Broadening adult engagement and education in science cafés: lessons from an STS — science communication boundary spanning experiment

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Abstract

This essay describes and reflects on a collaboration between a university Science & Technology Studies (STS) educator and a community science café organizer. Our partnership was designed to address two challenges: how to encourage diversity and inclusion in science café audiences and how to create assessments for broader 'science in society' content delivered to adult café learners. We used focus groups to develop STS learning constructs and do community engagement needs assessments. We describe the resultant café series development and other outcomes of our cross-domain work in STS, science communication, and science education. We conclude with observations about the power of collaborative storytelling and make general recommendations for how practitioners and scholars can address the described challenges in ways that might ease future collaborations.

Introduction

An interdisciplinary educator and a community practitioner walk into a bar…

The science café, as an institution of science communication, has continued to diversify in form and intention over its short twenty-five-year lifespan. Starting in 1998, when the practice of staging cafés began and quickly spread to more than twenty countries through the Café Scientifique "movement," these café events were often organized by individuals as volunteers[1] [Grand, 2014]. The original 'classic' café — a smaller open discussion in a pub between scientific experts and attendees around a particular "controversial and sexy" topic [Dallas, 1999]

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[1]The Café Scientifique website, created through initial funding from the Wellcome Trust, continues to exist today — for a listing of cafés in cities and countries around the world, see http://cafescientifique.org/ (accessed 3/31/2023).

— remains popular, while the contemporary category "science cafés" now also encompasses larger, professionally or institutionally organized live public events of various formats held in both academic and non-academic spaces, for audiences ranging from adults to older teens.

At the same time, North American and European science café organizers, as well as science communication professionals and researchers, have observed that problems of diversity and inclusion characterize diverse science café events. Science café attendees remain largely homogeneous — overwhelmingly highly educated [Navid & Einsiedel, 2012] and White [Childers, Governor, Osmond & Britton, 2022, p. 1063; for an exception, see Balls-Berry et al., 2018] and middle class [Wilkinson, Bultitude & Dawson, 2011] — and venues or language issues also make many such events further socioeconomically inaccessible [Eder, Darmawan & Cohen, 2021]. Even when cafés moved online during the COVID-19 pandemic, some demographic trends, like the dominance of middle-aged attendees, persisted [Pacini, Belmonte & Bagnoli, 2020]. One scientist, who was both a presenter and an organizer of a 2011 Artificial Intelligence café in England, captured the tension between broadening knowledge and building stable audiences often at play in café events. Organizers have recognized how homogeneous audiences might possibly result from unconscious biases.[2] Such cafés could also fail to attract diverse participants even when the topic is broad, and location is considered because, according to the assessment of Emily Dawson [2014], "informal science education [ISE] institutions" — like the many museums that host these events — "are not inclusive spaces" [p. 982; also see Feinstein & Waddington, 2020; and for science communication Canfield et al., 2020].

A different, but similar, tension also lies at the center of informal educational 'science and society' cafés. Many café events developed by universities and researchers who are seeking to broaden non-science audiences for their work do raise both science knowledge and awareness of science and society issues among participants. Education researchers have demonstrated the pedagogical functions of cafés and other public science "dialogue events" [Lehr et al., 2007], especially documenting their effects on the increased science comprehension of participants [Driscoll et al., 2003] and categorizing them according to the types of events and learning goals of organizers [Davies, McCallie, Simonsson, Lehr & Duensing, 2009]. STS (Science & Technology Studies) researchers have further shown some practical gains in 'public understanding of science' (PUS) in science cafés: for instance, café discussions gave participants a more complex understanding of science — e.g. how positions of scientific expertise could shift in a policy debate [Kerr, Cunningham-Burley & Tutton, 2007] — and promoted positive attitudinal changes towards science in society [Zorn, Roper, Weaver & Rigby, 2010; Stilgoe, Lock & Wilsdon, 2014]

But while broadening awareness of science has been a shared goal among many academics creating cafés and other 'science in society' educational opportunities, the expansiveness of such work has arguably generated methods and practices so

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[2]For example, one scientist, who was both a presenter and an organizer of a 2011 Artificial Intelligence café in England,noted: "it's the middle class intellectual types that attend but if you are actually trying to educate usefully and you've only got a room that can hold 100 people, then you know maybe that is the audience you need, or the useful audience." See Wilkinson et al. [2011, quote p. 380–81].

diffuse that they defy straightforward measurement. "As an interdisciplinary field, STS does not have easily demarcated boundaries"[Hess & Sovacool, 2020, p. 1], and in turn, few tools exist to assess its effectiveness for adult learners. The rise of institutionalized University STS curricula in the 1980s and 1990s reflected a multiplicity of goals — from continuing the trend towards helpful retention of women and non-White science students ages 12–18 [Gardner, 1998; Hurd, 1991; Seymour & Hewitt, 1997] to addressing a "dawning recognition that specialization does not fully prepare future citizens to respond knowledgeably and reflectively" to science and technology [Harvard University, 2023]. But in these and other formal educational settings, institutional precedents and political realities more often shape pedagogical decision-making — so more claims have been made about STS pedagogy's function and utility than have been actually demonstrated [Aikenhead, 2005].

"STS in Science Cafés" (2016–2019), a U.S. National Science Foundation-funded collaboration[3] between a university undergraduate STS (Science & Technology Studies) Program at Virginia Commonwealth University and Science Pub RVA (SPRVA), a community science café in Richmond, Virginia, launched to explore the intersections of these two issues. We simultaneously asked: how might broad STS content be employed to help a popular local café become more inclusive in its outreach and attendance? And how could the resulting series of STS cafés be employed to develop a larger community audience for adult 'science in society' learning, as well as to develop and test a user-friendly assessment tool for adult informal STS education?

