics (STEM) engagements; understand perceptions about the effectiveness of collaborations based on the outcomes in which participants are most interested; and synthesize lessons learned. At this initial point in the project, though, the survey was acting as an epistemic object whose content could take many different forms. To meet the project goals, the project team needed to undertake a process that would refine the survey so that it could act as a boundary object featuring a set of common standards that reflected shared social representations of issues surrounding these collaborations participants had.

b. Delphi method selection

In accordance with the project team's model of objects in projects outlined above, this refinement process would need to fulfill four criteria:

- 1) It needed to engage with two distinctive groups (tribe and CSO-affiliated participants).
- 2) It needed to identify social representations that tribes and CSOs would interpret consistently that could serve as a common set of standards.
- 3) It needed to track ways in which the survey was failing to act as a boundary object because it was not presenting social representations understood consistently by tribes and CSOs.
- 4) It needed to include opportunities to adaptively respond to these perceived shortcomings by treating the survey as an epistemic object whose incompleteness could lead to either refinements that enhanced the survey's performance as a boundary object or the identification of residuals that would need to be reconciled by the project through some other means.

The project team chose to undertake a Delphi expert-elicitation process (Delphi) to meet these requirements (Hsu and Sandford 2007; Dalkey and Helmer 1963). Delphis systematically explore experts' perspectives

TABLE 1. Mean value of first Delphi questionnaire responses (diff indicates the difference in the mean between tribes and CSOs). Standard deviations are shown in parentheses.

| | All | Tribes | CSOs | Diff |
|--|-----------|-----------|-----------|------|
| Challenge prompts | | | | |
| We need to demonstrate respect for each other’s sovereignty and independence | 9.6 (0.7) | 9.6 (0.8) | 9.6 (0.7) | 0.0 |
| We need to get buy-in from our own Tribal or CSO leadership | 9.0 (1.3) | 9.6 (0.8) | 8.7 (1.4) | 0.9 |
| We must get buy-in from our collaborators’ Tribal or CSO leadership | 8.7 (1.6) | 9.5 (0.9) | 8.5 (1.7) | 1.0 |
| We have different ways of understanding and thinking about climate change | 9.1 (1.6) | 9.2 (1.2) | 9.0 (1.8) | 0.2 |
| We both need to invest adequate time to ensure the collaboration works effectively | 9.1 (1.0) | 9.2 (1.0) | 9.0 (1.0) | 0.2 |
| We must establish trusting relationships between Tribal and CSO collaborators | 9.6 (0.8) | 9.2 (1.0) | 9.8 (0.6) | −0.6 |
| We need to navigate differences in access to resources and capacities | 8.6 (1.5) | 9.2 (0.8) | 8.3 (1.6) | 0.9 |
| We are accountable to different groups of people | 8.3 (1.9) | 9.0 (1.3) | 8.0 (2.0) | 1.0 |
| We need to ensure that funding is shared equitably | 7.5 (2.4) | 8.6 (1.9) | 6.9 (2.4) | 1.7 |
| We may have different goals for the collaboration | 8.4 (2.1) | 8.4 (1.0) | 8.4 (2.4) | 0.0 |
| We need to share ownership of climate knowledge that we create collaboratively | 7.7 (2.7) | 8.0 (3.1) | 7.5 (2.5) | 0.5 |
| We have different bureaucratic systems | 7.6 (2.2) | 8.0 (1.8) | 7.4 (2.4) | 0.6 |
| We need to share existing climate knowledge with each other | 7.4 (2.4) | 7.2 (2.3) | 7.5 (2.4) | −0.3 |
| Training prompts | | | | |
| Attending conferences that include training opportunities | 7.8 (1.8) | 9.0 (1.2) | 7.4 (1.8) | 1.6 |
| Talking to Tribes and CSOs about how to collaborate | 8.2 (1.8) | 8.5 (1.7) | 8.1 (1.8) | 0.4 |
| Reading official guidelines about government-to-government collaboration | 6.7 (2.6) | 7.5 (1.8) | 6.4 (2.8) | 1.1 |
| Reading written training materials such as handbooks for CSO–Tribe collaboration | 6.1 (1.8) | 6.5 (1.1) | 5.9 (2.0) | 0.6 |

