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AGENTS OF CHANGE:

SCHOLARLY INTERVENTION AT THE SCIENCE-POLICY NEXUS

by

Daniel J. Card

A Dissertation Submitted in

Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

in English

at

The University of Wisconsin-Milwaukee

May 2018

ABSTRACT

AGENTS OF CHANGE:
SCHOLARLY INTERVENTION AT THE SCIENCE-POLICY NEXUS

by

Daniel J. Card

The University of Wisconsin-Milwaukee, 2018
Under the Supervision of Professor S. Scott Graham

This dissertation examines an emerging "engaged rhetoric of science, technology, and medicine" (ERSTM)—an effort to ensure rhetoric's "broader impacts" by more directly engaging the practices of science and sociotechnical policymaking. Through careful analysis of engaged rhetorical practice, I identify divergent conceptualizations of both rhetoric and engagement and subsequently draw on new materialist rhetorical theory and empirical research on science communication and public engagement to advance "problem-oriented rhetorical catalysis" (PRC) as a mode of engagement capable of advancing rhetoric's institutional value and ethical commitments without abandoning its core disciplinary expertise and areas of inquiry. I further suggest the PRC is uniquely suited to address "wicked problems" and as such represents a productive alternative to deficit- and transmission-model engagement.

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TABLE OF ABBREVIATIONS

RSTM   Rhetoric of Science, Technology, and Medicine

STS   Science and Technology Studies

ERSTM   Engaged Rhetoric of Science, Technology, and Medicine

POROI   Project on the Rhetoric of Inquiry

NSF   National Science Foundation

PI   Principal Investigator

ARST   Association for the Rhetoric of Science and Technology

PRC   Problem-oriented Rhetorical Catalysis

SEQM   Systems Ethnography and Qualitative Modeling

SES   Socio-economic Status

PPCPs   Pharmaceuticals and Personal Care Products

NCSE   National Council for Science and the Environment

SoSC   Science of Science Communication

NAS   National Academy of Sciences

ACKNOWLEDGEMENTS

I'd like to first thank my advisor, Scott Graham, for investing in me before I even set foot on the campus of UW-Milwaukee. In the five years we've worked together, I always felt like a collaborator. He encouraged me to develop my ideas and put them out into the world, and my work is infinitely better as a result of five years of sustained intellectual dialogue. He has been a patient and thoughtful guide on a journey that for many is isolating, intimidating, and at times seems doomed to fail. I owe him a great deal.

Bill Keith and Dave Clark, too, have been incredibly supportive. Bill has the tremendous ability to dissolve the world beyond his classroom, office, or the coffee shop so that his students and their thoughts, feelings, and ideas can come into full view. Many times I have begun a conversation with Bill completely overwhelmed and left with a renewed sense of who I am as a person and what I need to do as a teacher-scholar. Similarly, Dave invested considerable time and energy in my development. Working closely with him on the NSF innovation corps grant was no doubt the most influential experience that didn't explicitly show up in this dissertation. I am incredibly fortunate to have conducted hundreds of interviews and spent numerous late nights refining slides alongside such an enduringly positive and caring man.

To my colleagues at UW-Milwaukee, ARST, ATTW, NCA, and RSA. I know my work is better for all the time spent conversing in seminars, workshops, and at conferences. I hope I have and can continue to sharpen others' ideas as much as they sharpened mine.

In addition, I'd like to thank mentors at UW-La Crosse: Dr. Kopp, Dr. Crank, Dr. Lan, and Dr. Thoune. They first inspired my interest in rhetoric and provided me with the foundation and encouragement I needed to pursue it at the graduate level. Thanks to Kathy Doering-Kilkenny, Brooke Barker, and Alex Gillen for happily answering questions and helping me with countless travel forms and permissions. I have no doubt the department would cease to function without them.

I owe thanks to my parents and in-laws for charitably listening as I struggled to construct and articulate this project and also for understanding when I would slip into the basement or off to the coffee shop during vacations and holidays. And to my sister for challenging me to articulate the value while always assuring me it was there. Thanks also to my dogs Sadie and Luna for taking me on the daily walks and runs that were so crucial to clearing my head. And finally, thank you to my wife Molly for providing support in every way I've mentioned—for being my smartest critic, the most generous reader, and a selfless partner. And for only making me call her Dr. Molly when I deserved it.

CHAPTER 1: INTRODUCTION

It has been said we now live in a post-truth world— that we have entered the age of alternative facts. Prominent politicians deny scientific consensus and attack funding for research and environmental protection. Invested publics are panicking. Scientific organizations, science journalists, and environmentalists are concerned that science no longer seems to inform sociotechnical decision-making. Facing rapid technological change, ongoing environmental destruction, and growing distrust of science, coordinating publics around scientific and technical policy has never been so important. The inauguration of the "post-fact" era certainly speaks to the problem of unwavering disbelief in the face of compelling evidence of the contrary—a problem pragmatist philosopher William James called tenacity (1975). While many pundits and scientists maintain that the solution to tenacity is simply to get better at communicating the "facts of the matter," scholars in the rhetoric of science, technology, and medicine (RSTM) and science and technology studies (STS) have expended considerable scholarly energy critiquing the modernist/positivist assumptions on which this approach relies.