This essay narrates the development and practice of our collaborative work, with an eye towards analyzing the 'messiness' that characterized its multiple scholar-practice domains — namely, science communication [Metcalfe, 2022], science education [Clark, Brody, Dillon, Hart & Heimlich, 2007], and STS [Law, 2015].[4] Riedlinger et al. [2019] have suggested that "where collaborating can create and validate stronger stories in the public domain," doing so creates opportunities for "effective and ethical use of storytelling in science communication" (p. 4) as well as increases the likelihood that research results will be taken up by practitioners. History of Science (Rader's primary field) and science communication practice (Gibbs' field) both claim storytelling as an effective means of analyzing results and describing processes [Harkness, 2009; Dahlstrom & Scheufele, 2018]. Ultimately, then, we use storytelling to make visible the complex web of opportunities and drawbacks that doing informal education research in this shared STS-Sci Comm space holds.

Within science communication, recommendations to attend to the research-practice divide are not new (see the work of the Research-Practice Collaboratory 2019; [Besley & Dudo, 2022]), nor is the observation that best practices likely require "embracing the chaos and messiness" that broadly define the field [Metcalfe, 2022, p. 6]. But our account builds on this existing work by introducing informal education

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[4]As Peterman et al. [2021] notes (p. 10) the NSF only funds public engagement of science programming in the service of researching questions about informal STEM learning, there are my folks beyond us working in this cross-field domain.

research insights into the conversation — in particular, it shows how, as education researchers have noted, important barriers to cross-field collaboration often make themselves visible only as 'stubbed toes' "along a path where many points can't (and shouldn't) be described as failure or success." [Clark et al., 2007, p. 111]. For those contemplating similar research undertakings, then, we conclude with recommendations for how to better understand and address these obstacles — and thus improve future collaborative journeys to improve research in this emergent field.

The initial experiment and outcomes

. . . and they built a small shared practice around mutual benefits and trust. (No joke!) Then they expanded on the questions generated to propose some research.

Pilot project

Our scholar-practitioner connection began when Cynthia Gibbs invited Karen Rader to present at Science Pub RVA (SPRVA): through this, the café itself became a kind of 'trading zone' for our educational and communication goals [see, for instance Lewis & Usher, 2016]. At the time, Rader directed her University's long-running STS program (STS@VCU, 2006–2019), an interdisciplinary undergraduate initiative that included daytime lectures featuring scholars and artists and some community engagement (mostly via staging occasional on-campus evening lectures that select locals sometimes attended). Interest in community audiences and the limited availability of University facilities for evening and late afternoon programming led Rader to pitch the idea of a short-term partnership. At that time, Richmond's three-years-young science café was an independent citizen-led initiative. Since Gibbs' vision for SPRVA was to be adopted by a local institution (PBS station or VCU), as well as reach more folks who classified themselves as "not really that into science", having historians, sociologists, and philosophers of science present at its cafés was especially appealing/motivating — so she accepted Rader's offer to collaborate. This initial one-on-one collaborative experience revealed some complementary interests.

Springing from this, we created a short-term independent pilot project, driven only by our own enthusiasm and available time investments. In Spring 2016 Science Pub RVA hosted the three STS scholars already scheduled to lecture on VCU's campus during daytime hours. Each presented an SPRVA café that same evening in what had become Gibbs' standard recommended format: a brief (20–30 minute) lecture to an audience followed by a Q&A period of equal or greater length. After each event, we circulated an exit survey, which in addition to SPRVA's standard questions[5] included one STS-specific assessment question: "How much did this program enhance your understanding of science in society?" on a scale from "zilch" to "crazy high," without any numeric delineations along the horizontal line spectrum that an academic survey would have posed on a numerical Likert scale.

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[5]The exit survey included several questions typically posed at SPRVA to understand the motivation for attending and to determine science orientation demographics (ranging from "I am a scientist" to "I am not that into science"). STS and science communication scholars have explored the difficult question of how to reach "not into science" people — and whether science engagement activities actually do — in particular, through collaborations across the science/art divide — like "Guerilla Science." See O'Connell, Keys, Storksdieck and Rosin [2020], Rosin, Wong, O'Connell, Storksdieck and Keys [2021] and Rosin et al. [2023]). But this was not work of which either of us was aware at the time of the small pilot; thanks to Bruce Lewenstein for bringing it to our attention.

Through such give and take, as well as by accepting some of one another's existing methods of work, and without the constraints of external justification, developing the pilot project built collaborative trust.

The pilot project generated some new data and new questions which affirmed incentives for each of us to pursue an expanded collaboration. The exit surveys also revealed that STS speakers had improved the engagement experience for SPRVA attendees: qualitative responses registered higher enjoyment and appreciation. Gibbs thus believed that the broader scope of STS ideas and themes that defined the academic program's work still held some promise for broader community engagement. Rader saw collaborating with SPRVA as a scholarly opportunity to research this question. As the co-developer of VCU's academic STS rubric and curriculum, as well as a researcher on the history of adult informal science education [Rader, 2019] she further wondered about the intersection of broadening engagement and STS learning: how might STS ideas (about the complexity and context-dependency of science and technology) serve the practical goal of broadening the community of adult learners for STS programming, at the University and beyond? Rader identified NSF's AISL "exploratory pathways" mechanism as a good fit for seeking external support to illuminate these questions — specifically by developing a combined program of events and research.

Grant proposal development

During grant proposal development we intentionally involved new partners to enhance the project's capacities, and we used the iterative process of external review to clarify and narrow both our research domain and our methodology. For instance, Rader realized that an assessment tool for adult informal STS education was needed to measure both engagement and content knowledge — so she recruited specialists Rockman et al., a professional educational evaluation firm, to the project. The Rockman team (Kristin Bass and Fatima Carson) worked extensively with us to understand the goals we had for our research — broadening community engagement, determining STS learning constructs, and validating assessment for the STS content of the cafés — and suggested ways we might build the concepts and infrastructure of the grant to support them. For instance, they recommended that we appoint an advisory board representing the diverse bodies of scholarship and practice our project involved; ultimately our board consisted of a science engagement practitioner, as well as multiple STS scholars and an informal learning assessment researcher. Likewise, although promoting café participant diversity was an issue that we initially flagged as important,[6] we were asked by NSF reviewers to further operationalize that goal. In turn, we involved VCU's Office of Community Engagement to determine appropriate conceptual categories and practical community partners [see, for instance Howard & Allison, 2004; Sickinger, 2018]. We narrowed our engagement goal to two demographically

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[6]The Carnegie Foundation elevated Virginia Commonwealth University to a "Community Engaged" designation in 2011 and it was reaffirmed in 2015; this made VCU just one of 28 public universities in the country with academic medical centers to achieve both distinctions. For a current list, see https://carnegieclassifications.acenet.edu/wp-content/uploads/2022/01/Current-Classified-Institutions_Carnegie-Elective-Classification-for-Community-Engagement.pdf (accessed 5/16/23).

prominent Richmond communities, African American[7] Richmonders and Richmonders with Disabilities, and in turn, connected with VCU's two most relevant partnerships: Carver Community and Partnership for People with Disabilities. We included requests to fund broad accessibility measures — for instance, streaming the cafés live on some social media platforms.