(Dalkey and Helmer 1963) through anonymous responses to multiple rounds of questionnaires. After each round, administrators summarize the results from the previous round and provide them to the experts with anonymous feedback and an opportunity to respond to these updates (Hsu and Sandford 2007). Delphi’s direct engagement with expert perspectives fulfilled the first criterion. Delphi could also meet the second criterion, as most Delphi-based research has focused on establishing consensus among participants (von der Gracht 2012), including use as a means of identifying similarities across different perspectives for mediation and conflict resolution (Miller and Cuff 1986). At the same time, Delphi could also meet the third criterion because it has been used to define differences across cultures (Ludlow 2002) and explore why opposition between groups exists (Keeney 2009). Last, the iterative nature of Delphi would provide opportunities to elicit feedback from the same experts multiple times, building stages of reflection on areas of both agreement and disagreement into the process that would help the research team fulfill the fourth criterion.

4. Delphi rounds and results

a. Participant selection

To make sure that the Delphi met the first criterion of the refinement process, the project team needed to solicit input from individuals affiliated with both tribes and CSOs who are experts regarding collaborative efforts around climate change decision-making.

Consistent with Delphi studies that have based participant selection on researchers’ knowledge (Hasson et al. 2000), the sample of experts was based on one of the author’s suggestions (Whyte). This resulted in a list of 22 individuals (10 tribe affiliated and 12 CSO affiliated).

b. First Delphi round

1) FIRST DELPHI QUESTIONNAIRE

The first Delphi questionnaire was completed during December of 2016. A previous stage of the project in the spring of 2016 included interviews with seven tribe-affiliated and nine CSO-affiliated individuals across five regions (Kirby et al. 2019).¹ These semistructured interviews qualitatively explored collaborative experiences and collaboration training strategies. The first question from these interviews resulted in a list of 13 challenges associated with collaborations between tribes and CSOs (Table 1) that stemmed from these interviews (Kirby et al. 2019).

¹ Whyte generated a list of potential interviewees that was based on people who have had a demonstrated and longstanding commitment to tribal involvement in climate science (minimum 5–10 years) and have at least three (usually far more) documents or official roles pertaining to doing this work, such as publications, climate science jobs with a tribal component, tribal staff positions, being named in tribal climate change plans, or conference organizers, among other such roles. Whyte selected individuals from this list who had not been interviewed to be participants in the Delphi process.

To help meet the second criterion of the refinement process, the project team looked to make sure that the issues being addressed were ones that both tribes and CSOs believed were important and should be included in the survey. Respondents were asked how important they thought it would be to include each challenge in the survey on a scale of 1 (not important at all) to 10 (very important). To understand any potential considerations about social representations associated with how these issues were being worded, they were also prompted to provide any suggested wording changes to ensure consistent readability between those affiliated with tribes and CSOs. They were also asked to offer suggestions about any additional challenges in case the previous interviews had missed something important from their perspective. Respondents were also asked to indicate how important it would be to include each of four types of training in the survey on a scale of 1 to 10. They were again prompted to suggest wording changes or additional forms of training. Finally, the interviews provided few suggestions about evaluating the effectiveness of training related to ethical engagements. Therefore, participants were asked to describe how they measure the effectiveness of training.

Whyte sent an initial introductory e-mail message about the project, and up to three solicitations were sent to potential respondents. Participants could complete the questionnaire through a link to an online Qualtrics, LLC, form, a telephone interview, or comments on an attached Microsoft Corp. Word version. One participant elected to complete the Word version of the Delphi, and another participant requested a telephone conversation for further comments following their completion of the Qualtrics version. A total of 16 completed responses were received (response rate: 73%; 5 tribe affiliated and 11 CSO affiliated).

2) ROUND-1 RESULTS

Table 1 summarizes the first Delphi questionnaire's results. Regarding the importance of including the 13 collaboration challenges, those rated most important were establishing trusting relationships and demonstrating respect for each other's sovereignty and independence (both means 9.6). The two lowest rated were sharing existing climate knowledge (mean: 7.4) and ensuring funding was shared equitably (mean: 7.5).

