

Designing Collaboration: Comparing Cases Exploring Cultural Probes as Boundary-Negotiating Objects

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ABSTRACT

This paper examines the use of cultural probes as a method for fostering collaboration within groups of diverse experts working on creative projects. Using two case examples, we show that probes—short, oblique, and at times whimsical sets of activity prompts—have boundary object properties that can jumpstart interdisciplinary and cross-functional exchange. The first case explores how social scientists and designers used a smartphone-based scavenger hunt activity to gather insights for a workshop on organizational innovation. The second case examines how artist/scientist pairs utilized probe-like prompts to develop short performances for an arts festival. Drawing together theoretical views on boundary objects and cultural probes, we suggest that designed experiences such as probes can create opportunities for both boundary work and the establishment of common ground, which is increasingly vital in the highly collaborative contexts that define work today.

Author Keywords

Designing collaboration, boundary work, cultural probes, boundary objects

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION

Collaboration among diverse groups of specialists has become the *de facto* way of working in the 21st century. We are in an era where creative projects—that is, projects directed toward making something new for a specific purpose—are key and innovation is highly valued. With an emphasis on making and doing, we are turning increasingly to new forms of organization to inspire and accelerate this creative practice. Groups, teams and virtual organizations, in

both formal and informal situations, are working across temporal, cultural, structural and expertise boundaries. In theory, it is expected that such collaborations will benefit from this mixture of expertise, knowledge, and methodological insight. In reality, however, this level of heterogeneity often results in conceptual and social islands that sometimes prove challenging to bridge.

Given both the rise in and challenge of collaboration, it makes sense that we see a parallel interest in understanding how interdisciplinary and cross-functional creative work might be most effectively structured and/or facilitated. Like many organizational experiences, a successful collaboration is a combination of social, psychological, cultural, temporal, and structural considerations [12,14]. Tools, routines, protocols and collaborative environments also help to supply scaffolding for pushing beyond common interpersonal barriers and encouraging interaction. While there is no one magic formula for spurring substantive engagement among a set of diverse individuals, some findings suggest certain approaches are more generative than others [4,19,20].

These insights can be applied in ways that showcase collaboration as a designed experience, one that cannot be strictly controlled but that can nevertheless be channeled purposively via particular structures and/or activities. In this sense, effective or substantive interdisciplinary collaboration can be seen as a multiplex design challenge, to which a spirit of design thinking and experimentation can be readily applied. We have approached the question in such a way and report in this paper how the use of a set of tool-based activities that prompt rapid, lightweight engagement among individuals can be a way of enabling them to bridge their differences and begin building synthesis as a group.

THEORETICAL ORIENTATION

Challenge of Diversity

Diversity within collaborations is positively correlated with the notion that varied inputs will be more effective in surfacing new ideas or identifying potential solutions than information drawn from a more homogenous set of individuals. Being able to see a particular problem or issue from more than one angle or approach increases the likelihood that one of those angles or approaches will yield a

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successful solution. This is the logic that underlies crowdsourcing at a large scale as well as interdisciplinary teamwork on a smaller scale [22,25].

For all of the potential insights and solutions that teams of diverse collaborators promise, interdisciplinary collaboration is often fraught with conflict, much of which stems from epistemological clashes surrounding disciplinary vocabularies, levels of analytical thinking, and valued areas of emphasis. Although greater diversity of disciplinary knowledge within a collaboration can increase the potential for original discoveries, it also increases the functional distances that separate collaborators and reduces their technical overlap, which in turn impairs interpersonal interaction [15]. Disciplines have distinct vocabularies, assumptions, methodologies, and intellectual goals—in short, epistemological frames—that facilitate work within but impede communication, trust, and understanding between disciplines [3,6]. Epistemological frames are defined as implicit beliefs about the nature of knowledge [21], which play an influential and conditioning role on an individual's thinking and learning [13,27], academic persistence [7], and ability to cope with ill-structured problems [16].

Practitioners from different fields often engage in boundary work as a way to protect and defend the legitimacy of their respective epistemological frames. In the sciences, for example, Gieryn writes that boundary work serves to expand or monopolize authority or to protect autonomy [9,10,11]. Since professionalization practices tend to reinforce, rather than lessen epistemological frames, we should expect evidence of some type of boundary work to be present any time that professionals from different disciplines work together.