Further conversations with the evaluation partners, trained in educational research, led us to agree upon the focus group as our primary methodology. Together we planned focus groups for front-end evaluation of broader community needs and assessment of attitudes, feelings, and beliefs regarding 'science in society' café topics and locations [Stewart, Shamdasani & Rook, 2007]. This method, combined with VCU's community engagement connections, we believed, would offer us — two middle-aged, middle-class White women with minimal experience in community-engaged informal education or research — the most reasonable opportunity to have meaningful conversations about informal science education with local historically underrepresented or ignored groups. Also, to ensure we had a shared understanding of STS for café topic planning and construct identification, Rockman planned a focus group with us as a kind of 'needs assessment' of what 'science and society' meant. This internal focus group, with an expert review of the Advisory Board, would introduce an iterative and collaborative element to our STS educational assessment development.

As the research proposal evolved, however, our researcher-practitioner collaboration became more complex, and in turn, its needs and capacities remained less discrete than our budget line items, carefully crafted language, and clear timelines. In December 2015 (midway through drafting the NSF grant proposal), SPRVA became a community engagement program of the local Richmond public television and radio station (originally Virginia Public Media but now VPM).[8] This partnership promised greater key capacities for both the research documentation and community engagement — specifically, VPM could take on the tasks of marketing café events (via radio spots and other targeted print media) as well as filming and editing, and eventually (in Spring 2019) live streaming of the cafés. Also, in the summer of 2016, we worked alongside Rockman et al. to train, develop, and gain VCU IRB approval for the initial community-engaged focus group research. We devised basic questions about possible STS topics of interest and possible neighborhood locations of the cafés since we knew (from Gibbs' past informal surveys) that the venue had been an influential factor in shaping the attendance of previous SPRVA attendees. Even with Rockman's encouragement and assistance before the grant was funded, however, learning and becoming CITI Human Subjects Research certified to support IRB process while also learning and practicing a new research method (how to conceive focus groups) captured two months' worth of our shared energy and time — for Gibbs, this was work was now something of a "force-fit" [Brunot, 2022], done on overtime while meeting VPM's mandate simply to develop community programs. The grant was fully funded in

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[7]With regard to race, ethnicity, and community identification, we chose "African American" for multiple reasons: first, because it is part of the Federal census category "Black or African American," and second, because many contemporary Black Richmonders are descendants of the at least 300,000 enslaved persons of African origin sold in Richmond (between 1830–1860) to cotton and sugar plantations in the Deep South. For more on this history, see https://www.sacredgroundproject.net/.

[8]SPRVA functioned institutionally, as a community engagement program of VPM, for a total of 33 programs (31 in person and two virtual) from January 2016 through September 2020. For more information, see https://sciencepubrva.org/.

October 2016, but as with nearly all non-profit philanthropy and academic grantsmanship, it had already morphed along the way, and it succeeded largely by relying on fronted, non-funded labor.

Funded research project

But opportunities and challenges ensued when research plans met structural and institutional realities. So, they adjusted their expectations — again and again.
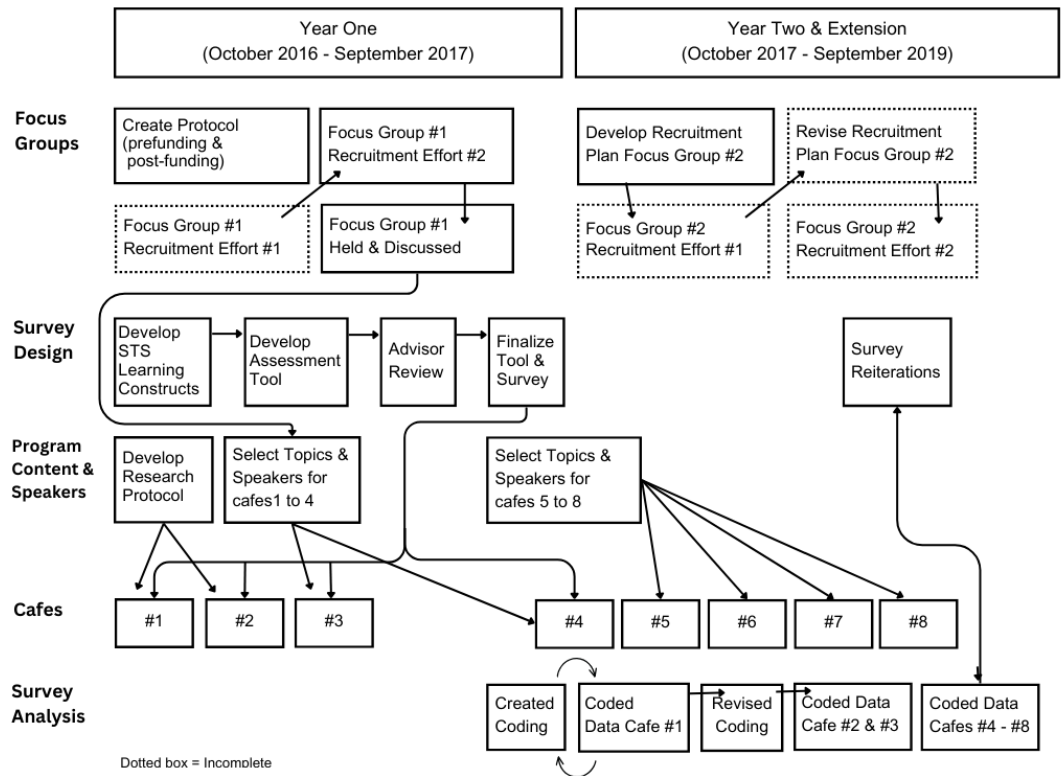

Figure 1. Research project overview.