Indeed, scholars in STS were prominent players in the "science wars" of the 1990's. They took aim at objectivity, certainty, and truth itself. They demonstrated science's bias, maintaining that all science was inherently

interested. The supposed wall between science and politics was destabilized. In other words, the impulse in STS (and RSTM, for that matter) has largely been to deconstruct science, to knock science down a peg by demonstrating its reliance on extra-scientific modes of being in the world. These efforts, broadly categorized as critical or deconstructive, have complicated any easy distinctions between facts and values, nature and culture, or science and politics. In spite of these important contributions, the problems we face as scholars and democratic citizens are increasingly "wicked." Wicked here is a technical term to highlight interconnected technical, scientific, and social dimensions of a problem (Rittel and Webber, 1973; Balint, Stewart, Desai, 2011; Graham et Al., 2017). Such anti-linear, multifactorial problems resist easy resolution.

Within STS and RSTM, there is a growing concern that critical or deconstructive approaches have set the stage for our current predicament (Collins and Evans, 2002; Druschke, 2017; Latour, 2004). Most notably, Latour (2004) lamented that "critique has run out of steam"—that the critical tools of deconstruction, postmodernism, and social construction have been co-opted toward concerning ends. While this is but one reading, the core question—what is the best way to promote sociotechnical decision-making processes attuned to both expertise and the values and lived experiences of all relevant publics?—is certainly a critical one for humanistic scholars of science. Indeed, whether you accept or reject Latour's argument that

critique has inadvertently provided the rhetorical blueprint for climate denialism, the notion that such critique may not be the optimal solution to wicked problems remains compelling.

In the wake of these critiques of critique, scholars in STS and RSTM have proposed a reorientation toward matters of concern (Latour, 2004), upstream scholarship (Collins & Evans, 2004), or engaged rhetoric of science, technology, and medicine (ERSTM) (Cagle, 2017; Druschke, 2017; Herndl, 2017; Walker, 2017; Parks, 2017). While there are important differences, these emergent "reconstructivist" approaches to science and technology all position scholars as potential agents at the science-policy nexus.

To be sure, rhetoric's civic and deliberative commitment paired with RSTM's expertise in the nuance and complexity of technoscientific practice situates RSTM scholars as a valuable resource in any effort to rehabilitate sociotechnical deliberation. Yet, questions remain as to what specific approaches have been tried and to what extent they have been successful. To that end, this dissertation examines recent attempts within RSTM to become agents of change at the science-policy nexus—attempts to shape the way science and science decision-making unfold. As scholars in RSTM shift toward interventional or "engaged" approaches, it is vital to evaluate precisely what is meant by engagement, and what embracing engagement might mean for RSTM. This dissertation attends to this need by analyzing

early attempts at ERSTM and offering case studies of two recent projects I was involved with. In so doing, I address the following research questions:

- What is the theoretical/practical rationale for ERSTM? (Chapter 1)
- What does ERSTM do? (Chapter 2)
- Do engaged projects meet their stated aims? (Chapters 3 and 4)
- What challenges and barriers will ERSTM face? (Chapter 5)

In this chapter, I first provide a thorough description of reconstructivism, defining important terms and highlighting driving theoretical and practical concerns. Subsequently, I establish strategic, ethical, and onto-epistemological rationales for ERSTM. I then work to build a preliminary framework to assess ERSTM, drawing on insights from a range of disciplines, including STS, RSTM, Science Communication, and Political Science. In so doing, I review "best practices" and identify potential sites, methods, practical arrangements, and key concerns.

Toward Reconstructivism(s)

A handful of STS scholars have proven particularly influential in spurring the emergence of ERSTM[1]. Certainly, Bruno Latour is near the top of the list. Foundational to these reconstructivist projects is Latour's notion of the nonmodern, which rejects (post)modernist distinctions between nature/culture and subject/object. Rather than distinct natural and social

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[1] For a more thorough and nuanced examination of STS' influence on RSTM, see Herndl (2017).

phenomena, Latour sees only hybrids—phenomena comprised of quasi-objects and quasi-subjects. Accordingly, for Latour there is no justification for bracketing off "nature" as the province of the sciences and "culture" for the humanities. Rather, we are all (as scholars, humans) articulated in networks of hybrids.

Latour's non-modernism not only calls into question traditional divisions between the sciences, social sciences, and humanities, but also positions academic inquiry as embedded within material-semiotic networks. Scholarly communities are driven by theoretical insights but one cannot overlook changing external circumstances. This is most evident in Latour's "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern" (2004). There, Latour expresses concern with postmodernist science studies' tendency to critique—to show the lack of scientific certainty in the construction of facts. Of course, Latour admits this has been part of his own project. His concern is not that it was "inaccurate" to say that facts are constructed, but that this brand of critique is a limited approach to changing scientific practices and at worst has served as the rhetorical blueprint for conspiracy theorists and science deniers.

Recognizing the limits of critique and concerned for emerging environmental threats (climate change, most notably), Latour suggests we shift focus from matters of fact to matters of concern.

> The question was never to get away from facts but closer to them, not fighting empiricism but, on the contrary, renewing empiricism…to the critical mind, if it is to renew itself and be relevant again, is to be found in the cultivation of a stubbornly realist attitude—to speak like William James—but a realism dealing with what I will call matters of concern, not matters of fact. (p. 231, 2004, emphasis original)

Importantly, this call for a renewed empiricism should not be conflated with either an outright rejection of constructivism or a return to positivism or modernism. Instead, this reconstructive approach attempts to gather what is given by experience—things, people, facts, values—to promote more satisfactory relations.[2] Of course, what Latour calls "matters of concern" echoes of what Pickering calls the "mangle of practice," or what Callon, Lascoumes, and Barthes call "states of affairs." These metaphors all work to counter a clear distinction between things and people, facts and values, nature and culture; instead, they urge a systemic perspective capable of accounting for the complexity of the world—the same complexity that sociotechnical decision-making processes should attend to.