One way of overcoming the potential debilitations associated with boundary work is to establish common ground collectively as a group. Common ground, in this sense, can be a common vocabulary, a working understanding of means and purposes, or a shared foundation of reciprocal trust and respect [15,23]. These qualities are sometimes established by recognizing shared similarities, i.e. shared gender, culture, theoretical orientation, etc., but more often common ground is the outcome of some effort on the part of the members of the group or team.

A method that often facilitates the establishment of common ground is to use an artifact, concept, or other type of 'object' that is flexible enough in meaning or presentation that it supports the variety of interpretations present within a diverse group. Star and Griesemer [24] famously dubbed these methodological tools 'boundary objects'. According to their conceptualization, true 'boundary objects' possess clear, symbolic representations of meaning, weak global structures, and the ability to support common identification. They are effective in lending themselves to multiple, overlapping interpretations so that actors can see beyond their respective epistemologies to find a kernel of shared understanding. Star and Griesemer's ur-example of a boundary object is a map of

the state of California, which administrators, volunteers, and scientists at a museum at the University of California, Berkeley successfully used to outline their differentiated, yet integrated, work.

Following on the work of Star and Griesemer, Lee [17] introduced 'boundary-negotiating objects' to the discourse on collaboration. She acknowledges that robust boundary objects are rarely used to initiate conversations among interdisciplinary or cross-functional collaborators. More often, teams employ less fully formed objects like a spreadsheet or a sketch to initiate engagement with one another. In her work at a large natural history museum, Lee discerns that there are five types of boundary-negotiating objects, which together are used to "record, organize, explore and share ideas; introduce concepts and techniques; create alliances; create a venue for the exchange of information; augment brokering activities; and create shared understanding about specific design problems" [13:403].

In distinction to boundary objects, boundary-negotiating objects allow teammates to quickly take a snapshot of an individual thought and transfer it in a lightweight fashion among the other members of the group. The lightweight character of negotiating objects assists in de-emphasizing their epistemological qualities, while at the same time their malleability encourages alteration and improvement by those with alternate points of view. As such, these objects become mechanisms for destabilizing and pushing against extant boundaries, and in this constant negotiation and re-negotiation groups begin to build a common base of reference. In sum, by offering a way for individuals with multiple epistemological perspectives to come together and begin negotiating the boundaries that separate them, boundary objects and boundary-negotiating objects can be useful in bolstering the integrative potential of interdisciplinary collaborations.

Cultural Probes for Boundary Work

Cultural probes [2,7,8] have been identified by many designers as effective ways to jumpstart ad hoc collaboration—that is, short term or rapid types of engagement. Traditionally, the focus on engagement was on ways of involving users or constituents as part of the design process, as can be seen in the definition by Boehner et al. [2]: probes are "designed objects, physical packets containing open-ended, provocative and oblique tasks to support early participant engagement with the design process" [2:1077]. For example, Gaver's original probes included disposable cameras, maps, and postcards, each of which came with instructions, or prompts, for creative use. Gaver widely documented the use of cultural probes in his research for The EU Presence Project, in which probes were used as a method for designing ways to increase the presence of the elderly in three European cities. Attempting to create an experience with a playful spirit, the design team left probes with groups of elderly participants to complete on their own and return back to the design team. This method had multiple aims in

mind: to better understand the wants and needs of this group, to learn about the community, and to elicit a dialogue between themselves as designers and the seniors. Gaver explains, “Trying to establish a role as provocateurs, we shaped the probes as interventions that would affect the elders while eliciting informative responses from them” [7:25].

Since Gaver’s work with the elderly communities, there have been many permutations of cultural probes, mainly in the field of human computer interaction. As in the EU project, most implementations of probes are not directly observed, but elicit and gather evidence from constituents on their own time and in their own manner. The purpose of probes has been highly contested over the years, particularly their use as a sort of “discount ethnography” [2,5] in which researchers substitute time spent observing people with time spent analyzing information gleaned from cultural probes. Traditionally, ethnography as a method involves not only qualitative forms of observation, but participation with a community such that the ‘emic’, or native, perspective is represented completely and holistically. Gaver, and others, explicitly say that probes should not be used as a method for collecting data, but rather as a way to interact with and inspire/be inspired by users.

We suggest that one of the parallel uses for probes is—in tandem with Gaver’s spirit of provocation—to spark collaborative work. In this sense, we believe cultural probes can assist in the rapid generation of new boundary objects. We do not suggest that these objects, created quickly, will easily bridge boundaries and create harmonious collaboration. Rather, the collective action of completing the probe provides opportunities to develop the kind of trust and overlapping knowledge and interests usually developed through the collaborative work in which the groups are engaged. The two cases we describe below articulate the way that probes can serve as methods for encouraging positive engagement amongst individuals with different epistemological frameworks. Notably, these probes appear to accomplish this work not by way of their common artifactual nature, but rather for their ability to prompt activities in which multiple perspectives are valuable.