Our funded project work embodied the messiness of the STS scholar- Science Communication practitioner research space — and this messiness presented both opportunities and obstacles. Here we describe the focus groups and café planning as distinct research components while also noting how decisions about each component shaped the other. As we began the experiment of scaling up our collaboration, now as institutional rather than individual partners, several planks of research and practice necessarily proceeded alongside one another *(For a graphic overview of our timeline and activities, see Figure 1)*. However, during proposal development, what we had thought would be relatively straightforward build-outs of these components quickly became more structurally complicated to execute. Our experience with the internal Focus Group on STS learning and the two community engagement Focus Groups provided initial cases in point.

Focus groups in practice

Having a limited understanding of learning and educational evaluation research, neither of us knew exactly what to expect from the "What is STS?" the internal

focus group was devised and held by Rockman in late February 2017. Gibbs had informal exposure to STS through the pilot project and her own flexible understanding of professional science communication on which to rely. In turn, Rader and other members of the advisory board held STS expert knowledge — including familiarity with research done by science education scholars on STS high school education assessment [Aikenhead, 1973, 1992] — but they knew little about how to translate the focus group findings into possible STS learning constructs.

Ultimately, Rockman drafted a list of possible STS constructs and café survey questions that drew themes from our focus group conversation, as well as from their own expertise. The list included modifications of some VOSSTS high school questions [Aikenhead, 2005] that overlapped with topics Rader identified as important, and also some questions that Rockman introduced which had been validated by previous evaluation research as effective self-report items for epistemological beliefs [Conley, Pintrich, Vekiri & Harrison, 2004]. Rockman formulated each construct as a statement that café attendees could rank numerically on a 7-point Likert scale from Strongly Disagree to Strongly Agree — on the assumption that framing this would make it easier for attendees.

Final decisions about which STS constructs to measure in the cafés, however, elided our STS-SciComm collaboration; instead, they relied primarily on the academic and professional expertise within the broader project team. As a practitioner, Gibbs decided to limit her exposure without fully understanding that the discussions and decisions would impose constraints governing future iterations of the café survey instruments. Rader and Gibbs discussed draft constructs further with Rockman and agreed to ask the Advisory Board to review three constructs: one involving Engagement with Science and Technology (1 question) and two Involving STS Learning: Science as a Human Endeavor (2 questions) and Complexities in the Development of Scientific Ideas (11 questions). Gibbs appreciated Rader's efforts to include a café practitioner in this process, but ultimately Gibbs determined that the core content of this complex activity was beyond her science communication and community partner expertise and capacities — and largely disengaged until the final decision meeting. With small modifications from the Board feedback (March 2017), these STS constructs became the full menu from which we would draw (later, during café planning) for STS learning survey development.

That same month, Focus Group #1 (n=5) was staged by Rockman, and it yielded robust community conversations and useful practical advice for how we might broaden the café engagement among Richmond's African Americans. Regarding café locations, nearly all of the self-identified African American participants suggested they preferred holding cafés in Black-owned restaurants and venues in historically-Black neighborhoods within Richmond. They also agreed that specific locations mattered less than doing work to broaden awareness through appropriate Black media. Not one of these participants was aware of SPRVA's existence before the focus group, but once the café concept and format were articulated to the group, they ultimately expressed interest in a wide diversity of science cafés topics, among them clean air, water, farming and food production, skincare, and Black Excellence in STEM.

Focus Group #1's important formative results gave us a research-informed way forward to increased community engagement, but they also made some obstacles visible. For instance, the administrative complexity of our community engagement research tasks nearly overwhelmed our ability to execute them in a timely fashion. Focus Group #1 recruitment to a minimally acceptable critical mass to allow for no-shows (12–15) took 4 months to complete. University bureaucratic challenges accounted for a large portion of this time: such issues are well-known in grant-getting [Taggart, 2021]. Obtaining and then issuing Visa gift cards as incentives for participating in focus groups — a critical tool for research participation — has since been centralized by VCU into a single online system. At the time of this grant, however, arranging these required training and extensive interaction with multiple systems and people at Rader's institution– from procurement (for advice on compliance) to budgeting staff (both at the level of Rader's larger academic unit (the College of Humanities and Sciences) and her home department (History, which had no experience with NSF grants).

Similarly, our community engagement work was unexpectedly hampered by last-minute changes in existing partnerships. In the wake of the 2016 U.S. presidential election, one of the project's additional VCU/African-American community partners (a local health advocacy and education group) experienced staffing cuts so severe that they had to cut back on their work with us and other partners in order to focus on their core services. In turn, we expanded our work with the first VCU/African-American Community partner (a university-neighborhood coalition), leaning more heavily on their networks, which yielded an initial critical mass (n=6) of potential participants. Gibbs and her VPM collaborators subsequently reached out to their professional connections in the African-American community (including those in non-profit historical, public policy, and teacher professional development arenas) to develop new recruitment leads. Rader worked with local merchants and circulated IRB-approved posters in local Black-owned locations to boost focus group enrollment. Working with individuals or new and one-off partners got us each only a few isolated volunteers. Rader then attended multiple Carver Community Association monthly meetings and explained, in person, the project's educational approach to community members, allowing time for a conversation and questions around that presentation to achieve greater engagement. Moving beyond our recruitment plateau, however, would require dedicated time that neither Rader nor Gibbs had for further developing relationships, some pre-existing and some new.