However, there were differences between tribe-affiliated and CSO-affiliated responses. Tribe-affiliated respondents' highest rating was for demonstrating respect for each other's sovereignty and independence while CSO-affiliated respondents' highest rating was for

“We must establish trusting relationships between Tribal and CSO collaborators.” On the other hand, tribe-affiliated respondents gave their lowest rating to “We need to share existing climate knowledge with each other,” while CSO-affiliated respondents gave their lowest rating to “We need to ensure that funding is shared equitably.” Overall, tribe-affiliated respondents rated these prompts more important than the CSO-affiliated respondents did. This difference was most pronounced for sharing funding equitably (mean 8.6 vs 6.9). On the other hand, CSO-affiliated respondents rated the importance of establishing trust higher than tribe-affiliated respondents did (9.8 vs 9.2).

For the importance of including the four sources of training, talking with tribes and CSOs was rated most important (mean: 8.2) and reading written training materials was rated least (mean: 6.1). Tribe-affiliated respondents rated each of these activities as more important to include in the survey than CSO-affiliated respondents did, with attending conferences that included training and reading official guidelines regarding government-to-government collaboration having the largest differences.

Beyond these numerical descriptions, respondents provided comments on particular prompts and the broader research effort that provided critical feedback about how participants possessing different social identities might interpret these prompts differently. Some were general: “In the final survey, you might consider clarifying the pronoun [we]. I have noticed in my work the positionality of tribal employees is sometimes confusing for them to navigate.” In response, the researchers switched from using “we” to “our Tribe” or “our CSO.” Another comment led the researchers to simplify language: “These statements seem pretty heady to me. I would try to rephrase and put at 9th grade reading level.” In other cases, language was clarified or removed because of concerns that it could cause confusion.

Some CSO-affiliated respondents expressed that their considerations about collaboration have multiple layers and, therefore, might not be answerable in a straightforward way. Responding to “We are accountable to different groups of people,” one asked, “People as in federal agencies, communities (urban, rural, native, nonnative?), etc. Are the people at the local, national, etc. level?” Regarding “We need to get buy-in from our own CSO leadership,” another responded, “Buy in for collaboration, info sharing within group, and sharing with public will raise different concerns.” To temporarily reconcile these concerns for the purpose of administering a survey, the wording of the first prompt was simplified to “have different considerations about

accountability” and was ultimately removed after the second Delphi round, described in the next section.²

On the other hand, some tribe-affiliated respondents were supportive of the prompts offered but suggested that differences in perspectives underlying collaborations are too rich to be captured by a survey. Such concerns were important input that constituted residuals (Star 2010) that could not fit into the common standards being developed for the survey. However, these residuals could help to fulfill the third and fourth criteria of the refinement process through shedding light on the shortcomings of the survey being developed. One warned, “[D]ifferent worldviews cannot be somehow combined to create one framework for collaboration; sometimes these worldviews are not commensurate and must be considered parallel.” Responding to the prompt concerning equitable sharing of funding, another implied that awareness of tribes’ historical experience of exclusion was essential for understanding views on funding: “Yes we need to navigate creatively, but we must also work to change these inequities, not just move around or about them as if we have no responsibilities to changing them.” With regard to training, another emphasized that covering such differences requires direct experience:

One of the things they did was have tribal elders come in and talk to us about how the climate has changed and affected them (salmon and root medicines). We visited a fishing camp and they shared their foods with us and we got to taste the root medicines. To me this was pretty hands on and exchanging cultures. I hope we can find a way for scientists to ‘connect’ with native people and how Tribes view the world around them.

c. Second Delphi round

1) REVISIONS FOLLOWING FIRST DELPHI QUESTIONNAIRE

The list of challenges was updated based on responses to the first questionnaire to ensure that the challenges

²The struggle over these prompts highlights an important simplification made in this study. To simplify the treatment of different social identities, this paper uses a model of reality in which individuals are described as possessing only one of two social identities (tribe affiliated or CSO affiliated). Reality is much more complicated. Some individuals likely identify with both categories simultaneously, and both the tribe-affiliated and CSO-affiliated categories feature many more levels of overlapping complexity within them. For example, tribes from different areas of the United States or scientists from different kinds of organizations might possess very different social identities from one another but also share some commonalities. Furthermore, any individual belongs to many different groups simultaneously, and these identities also interact with one another. Unpacking these different layers and how they affect each other and the outcomes of cross-cultural climate collaborations is a potentially fertile area for future research.

included were ones that would be important to both tribes and CSOs and would align consistently with their social representations of these collaborations. Table 2 compares original challenges with edited ones, along with examples of related respondent comments. In light of the first questionnaire’s quantitative and qualitative results, three of these challenge prompts were incorporated into others. There was also feedback about understanding distinctions between different tribes from a tribe-affiliated and a CSO-affiliated respondent. Therefore, a new challenge was added, “Tribes and CSOs are not all the same,” resulting in 11 challenges.