While Latour's nonmodernism represents an important theoretical resource for RSTM, it does not provide a clear rationale for ERSTM as an emergent research agenda. In what follows, I turn to some of ERSTM's

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[2] Latour's language here (and non-modernism more broadly) is dripping with philosophical pragmatism. I am confident one could arrive at ERSTM on the back of Dewey, James, and Rorty had Latour not been so influential.

proponents to outline such a rationale. More specifically, I draw heavily on a recent special issue of the Project on the Rhetoric of Inquiry (POROI) to outline what contributor Lauren Cagle identifies as the strategic, ethical, and onto-epistemological rationales for ERSTM. In so doing, I argue that these rationales suggest a variety of approaches to engaged scholarship in RSTM.

Sustaining RSTM

While Latour's nonmodernism both calls into question traditional disciplinary boundaries and points to changing external circumstances as a key driver of scholarly inquiry, ERSTM proponents point specifically to changing institutional priorities in U.S. higher education, namely the prioritization of STEM and increasing scrutiny of the humanities. To be blunt, scholars in the humanities are constantly forced to articulate their value, and while there are many productive arguments to be made, e.g. the humanities promote critical-thinking skills that are important in a democracy, more directly aligning ourselves with the missions of our STEM colleagues is one way to make our value more obvious.

For example, while Cagle admits that "it may seem uncouth to ride on [STEM scholars] longer cultural coattails" (2017, p. 4) and Herndl recognizes that his efforts to collaborate with STEM colleagues on funded research may be viewed by some of his colleagues as a "cynical move," (2017, p, 6) both note that these efforts may afford opportunities to pursue their core intellectual concerns and normative commitments in ways that wouldn't

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have been possible had they not embraced a more reconstructive approach. Druschke echoes this sentiment, arguing that National Science Foundation policy, e.g. the broader impacts criterion, and current thinking about science communication more broadly means that if rhetoricians aren't working with scientists, someone else will. "Without rhetoricians to encourage them, [scientists will] be left to believe that Claude Shannon and Warren Weaver are the end-all, be-all of science communication" (2017, p. 6). While I am sympathetic to those who wish maintain disciplinary autonomy and resist tailoring their research to institutional demands, I find compelling the suggestion that ERSTM may actually serve those ends in ways that more traditional approaches to rhetorical scholarship can't.

Taking Responsibility

Although only Cagle does so explicitly, Herndl, Druschke, and Cagle all submit ethical arguments for an engaged program that moves beyond our critical impulses. Druschke notes that "we need to develop tools, strategies, and collaborations to work 'from the inside'…making productive use of difference that makes a difference" (2017, p. 2). Similarly, Herndl argues that "many of us care deeply as citizens and community members about the kinds of problems engaged or mission-oriented RSTEM pursues (2017, p. 6). Cagle, drawing on Latour, makes a more sustained case that engagement offers one avenue by which we can "use our stances, education, and critical

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sensibilities to push back against those who would use our critical tools as weapons in service of aims we don't support" (2017, p. 6).

While the ethical argument tends to hinge on Latour's suggestion that critical approaches have served as a blueprint for anti-science arguments, the suggestion that RSTM should consider its societal contribution and explore ways to work more directly on problems that matter to external publics is compelling regardless. As Herndl suggests, interdisciplinary problem-oriented work can help connect "our work as scholars and our lives as citizens and members of emergent publics…parts of ourselves that are too often segmented in the academy" (2017, p. 6). For each of these scholars, a sense of urgency and concern about environmental and public health crises authorizes more explicitly interventional scholarship.

Intervening in Matters of Concern

Both the ethical and strategic cases for engagement, though compelling, are likely to find legitimate resistance. Scholars who choose to engage may find a natural pull into modernist notions of science and deficit-model communication, and a concomitant expectation that rhetoricians act as public relations specialists, subservient to the goals of others. Lynda Walsh captures this tension, asking, "how do we make ourselves a public resource without becoming a tool of hegemony?" (Walsh, 2013, p. 2). This sentiment also highlights how intertwined ethical and strategic rationales for engagement really are. In the absence of any easy resolution, I turn now to

what I find to be the most persuasive argument for engagement: the onto-epistemological.

The onto-epistemological argument takes as its starting point landmark scholarship like Latour's "Why Has Critique Run Out of Steam?" and Collin's and Evans' "Third Wave of Science Studies: Studies of Expertise and Experience" to argue that engagement represents an opportunity to advance RSTM's core intellectual interests. In other words, by reorienting ourselves toward reconstructive efforts, we better situate ourselves to achieve our ethical commitments and advance our institutional credibility, but also open up opportunities to better understand both science and rhetoric. For example, Cagle argues that "while we have something to offer STEM in terms of understanding and leveraging the rhetorical nature of knowledge production and dissemination, they have something to offer us as well" (2017, p. 7). And as Druschke notes in discussing her collaborative efforts, "the time I have spent with community organizers, ecologists, hydrologists, and evolutionary biologists has fundamentally changed and continues to fundamentally change the ways I understand both science and rhetoric" (2017, p. 7).

In recasting engagement as a mode of inquiry, the onto-epistemological argument represents a compelling rebuttal to concerns that a shift toward engagement is a shift away from the disciplinary inquiry and expertise that sets rhetoric apart. Working with scientists provides a front-

row seat to the very phenomena we aim to understand. As such, collaborative or transdisciplinary RSTM becomes a natural extension of rhetorical inquiry. I find the onto-epistemological rationale, with its emphasis on the co-production of knowledge, particularly compelling precisely because it hinges on a core insight of the tradition it seeks to reorient. If we take seriously the notion that science is rhetorical, that it is a social activity shaped by institutional, discursive, and material structures, it becomes hard to reject the suggestion that participating in that activity and those structures will yield new insights into the rhetoric of science.