CASE DESCRIPTIONS

The two case studies we showcase here are similar in that they both detail incidents in which it is important for a set of individuals with distinct background, expertise and methodological orientations to work together to accomplish some specified end. The cases differ in the amount of time each group had to work together, the use of the product they were asked to produce, and the context in which their probe-based activity was situated. Our comparison focuses on how the probe was deployed and taken up by participants, with consideration for the differing contexts in which they were deployed.

Case 1: Open Design for Organizational Innovation Workshop

In November 2011, author C organized and led a one-day workshop in Brooklyn, New York in collaboration with a project called *Amplifying Creative Communities*, a Rockefeller Foundation-funded initiative to document and foster urban activism in New York City, which is based at the DESIS Lab at Parsons The New School for Design. The Open Design for Organizational Innovation (ODOI) workshop was organized around the principle that a set of diverse constituents—designers, academics, students, and urban activists, among others—can build on and shape successful community practices by joining forces. Part of the Amplify model is that designers and community leaders co-design new scenarios and service concepts that solve issues pertaining their everyday life in their specific communities by connecting with existing action and networks.

The workshop was attended by over 30 designers and social scientists, the bulk of whom were from the greater New York City area, but also included participants from as far away as Australia and Italy. The goal of the day was to deploy open design methods to assist a long-standing community organization improve their structure, internal and external communication practices, and overall engagement with the community. Open design is a form design practice based on open source methods and creative commons principles whereby ideas are generated to be widely shared and used [1]. In this workshop, designers, non-designers and various other stakeholders were all brought together to encourage interdisciplinary, multi-perspectival dialogue that could seed accessible, available and sharable design ideas for the client organization. The ultimate aim of the ideas generated at the workshop was to improve the organization’s capacity to engage the local community.

The agenda for the workshop was centered on a set of hands-on activities. The morning was dedicated to orienting participants to the design task, understanding the client, and developing a sense of the constraints and opportunities for design. In the afternoon, the group broke into four separate teams to brainstorm and prototype ideas focused on the following four themes: Telling Our Story, Staying Connected, Finding and Mobilizing Resources, and Engaging End-Users. Workshop activities were documented by dedicated observers, who took notes, captured photographs, recorded audio and video, and collected the artifacts produced by participants.

Designing the Scavenger Hunt

Gaining an understanding of the context, specifically the neighborhood, in which the community organization did its work was an important first step for workshop participants. As a provocative way of saturating them in this complex situation quickly, we designed an activity that would be introductory in a fun and lightweight way, but also required small teams to produce a collective understanding of key local issues to benefit the larger group in its afternoon activities.

Given their diversity, we knew the workshop participants would represent multiple points of view and would have little existing common ground to draw on as collaborators. As such, we designed an activity that would have the properties of boundary-negotiating object, namely one that would allow teammates to record and share ideas, showcase individual perspectives, and build social bonds with one another. Through this activity, we hypothesized that groups would create a common base of knowledge that would also act as common ground for their subsequent integrative collaboration. The exercise was also intended to be easy enough so that anyone could participate.

The activity we ultimately decided on was a cultural probe fashioned as a scavenger hunt. Our initial impulse had been to allow individuals a block of time for unbounded ethnographic observation, but we elected to use a group scavenger hunt activity instead because of the flexible, but constrained, directions it provided for the participants.

To put a focus on the contextual factors of the client organization, we decided to ask participants to photograph aspects of the neighborhood. To orient them toward the organization during this exercise, we drew inspiration from the organization's webpage regarding their mission and vision, specifically regarding five areas of active engagement: home, family, economic development, community, and opportunity. We believed that these themes were broad enough to invite interpretation and creative thinking, but focused enough to point the participants toward the kinds of themes with which they would work in the afternoon design session.

Workshop participants were given one hour to work in small teams of 2-4 people. One member of the team needed to have a smartphone with a camera to execute the following instructions:

“The aim of this exercise is to begin thinking about the mission and vision of [community organization], and how that might be embodied in parts of the neighborhood . . . While exploring the neighborhood, pairs should take pictures, and post them to Twitter with the hashtag identified in each picture and the hashtag #odoi11. There is no need to complete these in order, and multiple photos can be uploaded with the same hashtags.