For the survey, these challenges needed to be associated with potential benefits and harms for participating tribes and CSOs. Therefore, for each edited challenge, the project team proposed a potential benefit and harm (provided in Table 3). Depending on the challenge, these benefits and harms were framed on the basis of changes in the tribe’s or CSO’s capacities, outcomes directly affecting the tribe or CSO, or more general societal outcomes.

The lists of forms of training and strategies for evaluating training were also edited. From a suggestion, “official” was removed from “Reading [official] guidelines about government-to-government collaboration.” Overall, though, respondents provided less feedback about training prompts than they did about challenges. Suggestions about additional forms of training led to three more: using multimedia online resources such as webinars or videos, attending particular events designed to enhance cultural understanding, and relying on particular individuals or organizations to facilitate and help navigate communications. Suggestions about evaluation strategies included extent to which participants incorporate lessons from training into their work, changes in the tribe’s or CSO’s approach to this work over time, surveys or interviews comparing responses before and after participation, tangible benefit of training versus the time and money spent to attend, conversations continue beyond the training event, stimulated interest in future training activities, and the number of tribes and CSOs that pursue collaborations. These additions resulted in lists of seven forms of training and seven evaluation strategies used in the second Delphi questionnaire. Finally, in response to concerns about clarifying pronouns, two versions of the questionnaire were used: a tribe-affiliated version and a CSO-affiliated version. These questionnaires were almost the same, but referred to “your Tribe” or “your CSO” accordingly.

2) SECOND DELPHI QUESTIONNAIRE

In February of 2017, a second Delphi questionnaire was emailed to those who had completed the first

TABLE 2. First Delphi prompts, responses, and proposed changes in second Delphi.

| Original challenge | Example response | Edited challenge |
|---|---|--|
| | <i>Example of one prompt incorporated into another</i> | |
| We need to navigate differences in access to resources and capacities | “I think this question could tie into the funding sharing question.” | Tribes and CSOs differ in their capacities and access to resources |
| We need to ensure that funding is shared equitably | “I found this question difficult to answer. What funding are we talking about? . . . CSOs and tribes are often operating on very different scales and budgets.” | [Incorporated into prompt above] |
| | <i>Example of major change</i> | |
| We have different ways of understanding and thinking about climate change | “Indigenous knowledges/sciences and western knowledge/science are two very different ways of knowing that are informed by distinct and sovereign epistemologies, ontologies, axiologies and methodologies.” | Tribes and CSOs have different systems for developing knowledge. |
| | <i>Example of minor change</i> | |
| We are accountable to different groups of people | “From an Indigenous ontology, we are not only accountable to different people but to all our human and nonhuman relations.” | Tribes and CSOs have different considerations about accountability |
| | <i>Example of almost no change</i> | |
| We must establish trusting relationships between tribal and CSO collaborators | “It’s central to the success of such collaborations.” | Tribes and CSOs need to establish trusting relationships with each other |

questionnaire along with an update about the process. Participants again could respond using an online Qualtrics questionnaire, a Word version, or a phone call. The first question featured the list of 11 challenges partnered with an associated potential benefit and harm. For each grouping of challenge, benefit, and harm, participants were asked to give comments or edits. Respondents were again provided with an open-ended section for providing feedback or suggestions. They were then asked for comments or edits concerning the seven forms of training and the seven strategies for training evaluation along with opportunities to provide edits, feedback, or suggestions about both.

3) ROUND-2 RESULTS

There were six CSO-affiliated responses (11 possible) and four tribe-affiliated responses (five possible) to the second Delphi questionnaire. For all 11 of the challenges, a majority of respondents provided no comments. Almost all comments were personal reflections about collaborations or were positive, such as, “I don’t have any real issue with the way the challenges are worded and I think that they cover a breadth of concerns that could come up when working with non-tribal CSOs and Tribal organizations.”