Here, I follow Herndl in marshalling Judy Segal's distinction between "applied" and "useful" scholarship (Segal, 2005). While it is tempting to assume that engaged rhetoricians will be locked into applied scholarship (e.g. determining the most effective way to persuade people to vaccinate their children), ERSTM should embrace the notion of useful scholarship—research that helps to understand and respond to matters of concern, states of affairs, or so-called wicked problems. An engaged program, when implemented thoughtfully, should afford the material resources, institutional position, and credibility to do just that. Indeed, Herndl's work on the Patel College of Global Sustainability as well as Druschke's multiple NSF-funded collaborative grants point to enormous potential.

Toward a Framework for ERSTM

As compelling as the strategic, ethical, and onto-epistemological arguments are, many open questions remain. Herndl notes in his introduction to the symposium on ERSTM that engagement "is an intuitive notion and operates like a 'god term' in much of our discourse including my own…it is protean and shifts its style, political positioning, and purpose as the site of activity alters" (2017, p. 10-11). An engaged rhetoric of science built on something like Latour's nonmodernism and committed to intervention is likely to be collaborative and transdisciplinary, but what exactly will it look like? The undefined nature of ERSTM suggests a range of paths forward, but it would be foolish to think rhetoricians won't face challenges as they attempt to work more closely with scientists. Indeed, many rhetoricians have expressed anxiety and hesitation over the potential pitfalls of collaborating with scientists (Ceccarrelli, 2013; Walsh, 2013; Herndl, 2017; Cagle, 2017).

At this critical juncture, I agree with Herndl's suggestion that "we need to survey the sites, types, and styles of work that engaged RSTEM does that can provide us exemplars and inventive possibilities going forward" (2017, p. 10-11). I conduct such a survey in the next chapter, but it would be foolish to do so before first briefly exploring the academic trajectory in science communication. To be sure, scholars in science communication, not rhetoric, are the de facto resource for scientists, politicians, and journalists concerned with the state of science in public discourse and policy making. As

such, in what follows I trace important shifts in academic science communication, and I identify current "best practices." In so doing, I demonstrate an embrace of dialogue, not only within the academy but also scientific societies and science funding organizations. Importantly, I also highlight a dissonance between the stances of science communication scholars and the practices of science communicators. This dissonance, I suggest, points to a kairotic moment for RSTM.

Science Communication: From Deficit to Dialogue

Within the discipline of science communication, recent years have seen a widespread embrace of "public engagement with science" as a way of dealing with rapid scientific and technological changes and a perceived crisis of trust in and war on science. Subsequently, scholars and practitioners have designed, implemented, and assessed a dizzying number of public engagement mechanisms—processes, techniques, and/or instruments. These mechanisms differ in structural characteristics, theoretical underpinnings, and normative orientation, but all respond to the failure of the "knowledge-deficit model" of science communication, which presumes that a lack of support for science is directly attributable to a lack of scientific knowledge.

To illustrate this shift, Bauer, Allum and Miller note three research paradigms that characterize the history of scholarship in the journal *Public Understanding of Science*: science literacy, public understanding, and

science and society (2007). Research in the "science literacy" and "public understanding" both generally assume a public knowledge-deficit, i.e. lack of support for/of science and technology results from a deficit in knowledge or attitude, respectively. As such, scholars in this area tend to propose education and marketing initiatives as key intervention, often focusing on communicating the "facts of the matter." In response to critiques of the deficit assumption, the most recent paradigm, "science and society" posits trust and democracy deficits, i.e. it is the experts, not the public, who are the problem. Subsequently, scholars working in this paradigm tend to propose participation, deliberation, and engagement based in part on a commitment to democratic ideals.

The shift toward engagement is evident outside of humanistic and social scientific scholarly communities, too. Recognizing a lack of public confidence and trust in science, the UK parliament committee on science and technology in 2000 recognized a "new mood for dialogue." In addition to improving public understanding of science and the communication of risk and uncertainty, the authors offer "changing the culture of science policy-making so that it becomes normal to bring science and the public into dialogue about new developments at an early stage" as the most important insight (Parliament. House of Lords, 2000). Similarly, the American Association for the Advancement of Science (AAAS), the world's largest general scientific society, advocates a "public engagement approach [that]

uses and builds on public understanding efforts, while moving toward more comprehensive and interactive opportunities for dialogue and exchange" (American Association for the Advancement of Science, 2018). Finally, the U.S. National Science Foundation's (NSF) "broader impact" merit review criterion has compelled researchers to interweave engagement into grant applications (2007). This emphasis on dialogue as opposed to command-and-control messaging and outreach campaigns is undoubtedly welcomed by rhetoricians and post-deficit science communication scholars.

Unfortunately, there remains a significant gap between the avowed stance of these organizations and the implementation of engagement. A recent survey of AAAS scientists found that respondents overwhelmingly cite "defending science" and "informing others about science" as their top communication goals, with engagement-oriented goals such as "building trust" and "establishing resonance" coming in much lower (Dudo and Besley, 2016). Additionally, a recent examination of the broader impact activities in 87 NSF grant proposals found that "[Principal investigators (PIs)] mainly propose academic-related activities that are intrinsic to their duties as university faculty members," e.g. teaching a course (Wiley, 2014, p. 6). And in the rare case that PIs do incorporate public engagement, they tend to choose "public understanding" style activities, such as creating materials for a website or disseminating findings through press releases or presentations (Wiley, 2014, p. 6). These activities look more like deficit than dialogue.