- *Take a picture of something that represents family (post it with #family and #odoi11).*
- *Take a picture of something that represents a home (post it with #home and #odoi11).*
- *Take a picture of something that represents economic development (post it with #development and #odoi11).*
- *Take a picture of something that represents opportunity (post it with #opportunity and #odoi11).*
- *Take a picture of something that represents culture (post it with #culture and #odoi11).*

- *Take a picture of community, post it with #community and #odoi11.*
- *Take a picture of sustainability, post it with #sustainability and #odoi11.*

Describe the community:

- *As you walk around the neighborhood, tweet a list of words that describe the kind of community you see, please include the hashtag #odoi11.*
- *Tweet a description of the character of the community with the hashtag #odoi11.”*

In all, the small teams collectively posted 46 photographs based on the cultural probe directions. Posted tweets all included one or more of the hashtags suggested in the prompt, and some also incorporated original hashtags, for example, the tag “#ornamentalparanoia” attached to Figure 1. Participants also produced several textual tweets, as well as dozens of additional photographs that were not uploaded via Twitter due to technical or time limitations.

Observing the Scavenger Hunt

During the scavenger hunt, observers followed and videotaped the groups as they made their way through the neighborhood. Observers also wrote detailed notes; two observers were also interviewed by one of the authors of this paper. The following details derive from these data in aggregate.

Toward the beginning of the walk, we noticed that groups were focused primarily on following instructions—so they restricted their attention to discovering artifacts and incidents that represented home, family, opportunity, community, and culture as directed. However, as they walked about the urban streets of Brooklyn completing their task, they also began to ask one another questions about their backgrounds, current work, and various other personal details. With these details quickly out of the way, we observed a noticeable shift in conversation that occurred soon afterward: teammates began to ask about and offer up their own expert insights related to the neighborhood and the design tasks at hand. For example, one group member who lived in a nearby neighborhood described the culture surrounding the neighborhood bodegas. In another group, toward the end of scavenger hunt activity, one group member asked another, a landscape architect, to explain the design for buildings he deemed “unattractive.”

Later in the activity, group members started to shift away from the scripted instructions and began looking for examples the reflected some of the collective conversation that had sprung up within the team. Groups began to capture specific images centered on their own themes. As the interviewed observer noted in her debrief: “they were very investigative” at the beginning of the exercise, yet as the groups continued to chat and wander their conversations became “less investigative and more analysis-based.”



Figure 1. Photo tagged #odoi11 #home #ornamentalparanoia



Figure 2. A photo of a fenced and locked community garden. Participants appreciated the irony of the juxtaposed words “community” and “open to public” on the sign.

One of the self-selected themes that emerged as teams shifted from an investigative to an analytical stance was ‘juxtaposition’—particularly the juxtaposition of locks, gates, and bars with ‘community’ areas. At first, groups began taking images like the one shown in Figure 2, which showcases a garden, complete with a sign advertising ‘Open To Public’, behind chain link fencing. As teams progressed through the probe activity, they began to record instances of locks on doors and gates, bars on windows, and ‘Keep Out’ signs. Their conversation shifted in parallel to reflect on the meaning of these symbols in the context of the community and in turn discuss the significance of an open/closed narrative in the neighborhood on residents as well as for the work of the client organization.

Similar conversation sprung up between the juxtaposition of new and old in the neighborhood; however, we do not have space to discuss this analysis at length herein. Suffice to say that groups were able to use the probe scavenger hunts as tools to build common ground with one another, and having established this were then able to collectively generate new

interests and interpretations about the neighborhood based on their own direct observations as individual teams.

Using the Scavenger Hunt

In addition to serving as a way to jumpstart collaboration within the workshop’s creative teams, the aggregate data compiled by all teams during the activity was meant to have utility for the second half of the workshop. In specific, we hoped that the multiple, but targeted, views collected by the teams would produce a sensible constellation of the client organization’s community context that could be used to inform any potential design solutions produced by the workshop teams. Thus, as workshop participants were returning back from their wanderings and settling in to lunch, we posted the Twitter feed (with accompanying photographs) on one of the walls in our meeting room so that everyone could see the aggregation of images and tweets from all groups and begin to establish a comprehensive view of the themes and issues salient to the client organization.