However, there were exceptions. One tribe-affiliated respondent questioned whether tribes’ and CSOs’

TABLE 3. Example potential benefits and potential harms associated with challenges.

| Challenge | Potential benefit | Potential harm |
|---|---|---|
| | <i>Example describing changes in capacity</i> | |
| Tribes and CSOs have different systems for developing knowledge | These collaborations have enhanced our CSO’s/tribe’s capacity to make connections across different systems for developing knowledge | These collaborations have conflicted with our CSO’s/tribe’s approach to developing knowledge |
| | <i>Example describing individual outcomes</i> | |
| Tribes and CSOs invest time to ensure that collaborations are ethical and effective | These collaborations were efficient ways to fulfill our CSO’s/tribe’s objectives | These collaborations used time that could have been more effectively used pursuing something else |
| | <i>Example describing societal outcomes</i> | |
| Tribes and CSOs need to collaborate in ways that respect and support tribal sovereignty | These collaborations have helped sustain or enhance tribal sovereignty | These collaborations have undermined tribal sovereignty |

governing systems were comparable, while two CSO-affiliated respondents expressed confusion about governing systems. Similarly, a CSO-affiliated respondent expressed skepticism about whether the benefits and harms prompts that the project team proposed adequately addressed the challenge of community buy-in: “Good question but how will you get at the depth required to understand.” A tribe-affiliated respondent asked, “Do you mean community members at large? What if collaboration was only at staff level? What are you trying to answer here?” The persistent confusion regarding potential benefits and harms led to the removal of these two challenges. These issues appeared too complicated to be effectively incorporated into common standards that would apply consistently between these two groups.

In one case, an adjustment arising from a first questionnaire response caused confusion in the second questionnaire. The phrase “and values” was added to “We may have different goals [and values] for the collaboration.” However, seeing this change, another respondent argued, “you have two very different terms within the same challenge, goals and values. Choose one.” Adopting a suggestion on the basis of one respondent’s social representations about goals and values had conflicted with another respondent’s social representations associated with these concepts. In response to the potential confusion, it was decided to revert to the original wording.

Other feedback elicited general edits. A tribe-affiliated respondent again emphasized simplifying prompts’ language and complexity in a broadly distributed survey. One CSO-affiliated respondent again emphasized cases where questions might include two potentially conflicting notions, particularly ethics/efficiency, while another again emphasized consistency in pronoun usage. In one case, this feedback informed the communication strategy for the Delphi. The first email solicitation for the second Delphi questionnaire did not explain the separate tribe-affiliated and CSO-affiliated versions. Only one response from a tribe-affiliated respondent was received, but it included this concern: “wondering why this is only about risks and benefits to Tribes? It’s not a one-way street.” It was necessary to ensure that this issue would not instill perceptions of inequality that would undermine the project’s social legitimacy (Daniels and Walker 2001). A clarification was sent to that respondent, and in the next two solicitations an explanation about the two versions was included.

From these responses, a revised list of nine benefits and harms was developed. Table 4 compares benefits and harms described in the second Delphi questionnaire and these revised versions. Only positive, affirmative, comments were

received from our respondents for training and strategies for evaluation, and therefore no changes to these lists were made given the responses to the second Delphi questionnaire. The prevalence of positive feedback regarding the remaining potential benefits, potential harms, forms of training, and strategies for evaluation led to the determination that the revised lists following the second Delphi questionnaire would not require an additional round of expert review.

5. Utilizing the dynamic role of objects

Following the second Delphi round, the project team was confident that the survey could operate as a boundary object representing common ground across social identities (Star and Griesemer 1989). It included items that could be treated as shared social representations concerning issues surrounding collaborations these experienced expert respondents agreed were important and had addressed potential communication challenges that might arise from differences in the social identities held by tribe- and CSO-affiliated respondents.

However, while respondents generally agreed that the survey contents were relevant and consistently translatable, they also intimated that a survey could not fully illuminate collaboration experiences. Even as the survey served as a boundary object, differences in perspective persisted (Nicolini et al. 2012; Boland and Tenkasi 1995; Star and Griesemer 1989). This shortcoming would apply to any boundary object (Star and Griesemer 1989) or quantitative research instrument (Jick 1979) because precision and general applicability come at the expense of failing to truly capture the messy, contextual nature of social life. Instead of viewing these shortcomings as instances of the “failure” or even “death” (Star 2010, p. 613) of the boundary object, however, the project team viewed them as part of an episodic process in which the survey’s role in the project oscillated between acting more as a boundary object and acting more as an epistemic object.