In comparison, Focus Group #2's community engagement (Richmonders with Disabilities) appeared to have stronger foundations, but its recruitment failed entirely because it was plagued with its own complexities and structural problems. With the Advisory Board's encouragement, we initially imagined and considered several different self-identified and intersectional disability subcommunities(such as the deaf, the mobility-impaired, and the autistic) as potential research candidates. We targeted one of these (the mobility-impaired) and identified four established VCU units or projects connected to diverse community members with this identity [including Sickinger, 2018]. Through the Spring and Summer of 2017, we held recruitment strategy conversations with three partners, and many key mobility-impaired disability advocates and researchers gave us excellent and direct advice that we followed about publicity and community engagement strategies — but to no avail. In turn, we engineered a 2-hour brainstorming summit

between researchers, university-community partners, VPM leadership, and key mobility-impaired community leaders. This large listening meeting re-energized the collaboration: it led to new ideas for outreach and language, which seeded a more welcoming recruitment flier and wider circulation of the marketing materials — but even still, a critical mass of candidates never engaged. Even with good partnership support and coordination, recruitment relied on relationships that were not sufficiently sustained well by the incentives of traditional university-community partnerships, so it consumed much time and energy and yielded no results.

As the community partnership conversations regarding Focus Group #2 recruitment continued, Gibbs communicated important practitioner concerns that sustainability was getting lost in our 'blue sky' thinking about broadening disability engagement. Specifically, Gibbs noted that only some 'universal design' elements supporting the inclusion of intersectional disability identities could be relatively straightforward and ongoing in SPRVA's cafés — such as providing accessible public transportation and staging in the many accessible spaces that fell within Gibbs' existing inventory of local restaurants and bars. Considering other more specific disabled identities and accommodations, however, would be harder to maintain and would challenge SPRVA's science education and engagement model. Some VCU partners had noted, for instance, that expanded recruitment might focus on the autism community, as many members had interests or skills in science or 'science in society' learning. However, delivering autism-friendly accommodations, Gibbs noted, would have conflicted with some of SPRVA's regular practices of intentionally shaping café atmospheres with ambient music, brighter stage lighting, and packed communal tables, as well as with VPM's goals of community service, as average attendance for its science cafés was now 105. Our STS cafés would need to be filmed and streamed, requiring extra 'real estate' (space) for equipment and staff, thus making it difficult to find isolated 'low stim' space within existing venues. We agreed that, while modifying the café vibe to broaden disability engagements for one or two events was achievable, it was not desirable — because, as researchers, this would be irresponsible, and as practitioners, SPRVA needed to focus on broadening audiences long-term, not on data collection/reporting regarding a single community event.

Ultimately, Gibbs' articulation of her ethical and institutional commitment to ongoing — rather than one-off — community engagement led to more focused and intentional conversions within our collaboration — but it also raised the bar for Focus Group #2's research target. Addressing sustainability along with recruitment issues forced us to make still more adjustments to our expectations, timeline, and activities for broadening engagement — to account for what we could still do. While waiting for the Focus Group #2 findings that we hoped would allow us to devise a fuller 'season' of events addressing broader community needs, we decided to transition to working on café planning and research protocols.

The complexities of doing research while planning STS cafés

We planned and held our first STS café in May 2018 — primarily in order to collect response process evidence for some of our STS learning assessment items [AERA, APA & NCME, 2014] — and for this event, we collaboratively created and

circulated a pilot STS learning survey. This survey was on paper (to be handed out at the end of the talk and discussion); it featured sample questions from each of our recently developed learning constructs as well as demographic questions based on U.S. census categories. Here, unlike during the STS learning construct development process, Gibbs inserted herself where she felt her expertise was more relevant and useful. For instance, Gibbs suggested that the survey's ease for SPRVA attendees would be enhanced if it was only a one-sided paper. Also, based on her observation that many audience members hand-wrote narrative comments on her previous surveys, we followed each Likert-Scale question with a fill-in-the-Blank space to give attendees an option for expanding narratively on their quantitative answers.

For the initial café, speaker recruitment was unique: it proceeded alongside our efforts to determine the STS content and our in-event research process for the café. Gibbs remembered that the AAAS *Encountering Science In America* report classified three reasons for informal science engagement: Personal (curiosity, fun, hobbyist, and information-seeking), Social (friends, family, community), and Professional (directly or indirectly related to one's career) or our first STS research café, we featured a historian speaking about the evolution and practice of synthetic biology — an STS content topic that reflected all the AAAS categories. In terms of café design, we devised standard scripts and methods for interacting with STS café attendees so that the experience through which STS learning and engagement would be evaluated remained constant across all events. We envisioned this (and ultimately, all) café programs as running about one hour; we asked the pilot and all remaining speakers to present for 30-minute talks and aimed to have an equal (30 minutes) for an audience-driven Q&A discussion.

To create a mechanism for obtaining attendees' informed consent to participate in the research — either to be photographed and/or to fill out a survey at the end of the café — we worked closely with the IRB. We devised consent signs regarding photography that were complemented with what we came to refer to as an 'airplane exit row strategy' to explain how attendee seating would impact consent to be photographed. Rader presented herself as the researcher to small groups of attendees entering the venue and explained that if they entered and chose to sit at certain tables, they could be photographed as part of the research. Choosing not to be photographed was possible, but it meant attendees would have to sit farther away from the event stage. We submitted these protocols, along with the pilot survey, to the IRB for review.

The IRB review process, although time-consuming at this stage, held value, both for the initial and subsequent STS cafés. Rader gained her first lived experience with the commonplace rigors of IRB review, a process she had not fully understood or appreciated when teaching basic IRB history to students in her STS and history of science and medicine classes. Indeed, the IRB (in two rounds of review) provided useful pre-event feedback regarding things like how to make ourselves accessible as researchers and our signage more visible. Also, after the first café, while waiting for Rader to code the results, we requested some basic formatting-only changes that were easily justified and quickly approved: for instance, when Gibbs observed that the majority of attendees did, in fact, utilize the blank spaces writing in comments around the small margins of the page, we reformatted the print and margins of the STS learning survey to encourage attendees who wished to offer us more qualitative responses to do so.