In the afternoon, workshop participants broke into four groups of approximately 8-10 people that were organized around the themes mentioned in the workshop description. Groups were asked to brainstorm and produce prototypes that addressed the theme outlined in their design challenge. During the brainstorming phase, we observed individual groups turning to the photographic Twitter feed for reference and also sharing images with one another that had not been officially tweeted. These early collaborative exchanges revealed that the teams entered into the afternoon activities with an existing experience of common ground and understanding of one another’s areas of expertise. The scavenger hunt gave them all a common body of knowledge—the local neighborhood—that they could then leverage to negotiate the nuances of different brainstorms and design solutions as they arose. Groups were able to unpack their expert understandings without contentious boundary work because they had developed a rapport with one another and a common body of knowledge via the execution of the cultural probe. While none of the final presentations overtly referenced the scavenger hunt activity, we suggest that it was a vital preliminary step that launched a day of successful collaboration. The probe was both a shared experience, which resulted in a body of common knowledge, as well as a grounded activity that could be used as a reference when negotiating the ideation and production of prototype design solutions.

Case 2: Across the Great Divide

The second case that we discuss with regard to cultural probes, *Across the Great Divide*, was a performance project developed by author A in which 4 artist/scientist pairs were asked to collaborate to develop 10 minute performances for an art and science festival held in upstate New York. For this paper, we will call the pairs H and S, L and J, M and I, and T and J. Each pair met three times over the course of several months to develop their project, and then once more to for a dress rehearsal the day before the final performance. Author

A acted as a facilitator as well as a participant observer for each of the pairs. She designed the meetings so that each was a bit less structured than the last. The first meeting comprised a probe-like activity (discussed in greater detail below); the second began with a review of the first meeting and moved into open discussion and development of the performance; and the third meeting provided a chance for the pairs to refine and practice their performances.

Designing the Cultural Probe

The probe provided at the first meeting was designed to encourage creativity and provoke discussion between the pairs as they developed their performances. It consisted of eight activity prompts. Each prompt was contained inside its own envelope, and markers and paper were left on the table (Figure 3). It included prompts that suggested discussion, as well as prompts that suggested activities like drawing and writing. Most topics focused on either each individual's work, or on the broader theme of art and science. The final prompt asked them to write a mission statement for the piece they would like to create. Author A designed the probes with four goals in mind 1) to help the pairs develop a rapport and working relationship, 2) to inspire creativity and meaningful conversation as they thought about what they wanted to do for their performance, 3) to serve as a kind of interview that each pair would answer collaboratively rather than individually, and 4) to serve as a tool for planning and executing the rest of the experience. To achieve these goals, the probe needed to have specific goals embedded, but not specific outcomes. By this, we mean that the process for each prompt needed to have its own arc, but that the direction in which the pairs took the task and the way they knew they were finished had to be their own.

The prompts given are listed here; however, in the activity, each was provided in a separate envelope with any additional materials, like the quotes and images provided in prompts 4 and 5.

1. *"I begin each day of my life with a ritual: I wake up at 5:30 AM, put on my workout clothes, my legwarmers, my sweatshirts, and my hat. I walk outside my Manhattan home, hail a taxi, and tell the driver to take me to the pumping iron gym at 91st street and First Avenue, where I work out for two hours. The ritual is not the stretching and weight training I put my body through each morning at the gym; the ritual is the cab. the moment I tell the driver where to go, I have completed the ritual." -Twyla Tharp* □ *What rituals begin your work? Take us through them. Write them down or draw them. At what moment are your rituals complete? At what moment do you begin your work?*



Figure 3: The aftermath of the cultural probe activity. Each envelope contained a prompt and any additional materials necessary for the pairs to complete the prompt.

2. *Find 5 things you have in common.*
3. *Draw an Artist or Performer. What words or phrases do you use to describe artists and performers? Draw a scientist. What words or phrases do you use to describe scientists?*
4. *Respond in any way you see fit to each of the following. (several quotes were provided).*
5. *Is this art or science? What does it mean? If you had to write one sentence together that would capture the meaning of this image, what would it be? (several images were provided).*
6. *Write the history of your career in Newspaper Headlines. Tell each other your histories. How are they different? How are they the same? Would your stories be in the same papers?*
7. *Draw where you work. Draw your favorite thing about your work. Draw your least favorite thing about your work*
8. *Write a mission statement for the piece you will create. What will it do? What do you want the audience to think about?*

Observing the Cultural Probe

This initial meeting became the crucible of the collaboration not only because the pairs set a direction with their "mission statement", but also because they had developed a kind of partnership that might be described as rapport, but it went beyond a simple "friendly relationship." The relationship developed between the pairs also contained their understanding of one another's views on the relationship between science and art, on the nature of science and of art, and on their perceptions of their own role within their field. This, in turn, provided rich qualitative data for the participant observer about the participants' beliefs regarding art and

science, as well as their approaches to collaboration and brainstorming.