So while public participation[3] is the coin of the realm for science communication scholars, it is clear there are open questions for those who wish to implement it. What exactly should public participation look like? Just how effective is it? Effective toward what end? In a thoroughly interdisciplinary edited collection on the topic, Tina Nabatchi draws on a wealth of theory and empirical research to argue that "successful" public participation initiatives share four critical characteristics (2012, pg. 20). In Table 1.1 below, I have distilled the four characteristics around who participates, what the participation consists of, how the participation is structured, and why the participation effort is held.

Public Participation Best Practices	
Who?	Assemble a "critical mass" or small, demographically representative group
What?	Engage participants in sharing of values and experiences, and consideration of a range of policy outcomes
How?	Oscillate between structured, facilitated small- and large-group discussion
Why?	Aim for tangible outcomes, whether behavior/attitude change or policy/planning recommendations

Table 1.1: Public participation practices distilled from Nabatchi (2012).

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[3] Public participation is but one term for practices that are also commonly called *deliberative civic engagement*, *public engagement*, *public inclusion*, *public involvement*, and in the context of science communication *public engagement with science*.

These four characteristics serve as a useful heuristic for designing and evaluating public participation efforts. Yet, this heuristic and others like it are necessarily superficial; none can prescribe a specific formulation for a given public participation initiative because the sociotechnical challenges we face are so varied. Indeed, as Nabatchi notes, "empirical research on [public participation] questions lags far behind the practice" (pg. 20).

So far I have demonstrated that "public participation" has garnered tremendous capital among academics and practicing science communicators alike. I have also suggested public participation presents challenges that have yet to be overcome or fully explored. However, there is a natural resonance among participation theory and practice and rhetoric's roots in practical and civic action. As such, scholars in RSTM and allied STS are well-equipped to contribute to the dearth of empirical research public participation. And the emergence of ERSTM suggests they are poised to do so. In addition to providing nuanced insight into persuasive discourse of and about science, careful examinations of scientific practices, and humanistic perspectives on the development of science and technology, RSTM and STS scholars have established expertise on a wide range of phenomena that are relevant to sociotechnical decision-making broadly and public participation specifically. Table 1.2 illustrates some of these expertises.

RSTM, STS, and Sociotechnical Decision-making	
Risk	Katz & Miller, 1996; Grabill & Simmons, 1998; Sauer, 2003; Kelly et al., 2015

Expertise	Lyne & Howe, 1990; Kinsella, 2004; Collins and Evans, 2002, 2007; Jasanoff, 2013; Goodwin, 2011; Majdik & Keith, 2011; Graham & Herndl, 2013
Uncertainty	Shackley & Wynne, 1996; Walker & Walsh, 2012; Simmons, Moore, & Sullivan, 2015; Walker, 2017
Stasis	Fahnestock & Secor, 1988; Graham & Herndl, 2011; Graham & Teston, 2012; Walsh, 2013; Teston et al, 2014
Policy (Pipeline)	Waddell, 1990; Jasanoff, 1990; Pielke, 2007; Graham, 2015; Dixon, 2016
Controversy	Ceccarelli, 2011, 2013; Fuller, 2013; Wynn & Walsh, 2013
(Data) Visuals	Lynch, 1985; Prelli, 2006; Gross, 2009; Graham, 2009; Reeves, 2011; Walsh, 2010, 2015; Walsh & Ross, 2015
Deliberation / Inclusion	Waddell, 1996; Callon, Lascoumes, & Barthe, 2009; Keith & Danisch, 2014; Teston et al, 2014; DeVasto, 2015
Communication Technologies	Simmons & Grabill, 2007; Miller & Kelly, 2017
Transdisciplinarity/ Collaboration	Wilson & Herndl, 2007; Blyth, Grabill, & Riley, 2008; McGreavy, et al., 2013; Druschke, 2014; Goodwin, 2014; Graham et al., 2016
Framing	Nisbet, 2009; Cox, 2010; Lakoff, 2010; Druschke, 2013
Citizen Science	Druschke & Seltzer, 2012; Mehlenbacher, 2017; Kelly & Maddalena, 2015
Trust	Miller, 2003; Spoel et al, 2008; Keranen, 2010; Walsh, 2010; Grundman, 2013; Ceccarelli, 2013

Table 1.2: A brief survey of RSTM's expertise in matters relevant to sociotechnical decision making and public participation.

The elephant in the room, as Ceccarelli elegantly argues, is that

no matter [RSTM scholars'] purpose—whether it be critical or ameliorative, focused on scientists or science writers or the publics affected by them—in every case, the people we should be addressing with a report of our findings are not the people we are addressing with our most valued academic work, and we have no established apparatus to facilitate the translation of that most valued academic work to the empowered stakeholders who could benefit from it. (2013, pg. 3)

In many ways, ERSTM positions itself as a response to Ceccarelli's concern, and this dissertation seeks to explore possible apparatuses and articulations that have been or might be pursued. The trend toward reconstructivism in STS and associated emergence of ERSTM speaks to a collective anxiety over disciplinary impact in an increasingly wicked world. The state of science communication as a discipline and practice suggests a kairos for RSTM—an opportunity to embrace.

Chapter 2: A Praxiography of ERSTM

In Chapter 2, I analyze recent attempts at ERSTM in light of theoretical developments and practical concerns in STS, Science Communication, and RSTM. While the previous chapter establishes the exigence for ERSTM, this chapter is concerned with how (or if) scholars have responded and to what extent these responses align with reconstructivist theories and goals. In short, in this chapter I treat recent RSTM scholarship as artifacts for study.