Figure 2 illustrates changes in the survey’s relative role in the research project on the y axis (epistemic and boundary object) over time (x axis). The curve represents the role of the survey over the course of its development. The area underneath the curve represents uncertainties surrounding the use of the survey as a boundary object that contribute to its use as an epistemic object. This gap offers opportunities for insights resulting from observing similarities and differences across cultural, disciplinary, and professional boundaries (Daniels and Walker 2001). Comparing different perspectives across these kinds of boundaries can help to shed light on the nature of these perspectives, illustrate

TABLE 4. Second Delphi and revised final benefits and harms comparison.

| Delphi 2 | Revised final |
|---|--|
| <i>Example of removal</i> | |
| Benefit: These collaborations enhanced our organization's/tribe's impression of the importance of this work | [Removed] |
| Harm: These collaborations reduced our organization's/tribe's interest in doing this work in the future | |
| <i>Example of substantial change</i> | |
| Benefit: These collaborations have increased our CSO's/tribe's capacity to contribute to the development and appropriate sharing of collaborative knowledge | Benefit: These collaborations can result in new knowledge created through tribes and CSOs working together |
| Harm: These collaborations have undermined our CSO's/tribe's willingness to contribute to the development of collaborative knowledge in the future | Harm: These collaborations can result in knowledge that our CSO/tribe helped create that we will not own |
| <i>Example of minor change</i> | |
| Benefit: These collaborations were efficient ways to fulfill our CSO's/tribe's objectives | Benefit: These collaborations can be an effective use of our CSO's/tribe's time |
| Harm: These collaborations used time that could have been more effectively used pursuing something else | Harm: These collaborations might not be an effective use of our CSO's/tribe's time |
| <i>Example of almost no change</i> | |
| Benefit: These collaborations have helped sustain or enhance tribal sovereignty | Benefit: These collaborations can help sustain or enhance tribal sovereignty |
| Harm: These collaborations have undermined tribal sovereignty. | Harm: These collaborations can undermine tribal sovereignty |

new opportunities for common ground, and offer insight into the process of doing work across disciplinary and cultural boundaries itself (Pohl 2011). This tension in research objects' oscillation from establishing temporary clarity to revealing new questions and back again can drive exploration and learning (Nicolini et al. 2012; Knorr Cetina 2001). In projects spanning across cultural, disciplinary, and professional boundaries, this tension presents opportunities for insights into differences as well as opportunities for developing greater

understanding and common ground (Pohl 2011; Daniels and Walker 2001).

At first, the survey primarily acted as an epistemic object because of uncertainty about its eventual content. As the first round of the Delphi was conducted, areas of agreement emerged as respondents provided clarification about what challenges they perceived were important to include in the survey, moving the survey toward acting as a boundary object. However, new questions also emerged, demonstrating shortcomings in understanding

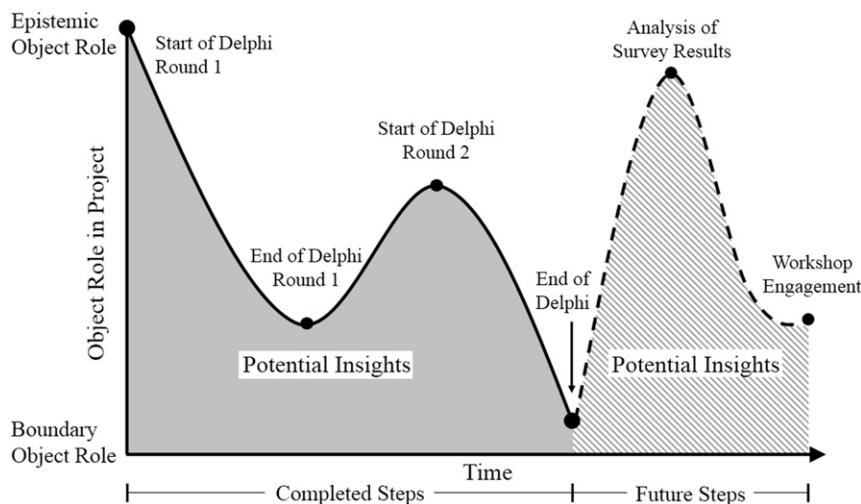


FIG. 2. The continuing research process and the survey's evolving role.