As the pairs moved through the eight prompts in the probe, some adhered more closely to them than others. For example, L and J diverged from the prompts quickly, using them more as a point of departure from which to engage in their own conversations, while M and I adhered strictly to the probes.

The pairs also engaged in much boundary work while completing the probes, but, as Halpern [10] argues, boundary work, under certain circumstances, can become a way to negotiate and establish new roles in interdisciplinary activities. There was some indication that this is what happened.

Using the Cultural Probe

Each pair left with a mission statement for their performance, but they also incorporated their work on the other prompts into their scripts. At the second meeting, the pairs were given their notes and sketches from the probe, along with transcripts from their first meeting for reference. At this point, each pair developed along a different trajectory. One pair, M and I (a physicist and a dancer), found similarities in the process of creating a dance and of creating new knowledge in physics. During the first meeting, they began to develop a model to describe this process. They spent the second meeting refining this model and trying to develop a way to speak to an audience about it. Another pair, L and J (a poet and a physicist) found that during the probe, one of them would respond to a prompt, and, in doing so, would spark a memory or idea from the other. The pair found that they greatly enjoyed these mutual springboards and aimed to develop a performance that could display this process. Each instance of interacting or negotiating, then, resulted in a different way to use these interactions in the final performance.

DISCUSSION

The scenarios for cultural probes we outline herein are based on a pair of different collaborative experiences, marked in particular by different temporal features (i.e., one day versus several months) and different technical features (i.e., an aggregated Twitter feed versus interaction with physical objects). These distinctions provide ample basis for comparison and synthesis. To distinguish probes used to facilitate boundary work from traditional cultural probes or boundary objects, we use the term ‘boundary probes’. We make three arguments about the nature of these probes in the following section.

Exogeneity

The first key element that spans both of these two cases is the function of a probe as an ‘exogenous shock’ [26] to the small organizational system that is the team, working group, or other social structure. The exogenous nature of the probe—the fact that it is inserted from the outside into a collaborative situation in an attempt to provoke some type of response—

renders it different in many ways from the traditional conceptualization of a boundary object or boundary-spanning object, which is typically conceived as an inductively recognized tool developed by a group of collaborators over a period of time. When Star and Griesemer [24] speak to the plasticity of the map of California as a boundary object for zoological researchers and their collaborators, they underscore that the bridging work being done by the tool is an outcome of previous trial and error; the object is not an input. The map comes to be recognized for its ability to span disciplinary epistemologies, methods, specialized language, power differentials, social homogeneity, etc., but does not start out with these affordances.

In many situations in which unfamiliar and diverse groups of people must learn to collaborate quickly, however, there is no time for such recognition around objects or artifacts to develop. In these cases—such as those articulated in this paper—a probe becomes an initiating mechanism for collaboration. It is an outside interruption to normal practice that requires immediate adjustment, and it is that intentional disrupting effect that endows the probe with its utility. The activity required by the probe’s directives engenders boundary spanning. Individuals with disparate perspectives come together through their joint action, and it is through this work that they find common meaning, purpose or direction. The activity becomes codified in a recognizable way—it takes on the affordances of plasticity and multiplex commonality that we understand in the more material conceptualization of boundary objects. The activity brings people together, but goes beyond more than just breaking the ice by being plastic enough to incorporate multiple perspectives. A boundary-spanning probe in this case acts as a scaffold, not a prescription; it is a coherent and enticing alternative for collaboration, not a step-by-step recipe.

When thinking beyond these empirical cases toward a more generalizable theory of boundary probes, we would suggest designers build on the exogenous shock value of activities that intervene to push people beyond their normal routines and practices. When they must engage in an activity that is totally new and equally unsettling for all, people can legitimately start afresh without the need for the extensive impression management that complicates so many interdisciplinary collaborations. It is this leveling of the social landscape that gives the probe its boundary spanning affordance.