As such, I curate a comprehensive list of RSTM scholars, starting with the Association for the Rhetoric of Science, Technology, and Medicine (ARST) membership list. I will expand the list as necessary upon further analysis of

conference programs and proceedings, university bios, and journal articles.

Once a list is compiled, I will collect CVs, university bios, press releases,

personal bios/webpages, scholarly articles, and any additional relevant

materials, e.g. press releases, project deliverables, reports.

I subsequently analyze these materials, drawing on a praxiographic

approach. With the insights of Chapter 1 serving as a starting point, I

develop and refine a coding schema. I then code artifacts at multiple levels

of granularity. Ultimately, my aim is to delineate the relationship among

institutional arrangement, method, theory, site/object, and outcome in

interventional RSTM not only to take stock of current efforts, but also as an

entry point into a broader analysis of the role of ERSTM in the broader

science communication and sociotechnical decision-making landscape. Put

simply, I work in this chapter to assess the varied approaches to ERSTM in

relation to their avowed aims.

Chapter 3: Staging Transdisciplinary Intervention with/as Rhetoric

In Chapter 3, I offer a case study of a collaborative effort to catalyze

transdisciplinary action to address cancer-obesity comorbidity and risk

coincidence. This effort aimed to respond to both the challenge of

coordinating different expert communities of practice and the growing body

of evidence suggesting a strong link between cancer, obesity, and low socio-

economic status. The project serves as an excellent case study of ERSTM for

a variety of reasons. First, the project team was comprised of rhetoricians, academic medical practitioners, and a professor of public health, and so follows Cagle's call for transdisciplinary approaches. Second, the project leverages rhetorical perspectives on systems, science, deliberation, and expertise in order to create a "boundary object" – a tool that was immediately used to facilitate decision making by relevant stakeholders. In this case, that object was a map of cancer and obesity treatment and prevention practices.

As a member of the research team, I acknowledge some inevitable biases. However, I believe my participation in the project uniquely situates me to conduct a critical re-reading of the project through the lens of ERSTM. My goal here is not to hold up this project as a model for ERSTM—as ERSTM at its finest. Rather, I aim to interrogate the methodological choices as well as the project's aims and outcomes. For example, this project exemplifies the tension between expanding knowledge of disciplinarily defined phenomena (transdisciplinary coordination) and immediate, practical action. I aim to highlight and explore such tensions, challenges, and limitations to inform future efforts at ERSTM.

Chapter 4: Rhetorical Engagement with Science (Communication)

In Chapter 4, I offer a case study of a recent attempt to identify promising spaces for intervention in the emerging problem of pharmaceutical

contamination in Lake Michigan (and waterways across the U.S.). This effort

aimed to respond to both the challenge of intervening in complex,

distributed systems and the growing body of evidence that pharmaceuticals

in our waterways are affecting our ecosystem in concerning ways. Much like

in the previous case, a collaborative team comprised in part of RSTM

scholars attempted to catalyze a response to this wicked problem by

bringing together a variety of stakeholders around a boundary object—in this

case a map of practices involved in pharmaceutical contamination.

Here again, I was a member of the research team that designed and

implemented this project. Interrogating this positionality will be a feature of

the chapter. This position uniquely situates me to explore the methodological

choices in relation to ERSTM's exigencies and aims. For example, project

participants identified public relations activities as a primary mode of

intervention. This is an area that RSTM has limited experience in, and quite

frankly, actively avoids. This experience exemplifies one that many STM

rhetoricians fear—the assumption and expectation that they will serve as the

resident public relations expert.

Chapter 5: Toward a Science of PRC

In Chapter 5, I reiterate the role RSTM can play in addressing problems at

the science-policy nexus. I synthesize the insights of previous chapters to

reexamine promising opportunities, pressing liabilities, and remaining

questions. I discuss the tension between projects driven by discipline-

specific expertise and knowledge building and problems driven by other exigencies (e.g. environmental, political). I further speculate on the implications of this dissertation with regard to emerging efforts to develop a "science of science communication," specifically the need to explore ways to measure the value of PRC.

CHAPTER 2: A PRAXIOGRAPHY OF ERSTM

In chapter 1, I traced the emergence of ERSTM. I highlighted ethical, strategic, and onto-epistemological rationales for ERSTM. While Druschke (2017), Herndl (2017), and Cagle (2017) convincingly offer the "why" of ERSTM, the "what" and "how" are relatively nebulous. In many ways, this chapter 1) attempts to answer Hendl's call for a survey of the sites, types, and styles of work that ERSTM does and 2) proceeds from Ceccarelli's 2013 evaluation of RSTM scholarship in which she concludes that we lack "any evidence that our attempts at intervention have the slightest chance at…[accomplishing] the shift from understanding to action" (p. 2). If we are to take calls for ERSTM seriously, what do engaged rhetoricians do? How do they do it? And what are the risks?

Answering these questions will help to guide future discussion of the value of ERSTM as well as the planning and implementation of engaged projects. In addition, answering these questions is particularly pressing in light of critiques of past engaged efforts. Indeed, Ceccarelli's suggestion that rhetoricians "have no established apparatus to facilitate the translation of our most valued academic work to the empowered stakeholders who could benefit from it" (2013, p. 3) points to both the reason for and biggest challenge to ERSTM. Further, in response to panel presentations at the 2013 ARST preconference on collaborating with scientists, Ceccarelli (2014) asks

"where's the rhetoric?" She reviewed the presentations of the five panel members, questioning in each case how their contributions to their respective collaborative efforts were "distinctly rhetorical." In so doing, she pushed for more specific elaboration of just what each scholar did, "what language and arguments [they used] to establish a role for rhetoric" in the practice of science (p. 6). While it is easy to read her analysis as dismissive of ERSTM, I instead want to take seriously the need for careful examination of engaged practices. I will return to Ceccarelli's comments later, but for now I will simply conclude that she endorses Herndl's call for a survey of the sites, types, and styles of work that ERSTM does.