But during Year 1 of the grant, the process of planning and staging STS café events which did double duty (broadening the engagement of community members and involving them in research) while also tending to multiple cycles of IRB review, created some tensions in the dual research/engagement space we had constructed. Gibbs experienced the ongoing IRB review processes as especially demanding when she was already working at the margins of her contracted time to get not just the STS cafés but the fuller program of VPM cafés up and running. Further, IRB discussions themselves sometimes directly confronted the question of contradictory mandates for the researcher and the community partner: how could we balance addressing the IRB's reasonable and exacting ethical standards with the existing SPRVA mission to deliver spontaneity and frame audience experience and content delivery in a fun and socially rewarding way? When our initial protocols for post-café informed consent were rejected by the IRB because our welcoming remarks script included playful humor about how "surveys are cool," the IRB reviewer noted that such language coming from a researcher was potentially coercive. We collaborated to neutralize such language: Gibbs instead would simply announce that there was going to be an education research survey for which attendees might choose to stay. Then, after the STS talk and Q&A exchange were both concluded, she would introduce Rader who would neutrally communicate the research intentions and reiterate informed consent mandates (i.e. the survey is voluntary and does not require participation). Such a solution preserved the STS education research at what the science communication partner felt was a superfluous cost exacted against the fun and casual vibe of the café attendee experience.

As planning continued, additional concerns arose about the research project's mandates conflicting with our institutional mandates — both for SPRVA's broader mission as a part of VPM and for Rader's academic year work plan as a VCU faculty scholar/researcher. As science communication practitioners, VPM and SPRVA wanted to accommodate a large crowd of at least 100 people — to draw in more people for VPM's "Science Matters" local television and radio programming. But that target meant that many smaller, locally-run venues (including many African-American owned) were deemed inappropriate from the start for the STS 'broadening engagement' cafés. Thus, although SPRVA scouted and presented to Rader several venues that met the location criteria which Focus Group #1 (African American) needs assessment research deemed desirable, only very few RVA venues had the capacity both to accommodate 100 attendees, as well as food and drink service, and grant's necessary research presentation and documentation equipment. Likewise, Rader had used all her Summer 2019 grant-funded research time to participate in collaborative café planning and enhance recruitment for Focus Group #2. When Focus Group #2 did not materialize, this left the shared project without additional community-engaged need assessment and Rader and Gibbs without dedicated research time to code the pilot STS café 's survey responses — so that the STS learning constructs could be process-validated before making decisions about which constructs and questions to continue forward with in subsequent surveys. Rader negotiated an unfunded course release for Spring 2019 with her department chair based on her need to make timely progress on the grant, and during this time, her office unexpectedly flooded, almost destroying the paper survey data (not yet digitized) which was housed (per IRB protocols) its locked closet.

When we recognized that these issues were structural and could not be resolved, just as with the Focus Groups, we again adjusted our expectations and timetable:

we fell back on compromises that balanced the needs of STS education research and science communication engagement to design and execute the remaining 'science and society' learning cafés. For instance, to devise a research-informed approach to broadening accessibility within Richmond's African-American community, we met once to discuss the Focus Group #1 results with Rockman and shared them with the community partners; in turn, we created a café 'mini-series' in which two of the remaining six 'science in society' events would be responsive to the needs assessment. We staged these two events at the larger black-owned businesses in historically African-American Richmond neighborhoods (one was a restaurant and the other, a theater with restaurant event space). The speakers for these cafés were recruited by cross-checking topics suggested by Focus Group #1 against a larger list (on which Rader and Gibbs collaborated) of available STS and historical researchers in these areas — and this resulted in one café on 20th Century Black Excellence in Science (October 2018) and one on herbal medicines grown and developed by enslaved Blacks for their community in the Antebellum U.S. South. The remaining STS cafés featured scholars from different disciplines (1 scientist, 1 sociologist, 1 historian, and 1 interdisciplinary STS scholar) speaking on a wide range of STS topics; these were held either at popular large venues in SPRVA's existing inventory (mostly bars and restaurants) or at new venues that both SPRVA and VPM thought might reach new audiences — for instance, we held one event at a popular young adult concert venue.

Marketing for the Richmond African-American cafés revealed another area (like the STS construct development) in which we had uneven stakes and capacities — and so it, too, proceeded compartmentalized rather than collaboratively. VPM staff devised and implemented a small-scale targeted paid marketing strategy that included the two African-American focused STS cafés being promoted by three African-American focused local media companies: two print and one gospel radio station. For Rader, the measure of marketing success would be discrete: simply more diverse community attendance at the 8 STS cafés. But Rader was only a stakeholder in the diversification of STS cafés. For Gibbs, what defined 'more diverse' community engagement was more complex and engaged her practitioner energies more deeply: it was a matter of how best to enhance her ongoing efforts (zero-cost approaches, including email notices to its 1,000+ subscribers, word of mouth, community calendars, no-cost social media posts, and periodic radio spots on VPM a week or two prior to each café program) in a sustainable manner beyond the research project and regardless of topic or speaker background.

As of May 2019, we faithfully executed all planned STS café events and gained some insights into the community engagement questions we had originally posed. Both mini-series cafés — those focusing on Focus Group #1's recommended topics and staged in Focus Group #1's preferred locations — had significantly higher African American community participation. More specifically, these two events averaged 22.2% African American attendance (as measured by self-identification by those who took the STS learning survey); the remaining six cafés averaged 5% African American attendance. That said, we also note that one of the other six cafés featured a self-identified African American STS speaker on a topic (the technology of sports) not identified by Focus Group #1 as of interest. This café (again, as measured by self-identification of the survey takers) attracted an African American audience similar in percentage to that drawn by one of the Focus Group-informed cafés. Our research suggests, then, that holding STS cafés informed by

community-engaged needs assessment can effectively diversify participation in science cafés — but so, too, can featuring speakers that better represent the community itself.

Table 1. STS Science Café Programs. Bolded items indicate African American Focus Group café topics and/or self-identified Black presenters and attendee percentages.