Scaffolding

In addition to their external orientation, probes provide a recognizable structure for people to act upon. This structure is elemental for engendering productive boundary work—work that serves as a way for each team to become familiar with one another, establish a group identity, and collectively orient toward project goals. In response to a specific set of direct questions and a directed technological methodology, small teams on the scavenger hunt, for example, were able to move beyond the specifics of the task to develop a kind of

‘question and answer’ rapport in which different group members specifically asked one another for input related to their respective expertise. The probe’s instructions—the recognizable scaffold—nudged groups to begin joint work together as outlined above, but soon these limits gave way to make room for more endogenous forms of collaboration like creating new themes for documentation. As time moved on, we also saw a pattern of inquiry and analysis emerge within groups, as in the example of teammates querying a peer about architecture having come to recognize the relevance of her expertise over the course of the activity.

In the Across the Great Divide case, probes provided a different type of scaffolding. Here, the prompts were divided into several kinds of activities: activities in which participants shared their professional experiences (e.g., prompt 6: your career in headlines; or prompt 2: finding things you have in common); activities specifically designed to bring the subject of art and science into conversation (e.g., prompt 5: looking at images and deciphering whether they were art or science; prompt 6: responding to quotations about the relationship between art and science); and activities designed to spark conversation about what their collaboration would look like (e.g., prompt 8: design a mission statement for the piece you will create). Because of this directed design strategy, pairs engaged in very direct forms of boundary work and then collaboration: they first learned about one another’s professions, then with that conversation in mind, they used that knowledge to help them draw boundaries between and around their work, and finally to use those boundaries to help them develop a narrative. As a result, their eventual collaboration took on a constructive nature in which teams were able to negotiate with interest and respect, and ultimately create artifacts that had collective meaning in the context of their larger festival agenda. For example, a physicist and dancer described a similar cycle of observation, synthesis, creation, and presentation in their work. They used this cycle as the basis for their performance, highlighting the ways science and art were similar. Part of their comfort level in doing so stemmed from the safety they found in the boundaries they had designated between art and science.

Again, drawing out the generalizability of boundary probes, we see that they need to be designed with enough specificity to guide an initial set of actions in a mutual direction (i.e., collection of tagged, neighborhood photographs; production of festival artifacts). Tasks need to be recognizably salient to the context in which they’re found, but they also need to be easily understood in a way that compels directed engagement. In the cases presented above, it was precisely the recognizably relevant, yet plastic, nature of these activities that encouraged engagement by everyone and facilitated open discussion and exchange. Their lightweight, almost informal, structure was also significant: there was little pressure on the teams to come to a specific conclusion or consensus by argumentation, rather the mandate to explore together necessitated a style of interaction that eventually encouraged genuine collaboration, including synthesis and/or

the production of a collective point of view. Directed, but unbounded, tasks like those articulated here appear to be valuable in de-emphasizing behaviors that amplify epistemological differences, while yielding a social environment in which diversity can be channeled profitably and lightheartedly.

Improved by Diversity

Both of the cases presented here showcase the third important feature of a boundary probe: its ability not only to encourage joint participation within diverse communities, but also to be improved by that diversity. For example, in Across the Great Divide, there were several task prompts that required participants to answer questions about themselves and their work (e.g., prompts 2 and 6). The result of this complexity might have been an overt conflict or a collaboration breakdown. Instead, because the task scaffolded activity toward a cumulative project in which broad thinking was required—the production of a mission statement—the probe enabled the group to find direct value in their diverse viewpoints.

The scavenger hunt too benefitted from the multiple eyes and diverse perspectives of its participants. The probe’s prompt to look for local evidence of community, family, etc., was by definition one that needed to be considered from varying perspectives. Urban planners and designers took pictures that incorporated their knowledge of built structures and the social landscape of the city, while social scientists and designers saw different aspects of the environment. In each case, the scaffolded nature of the probe’s tasks acted as a funnel for diverse inputs to become collective insights. An effective boundary probe allows each participant to offer insights based on his or her area of expertise, but simultaneously transforms that diversity—usually by providing a change of conceptual frame—into something salient for the work the group must do together.

In summary, we underscore the fact that many of the practices common to cultural probes are also important in the creation of boundary probes. Oblique tasks that invite interpretation and meaning making have the most potential to spark creative discussions. Good probes often require the use of varied media and modes of thinking. For example, they use prompts with photography, drawing and mapping to encourage visual thinking, as well as different kinds of written prompts, such as phrases, poems, and, as in Across the Great Divide, newspaper headlines.