As such, in this chapter I analyze recent ERSTM scholarship in light of theoretical developments and practical concerns in STS, Science Communication, and RSTM. In short, I treat RSTM scholarship as artifacts for study in order to determine 1) if/how rhetoricians have responded to calls for engagement since Ceccarelli's 2013 appraisal and 2) to what extent these responses align with reconstructivist theories and goals. In the time since Ceccarrelli's assessment, the calls for engaged work have only gotten louder. The time is right to reevaluate the scholarly practices of RSTM.

Methodology: A Praxiographic Approach to Engagement(s)

Importantly, my aim is not simply to document the myriad activities we might label public engagement or science communication broadly, but rather to determine the extent to which RSTM scholars are participating in

"upstream" or "engaged" rhetorical work and how engagement is enacted. In other words, rather than look for evidence of a certain brand of activity, I aim to read the practices of engaged rhetoricians through the lens of the theoretical justification and practical rationales that I identify in chapter one.

Although I am indexing this study to RSTM scholars my interest lies not in evaluating or judging rhetoricians so much as examining ERSTM engagement *practices*. More specifically, I adopt a *praxigraphic* approach to ERSTM. Praxiography is Annemarie Mol's term for an ethnography of practices that focuses on doing and intervening (Mol, 2002; Herndl and Cutlip, 2013; Graham, 2015; Card, Kessler, Graham, 2018). Mol operationalizes this approach in order to demonstrate that atherosclerosis is differently enacted by a patient at home, a technologist in a lab, or a pathologist with a microscope. In so doing, she contends that there is not one atherosclerosis, but many *atherscleroses*. Rather than conceive of atherosclerosis as a single entity about which there are multiple conflicting perspectives, a praxiographic focus asks what does atherosclerosis look like in practice and how do different atherosclerosis practices relate to one another? Such an approach is well-suited for this study of ERSTM because it presumes that "engagement" is a diverse constellation of practices—many engagements—and as such, seeks to account for the consequences of those varied practices. This attention to the multiple ways in which engagement is

and might be enacted is much needed as RSTM scholars debate the value of "engagement" writ large.

Of course, a deep praxiographic study of ERSTM would certainly include sustained ethnographic observations of engaged practices. I work toward such an approach in chapters 3 and 4, but in this chapter my aim is to develop an expansive sense of the many ways ERSTM might be enacted. Given the breadth of this investigation, I rely heavily on discursive traces of engagement. At first glance, this may seem incompatible with a praxiographic approach's emphasis on material practice. However, discursive analysis that focuses not on linguistic strategies—on how events are discussed—but instead on what practices are made manifest represents a compelling approach for rhetoricians (Card, Kessler, Graham, 2018). As such, my analysis of engagement practices asks not how is engagement discursively represented? but what modes of engagement does RSTM enact?

Methods: Data Curation and Schema Deployment

In order to account for a diversity of RSTM engagement practices, I began with a preliminary list of scholars who have self-identified with ERSTM. The list initially included contributing authors to POROI's 2017 *Engaged RSTEM Symposium*, and was expanded based on citations within those articles as well as additional scholarly database searches for "engaged," "applied," "interventional," and "upstream" rhetoric of science, technology, and medicine. A substantial, though not exhaustive list of scholars who have

advocated for ERSTM, broadly conceived, was compiled. The completed list consisted of a dozen scholars (see Appendix B).

Once the list was compiled, I performed an iterative series of searches for publically-available artifacts. I collected journal articles, university biographies, project deliverables, reports, press releases, blog posts, CVs, and professional websites—anything that might provide insight into the practices of ERSTM. I treated these artifacts as engagement in some cases and as traces of engagement in others. For example, a public-facing op-ed and a scholarly article describing a collaborative project with a scientist both provide valuable information—the former as an example of engagement and the latter as a description of prior engagement. Of course, if the latter was published in a policy journal, it both describes engagement and was itself a form of engagement. A convenient affordance of focusing on publically-available textual traces of engagement is that it provides insight into what activities RSTM scholars value and as a result how external stakeholders might perceive ERSTM scholars. Once all publically-available artifacts from 2011 to present were compiled, the final dataset consisted of over 500 datapoints associated with the twelve scholars.

Once the dataset was compiled, I developed and refined a schema of ERSTM practices through multiple rounds of qualitative analysis. The final schema consists of six "modes of engagement," three "characteristics of engagement," and three "elements of rhetoricity". In highlighting emergent

distinctions among the various engaged practices in the dataset, this schema

provides a useful heuristic for examining ERSTM. In drawing these

boundaries, I aim not to reduce the complexity of engaged practices, but

rather to illustrate recurring approaches and explore their affordances and

constraints. Table 2.1 (below) contains descriptions and examples for each

mode of engagement, characteristic, and element of rhetoricity.

Of course, categorizing practices based on the artifacts in my dataset

required significant interpretive work. The resulting data is no doubt colored

by my own reading of abstracts, CVs, etc. as well as the personal accounts

of the rhetoricians in the dataset. Nevertheless, I have attempted to account

for the primary mode of engagement and characteristics of those

engagement activities for each artifact in the dataset. This approach to data

collection privileges activities that already have institutional value—activities

that have been published, listed on a CV, or otherwise documented by a

university, news source, or a rhetorician. There are certainly many important

behind the scenes activities this approach simply does not account for.