Date	Speaker	Speaker's Subject Areas	Talk Title	Audience Self-Identified as AFAM (%)	Lecture Length (minutes)	Q&A Exchange Length (minutes)
May 2017	Luis Campos	History, STS	Life by Design, A Century of Synthetic Biology	2.5%	26.5	20.75
Sep 2017	**Evelynn Hammonds**	History, AFAM Studies	**The Diversity Problem in Science**	**14.8%**	32.5	24.25
Oct 2017	Stuart Firestein	Neuroscience, STS	Why to Love Doubt and Uncertainty	4.4%	28.25	28.5
Feb 2018	Susan Lederer	History, Medicine, Bioethics	Philanthropy of the Body	0%	31.0	25.0
Mar 2018	Lee Vinsel	STS	Taming the American Car	8%	28.5	29.0
Apr 2018	Sainath Suryanarayanan	STS, Biology	Working Bees to Death	2.4%	46.5	20.0
Jan 2019	**Carolyn Roberts**	History, Medicine, AFAM Studies	**Hidden Histories of African American Medical Practitioners**	**29.6%**	21.25	22.5
Apr 2019	**Rayvon Fouche**	STS, American Studies	**How Technology Changed Sports**	**12.5%**	27.25	22.75

The complexities and time-intensive nature of our tasks during the café program execution, however, effectively swamped other forms of reflection on the community engagement questions that might have improved outcomes. For instance, when reviewing the research documentation videos, we learned that talk-to-discussion time ratios of the seven STS café programs varied widely (the talks ran from 21.5 to 32.5 minutes long, and one was even longer (47 minutes); the Q&A exchange periods at the eight cafés varied between 20 and 29 minutes). But we learned this only after all of our research documentation videos were processed and shared in April 2019; by that time, Rader had negotiated additional course release to code the surveys, but now she was focusing more on making sense of the complexities of qualitative data — what attendees own words about the experience better revealed about adult informal STS learning than their Likert scale response — than on community engagement. Although our work showed that better standardization of events might have been desirable to improve engagement as desired by the practitioner, we determined that too late to do anything about it in program planning. Similarly, in Spring 2019, we collaborated to develop a coding scheme for the qualitative data from the STS learning survey. However, the decision to code qualitatively meant that our coding timelines had to be extended. In turn, we could not determine midstream what STS learning questions were

understandable — to take the next step and validate them intentionally rather than cycling through the other construct questions on the café surveys. Because we had little time to holistically discuss and process the work as we were doing it, we failed to make each subsequent decision optimally responsive to our ongoing findings.

Reflections on our STS/Sci Comm messiness

It all ended too soon. But what looked like endings were actually beginnings — and the biggest lesson we learned was how better to work in emergent spaces that were neither pubs nor lecture rooms.

Our collaboration did not wrap up neatly for many reasons — some historically unique and beyond our control. The STS@VCU Program ended in Fall 2019, in between two VCU Deanships and before the COVID-19 pandemic began — and Science Pub RVA ended in Fall 2020, shortly after offering its final VPM-partnered café virtually during the first year of the COVID-19 pandemic. Three years later, however, Rader initiated a return to this essay, which we had drafted originally to serve mandatory NSF project assessment goals in 2019.[9] To the surprise of us both, re-writing it has encouraged us to work together — specifically to write up the qualitative STS learning assessment results obtained from the surveys. Bevan and her colleagues have suggested that immersive storytelling work between STS, science communication, and science education is key for engaging those who do not already seek out science engagement — and for this reason, it should be intentionally incorporated into future research practice partnerships [Bevan, Rosin, Mejias, Wong & Choi, 2022]. Ultimately, though, telling our story has allowed us to envision a way forward in a cross-domain collaboration that is both intentional and emergent (brown 2017), with some parts grounded in the siloed worlds we are each used to (informal science communication and STS scholarship and teaching) and others threaded to a new world we were — and still are — trying to envision.

Our work as STS-SciComm "thinking partners" [Peterman et al., 2021] was both supported and challenged by some broader structural features of our individually-siloed worlds. Science communication scholars and practitioners have previously made the case that the field needs new "work that comes from different paradigms, mobilizes different methods, and draws on different disciplinary traditions." [Davies, 2022, p. 311] Our project actively engaged several scholarly areas — informal science education, STS, and science communication — each of which has evolved as a distinctly different research field, even while the boundaries between these fields have also been acknowledged to be porous, overlapping, and historically contingent [Lewenstein, 2015]. Ultimately, the dynamics of our scholar-practitioner partnership mirrored those identified by researchers on interdisciplinary collaborations [Tartas & Muller Mirza, 2007] and teacher-education researcher collaborations [Torres-Olave & Bravo González, 2021]. In these and other interdisciplinary research, "zones of tension" develop as precipitated by project-based challenges, and these "can be seen as playing a role in the development of new objects and outcomes" [Tartas & Muller Mirza, 2007, p. 165].

As Horst [2011] has noted, if one takes an STS approach to understanding these tensions as itself kind of knowledge-making, then our research-practice experiment was a crucial means for determining how to make the cross-domain space of STS education, science communication, and community engagement a more robust and practical place in which to work. During the original work, we could certainly appreciate how our project drew strength from productive cross-talk and compromises, but now we also appreciate that we were occupying what STS scholars have described as an "intersection of discursive and material practice, partially, but not completely shared" [Galison, 2010, p. 32]. Some of our interactions, then, were likely successful because our coordination and exchanges were flexible, but others remained intransigent. By default, we first approached challenges as one-off problems to be 'debugged,' even when some challenges represented structural features of our scholar-practitioner collaboration. But each time we followed Horst's suggestion [2011] to 'take our own medicine' and reflect, we recalibrated our practices accordingly, and in this way, we succeeded by normalizing and reshaping our expectations around the time-intensive and contingent realities of cross-domain work.

Recommendations for cross-domain collaboration

In conclusion, then, our narrative reflections "on taken-for-granted methods, languages, and practices" [Davies, 2022] inspire us to make concrete recommendations for how some challenges we faced in cross-domain work could be better addressed by practitioners, both at the project and the institutional levels. We will not say much about one key challenge we experienced because it is one that has already been named and addressed: namely, research inexperience. Inexperience deeply impacts both new practitioners working in cross-field STEM engagement and education research domains for the first time and new researchers working for the first time across the science communication, science education, and science engagement fields. CAISE (the Center for Advancement of Informal Science Education) started and continues to work to address this challenge in many ways. Through providing accessible digital resources and holding AISL grant recipient conferences funded by the NSF, CAISE has begun to increase necessary communication and discussion among all parties involved.