Boundary probes differ, however, in their structured ability to start conversations. Whereas Gaver’s classic probes are meant to be completed alone and mailed back to the researcher/designers, boundary probes are group tasks—which, on some occasions, are observed by the researchers or designers. The most important point to bear in mind when conceiving of boundary probes is that there is no standard design; there is no template for engendering joint engagement. Rather, each probe must be salient enough to make sense within the larger context of the project,

recognizable enough to prompt immediate understanding, robust enough to improve with diverse inputs, and scaffolded enough in its task design to converge toward a joint outcome.

ROLE OF IT IN BOUNDARY PROBES

Each of the examples we present herein involve a fair amount of co-located activity, which prompts the question: what is the role of information technology in boundary probes? The challenges of distributed collaboration, which are many and well documented, often revolve around a lack of common ground and, thus, trust. These issues fall well within the scope of boundary probes, which could easily be adapted to these distributed settings. Given that we do not yet have extensive empirical data from which to draw grounded conclusions, we take this opportunity to speculate on the affordances that networked tools and/or mediated interactions might provide for provoking successful collaboration at a distance.

In the case of the neighborhood scavenger hunt, which involved both distributed and co-located interaction, Twitter and its companion application, TwitPic, enabled unknown collaborators to move beyond their individual viewpoints toward nascent collective understanding. The mobile app allowed individuals to spread out across a large distance to take advantage of spatial distribution as well as personal perspective. The use of hashtags allowed for folksonomic cataloging of photographs and provided a lightweight form of organizing that both allowed individuals to formalize insights (i.e., the creation of new tags) while insuring proper aggregation (i.e., use of provided hashtags). Finally, TwitPics' display of each uploaded picture—ordered by time—emphasized the democracy of the task as well as the equality of each input—a key element of a boundary probe as articulated above. By using a simple social media tool like Twitter, the task was transformed automatically from one of personalized presentation to one of crowdsourcing and collective intelligence.

This efficacy of Twitter in this case hints at additional features that could extend Twitter or a similar crowdsourcing tool to support the same task with groups who are completely distributed. Photo and textual input could remain the same (i.e., uploading files with hashtags and other metadata), however the design of the interface that assembled and displayed these aggregated inputs would need to engender an interaction space that supported collective sensemaking. In the spirit of a digital light table, clusters of images could be automatically organized into thematic groups by hashtag, but the tool would also need to provide users an easy way to perpetually revise organizational schemes as they negotiated together to understand the meaning of the data. During this sensemaking process, the tool might also provide ways for collaborators to hear the thinking aloud of fellow team members as they draw inferences and make associations—an affordance that is currently built into other collaborative task spaces like massive multi-player online games.

Boundary probes in distributed collaboration could also support extended activity in a way that is impossible in face-to-face situations. Probe activities could be designed so that their exogenous shock value lies less in an immediate, re-ordering intervention and more in the gradual recognition of collective value. The most obvious precedent for such a tool is a casual social game like Farmville. If a boundary probe were designed as a game, distributed collaborators could engage in a set of scaffolded activities over a period of months, occasionally checking in to track their progress. Per the design of the probe, the group might build on and revisit their collective insights at successive phases, leveling up at certain points to meet new challenges that result in greater collaborative outcomes.

Whether groups are wholly co-located, totally distributed, or somewhere in between, the opportunity to design and implement boundary probes affords design researchers the opportunity to discover more about the socio-technical bases that allow people to work and play well together. Our future work will explore how issues such as probe type (i.e., challenge, game), situational context (i.e., workplace, neighborhood street, online), and timing (i.e., rapid, longitudinal) effect group dynamics and collaborative outcomes. We believe that this perspective on collaborative interaction will yield discoveries and insights that will benefit the CSCW community.

CONCLUSION

The two boundary probes described in this paper were each designed as sets of structured activities that would engage diverse participants in directed work that could build on epistemological differences in an aggregative instead of homogenizing way. The design of these probes drew on insights from boundary objects [17,24] and cultural probes [7,8] as mechanisms for facilitating new insights and interactions. In both cases, we saw teams use the activities comprising the probe to share ideas, create alliances, exchange information, and develop shared understanding.

To understand what made these activities successful, we go back to their design. Although each probe activity was tailored to the project in which it was situated via specific prompts, the expected outcomes were unbounded and even ambiguous. In other words, the open-endedness of the goal created space for expertise and personal discovery, while the focused nature of the prompts guided this diversity in a way that allowed collective brokering and sensemaking to support the establishment of common ground. While these two case studies are exploratory in nature, they show great promise for future collaborative work, both on and offline.

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