(Knorr Cetina 2001). The second Delphi round would need to help resolve these issues, and so the survey increasingly acted as an epistemic object stimulating uncertainty in the period leading up to the second round. The project team needed to attend to feedback about challenges surrounding wording survey prompts such as reconciling pronoun usage, make new suggestions about refining the list of challenges addressed, and reframe the challenges in terms of potential benefits and harms. The responses that the project team received from the second Delphi round provided positive affirmation about the changes to the survey that were made, enhancing the extent to which the project team viewed the revised survey as a boundary object presenting a set of standards for assessing experiences in cross-cultural climate change collaborations.

However, this standardization process also produced residuals (Star 2010) that could not be incorporated into the survey effectively. Potentially important challenges could not be addressed effectively (i.e., governing systems and community buy-in), and the warnings from the first Delphi round that no survey could fully address the complex differences in perspectives across the boundary between CSOs and tribes could not be addressed. Therefore, even as it was about to be utilized as a boundary object at the conclusion of the Delphi, to some degree the survey still acted as an epistemic object that represented uncertainty. As time moves beyond the completed Delphi toward upcoming steps, the survey (dashed curve) will likely again act more as an epistemic object that invites different interpretations. Its results will reveal more differences, and the project team's understanding of the survey's incompleteness as a measurement tool will likely increase again (Knorr Cetina 2001).

From these considerations, the project team tailored the survey to accentuate potential tensions emerging from its oscillations between acting as a boundary object and an epistemic object. In addition to the quantitative data prompts developed here, open-ended questions were included in the survey to collect qualitative perceptions about benefits, harms, and training as well as ideal visions of collaboration. Furthermore, the project plan includes a future workshop with focus groups to get feedback about interpreting the survey results. Discussing survey results with tribe-affiliated and CSO-affiliated experts will help reconcile understanding and move the survey and its results once again toward acting more as a boundary object. However, it is also likely that at that stage the project team will have a greater understanding of how the survey was inevitably imperfect and ultimately failed to fully assess experiences in these collaborations. Therefore, at the workshop engagement

stage in Fig. 2, the survey simultaneously plays a mixed role as a boundary object and as an epistemic object, stimulating inquiry and engagement within this multidisciplinary and multicultural project.

A CSO-affiliated response to the first Delphi questionnaire described the benefits of continuing to seek to identify and bridge such differences: "I think a lot of it comes down to understanding of one another and appreciating the differences and how these can benefit the collaboration between the two groups. If both groups are open to having a constructive dialogue and willing to respect one another in terms of experiences/perspectives, then these interactions will be, at least at some level, enhancing." As cross-cultural collaborations between tribes and CSOs are explored further in this research, the research project itself has the potential to continue illustrating the potential value of engaging across different cultural, disciplinary, and professional boundaries.

6. Conclusions

Indigenous peoples' collaborations with climate change decision-support organizations exemplify issues associated with engagements between climate scientists and communities affected by climate change. This paper has detailed a cross-cultural and cross-disciplinary research team's efforts to refine a survey into a boundary object that could assess these collaborations as comprehensively, consistently, and equitably as possible. However, this refinement process revealed that the volatility of this survey's role actually produced essential contributions for this cross-cultural effort. As the project team attempted to define a list of social representations shared by both tribe- and CSO-affiliated individuals that would offer common standards for evaluation, residuals were produced that resisted being incorporated into these standards that shed light on the boundary between the social identities of tribe- and CSO-affiliated participants. The project team was therefore able to use oscillations between the survey acting as a boundary object consolidating understanding and the survey acting as an epistemic object emphasizing gaps in understanding to iteratively delineate the boundaries between participant perspectives and the common ground they shared.

Delphi was a particularly effective tool for taking advantage of the potential insights emerging from these shifts in the survey's role. While Delphi studies have primarily focused on either establishing consolidation (von der Gracht 2012) or on highlighting differences (Keeney 2009), this project demonstrates that Delphi can assist cross-cultural engagements through offering the flexibility to do both. The Delphi did result in a refined survey that was based on relatively common

ground between tribes and CSOs, but it also provided indications about the insufficiency of a quantitative survey to capture the complexity of cross-cultural collaborations. Critical differences in tribes' and CSOs' perspectives could remain invisible to quantitative survey questions, and therefore the research team added more qualitative elements to the survey and future research plans to provide opportunities to further explore differences in perspectives as they continue to be revealed. Those interested in understanding and undertaking cross-cultural engagements between scientists and communities around climate change can benefit from attention to how objects assist in building bridges across cultures through illuminating gaps between them.

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