But neither STS scholars nor Science Communication practitioners can begin to take advantage of these existing resources until they face another challenge: the administrative complexities and inequities of cross-domain work that must be assertively acknowledged and not ignored at the start of any project. The material reality of the larger amounts of unpaid time and energy required in innovative boundary-spanning work makes it all the more important that collaborations such as ours are better supported — even incentivized — to pursue projects and grants in ways that "align funding with the mission and values of both the funder and your agency" [Brunot, 2022]. At VPM, Gibbs' work was subcontracted, but her experience was consistent with research findings showing that "being awarded a grant has a bigger impact on smaller nonprofits" structurally challenged by administrative and planning capacities to effectively divide the grant work into different revenue sources simultaneously [Lu, 2016, p. 391; see also Andreoni, Payne & Smith, 2014]. Likewise, Rader — working in a small interdisciplinary program — was not well-served by decentralized University structures. As a full professor, she held enough privilege to take on an innovative project but still spent much time and energy creating and troubleshooting networks of requirements,

Table 2. Summary of STS/SciComm Challenges, Recommendations and References.

STS/Sci Comm Boundary-Spanning Challenges	Recommendation(s)	Relevant Research
Administrative complexities and Inequities	Restructure effort & enhance resourcing (for faculty, staff, non-profit participants) to achieve alignment	Wimsatt, Trice and Langley [2009]
	Improve process transparency & communication	Jaeger, Meltzer and Rowan [2019]
	Standardize federal grants	Schiller and LeMire [2023]
IRB "Incommensurability" Tucker King, Bivens, Pumroy, Rauch and Koerber [2018]	Proactively build relationship with IRB	Koerner [2005] and Marshall [2003]
	Revisit IRB subpanel composition	Tucker King, Bivens, Pumroy, Rauch and Koerber [2018]
	Consider and assess "Participatory Approaches"	Bozeman and Hirsch [2006] and Murray and Santos [2022]
Community Engagement "Silos"	Develop Authentic Relationships within a Project: Plan & Resource On-going Interactive Partnership Meetings	Vasquez et al. [2020]
	Expect Detours: Commit to "Caring Craftwork" and non-judgement of detours and 'stubbed toes'	Davies and Horst [2015], Clark, Brody, Dillon, Hart and Heimlich [2007] and brown [2017]
	Devise holistic valuation and evaluation standards, towards incentivizing and sustaining researcher-practitioner partnerships	Wanjiru and L. [2021] and Irish Universities Association [2022]

processes, and people to address administrative tasks — time that could have been better spent on the research itself. At the largest structural levels of funding research, many administrative challenges could be eased by standardizing the mechanisms and processes of grants, starting with all large federal agencies, so that idiosyncrasies of administration don't need to be learned and relearned with each grant success [Schiller & LeMire, 2023]. In the meantime, however, when such projects are funded, Universities — those institutions that draw the largest rewards from grant overhead — need to work more closely with both researchers and community partners to ensure that the effort and resourcing of all involved personnel (including faculty, staff, and non-profit participants) is restructured to achieve alignment with project goals [Wimsatt, Trice & Langley, 2009]. Also, before taking on such projects, however, process transparency and communication with practitioners and partners about these issues need to be improved to better ensure that expectations on both sides are realistic [Jaeger, Meltzer & Rowan, 2019].

Similarly, Tucker King and her colleagues working in Health Communication have labeled the challenge that we and other cross-domain researchers face with IRBs as one of "incommensurability" [Tucker King, Bivens, Pumroy, Rauch & Koerber, 2018, p. 907]. Because our work was grounded in both social science practices (adult education and communication research) and humanities theorization (historical and philosophical dimensions of epistemology and science learning), the IRB's intensely bureaucratic process was not only opaque to us but IRB reviewers' expertise was inevitably mismatched to our needs and goals. In the absence of larger structural changes — such as moving to what many have called "participatory approaches" by involving citizens and communities directly involved in research with assessing its ethics [Bozeman & Hirsch, 2006; Murray & Santos, 2022] — Universities must more frequently revisit IRB subpanel composition to achieve better understanding and alignment for emergent cross-domain research [Tucker King et al., 2018]. But as our experience and the research of others in the communication fields suggests [Koerner, 2005; Marshall, 2003], researchers and practitioners themselves can begin to surmount the challenge of incommensurability by forming meaningful educational relationships with their IRB members and leaders in advance of submitting and processing any proposal.

Lastly, the challenge of silos in community engagement research strikes us as the most difficult for cross-domain projects (like ours) that don't directly involve community engagement expertise beyond existing University partnership arrangements. If holistic evaluation standards aimed at mutually incentivizing researcher-practitioner partnerships were *co*-developed by University and community partners, then that would go a long way towards eliminating this challenge entirely [Wanjiru & L., 2021; Irish Universities Association, 2022]. Ideally, that would mean that such partnerships themselves could not exist without sustainable and regularized mechanisms for working together, as well as for collective assessment and decision-making about taking on new projects (like ours) under their umbrella. In the meantime, we recommend that researchers and practitioners who are considering collaborating work to develop, in advance, authentic relationships with members of any community with whom they intend to partner. Further, once grant and funding proposals are being developed, be sure to plan for and resource ongoing interactive partnership meetings to sustain these relationships within the project and beyond. Finally, and above all, the scholars, practitioners, and community partners involved must embrace the idea that cross-domain research (especially involving education) continuously, and often invisibly, requires "messy puzzle-solving" through which all participants need to "integrate disparate social and conceptual domains" [Clark et al., 2007, p. 116]. By committing to what Davies and Horst [2015] have called the "caring craftwork" of research management, innovative cross-domain researchers can minimize the pain of inevitable 'stubbed toes' during this work — and, in turn, meet these and other obstacles and detours with the non-judgment, moving forward with continued grace and resilience.

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