Modes of Engagement

Code	Description	Example
Dissemination of Rhetoric to Public	Translation / dissemination of the insights of rhetorical theory or scholarship to "public" audiences, e.g. audiences not defined by expertise relevant to the context	Publishing an op-ed in a venue of broad readership, e.g. local or national newspaper; giving an interview or lecture for a general audience
Dissemination of Rhetoric to Non-Rhetoric Experts	Translation / dissemination of the insights of rhetorical theory or scholarship to extradisciplinary experts, e.g. science or policy-making publics	Publishing research in a STEM- or policy-oriented journal; writing a report to STEM or policy researchers or practitioners
Science Public Relations / Communication Consulting	Advocating for science, disseminating the results of scientific research, or providing scientists insight on how to effectively communicate specific research	Writing blogs, press releases, grants, or managing social media for STEM practitioners
Science Communication / Public Relations Pedagogy	Teaching scientists or science students how to effectively communicate science, broadly construed	Publishing curricular development activities; giving workshops or lectures for practicing scientists
Rhetorical-Humanist Pedagogy	Teaching scientists or science students to more ethically do science and engage non scientists	Publishing curricular development activities; giving workshops of lectures for practicing scientists
Problem-Oriented Rhetorical Catalysis	Designing and facilitating dialogue on "matters of concern"	Designing and facilitating a conference; facilitating an interdisciplinary group of researchers or practitioners

Characteristics of Engagement

Code	Description	Example
Collaborative with Experts	Activity involves collaboration with science or policy-making publics	Publishing alongside colleagues in STEM fields or employees of regulatory agencies; conducting participatory action research involving a group of STEM or policy experts
Policy-oriented	Activity explicitly makes policy change a top priority	Publishing in a policy journal or with a policy-making agency; making recommendations to a policy-making body
Grants	Activity is grant writing	Writing a grant, collaboratively or solo, that involves STEM, rhetoric, or policy broadly conceived

Elements of Rhetoricity

Code	Description	Example
Rhetoric as Theory	Application of concepts and theories from a core rhetorical tradition to specific cases and texts to refine rhetorical theory and/or illuminate the rhetorical practices of science	"Can we introduce to *specific concepts and findings that are distinctly rhetorical*, and in so doing, have a positive influence on those scientists" (Ceccarelli, 2014, p. 7)

Rhetoric as Object of Inquiry	Examination of the ways communities form and negotiate life, usually with an emphasis on the role language plays in those processes; emphasizes the phenomena of interest and leverages a variety of methods and theorists	"Rhetoric offers a useful perspective…complicates and contextualizes the practice of science and its translation into policy; rhetoric adds necessary—even ethical—depth and nuance…" (Gottschalk Druschke, 2014, p. 4)
Rhetorical Praxis	(Rhetorical) practices and processes that enact the insights of rhetoric as theory and rhetoric as object of inquiry; activities that appear to be rhetorical action as opposed to rhetorical inquiry	"The boundary between doing communications work and my research into the rhetoric of collaboration and science reporting in large NSF projects is likely to become blurry and I am not sure how I will intellectually or practically separate the two.

Table 2.1: Final schema of ERSTM

Given the complex and multifaceted nature of engagement practices in the dataset, it is worth briefly exploring some of the distinctions on which these modes rely. Dissemination of rhetoric to public as an engagement practice is an RSTM analog for what is commonly held to be the goal of science communication—disseminating the insights of "basic research" to a general public. Dissemination to non-rhetoric experts, then, is similar insofar as it involves sharing the findings of RSTM research, but makes an important distinction about the audience. Rather than a broad, undefined public, this mode works to target the "empowered, external stakeholders" that can put RSTM research to practice (Ceccarelli, 2014). There are also two modes involving "public relations" or "communications." These modes emerge from distinctions between 1) ethical / effective and 2) pedagogy / practice. While often blurry in practice, these distinctions map well onto distinct activities RSTM scholars report being asked or expected to deliver. Rhetorical-humanist pedagogy and problem-oriented rhetorical catalysis (PRC) contrast with these in some ways along the effective / ethical distinction. Whereas my use of "communications" is meant to capture the aim for *effective* communication (i.e. an instrumental sense of communication), these two modes emerge from normative commitments to ethical science-society relationships.

Of course, treating these as discrete forms risks creating one-dimensional strawmen out of what in practice are diverse in motivation and

approach. Accordingly, I now examine a representative sample of artifacts from two scholars in the dataset, Leah Ceccarelli and Bridie McGreavy. Table 2.2 contains artifacts and their primary mode.

Sample of Coded Artifacts		
Ceccarelli	**Mode**	**McGreavy**
"Argument Anatomy, Science and Public Controversy" (2014) Presentation at International Society for Environmental Epidemiology Preconference Workshop	Dissemination to NR-Experts	"Addressing the complexities of boundary work in sustainability science through communication" (2013). Collaborative in *Sustainability*.
"How Metaphors About the Genome Constrain CRISPR Metaphors: Separating the 'Text' From Its 'Editor'" (2015). Interdisciplinary and collaborative, *The American Journal of Bioethics*	Dissemination to NR-Experts	"Why rhetoric matters for ecology" (2016). *Frontiers in Ecology and the Environment*.
	Dissemination to NR-Experts; Rhetorical-Humanist Pedagogy	Graduate students as boundary spanners: training scientists to meet the challenges of sustainability" (2016) Interdisciplinary and collaborative, *Journal of Environmental Studies and Sciences*.
"Stop Calling Science a 'Frontier,'" The Seattle Time (2014c).	Dissemination to Public	

Table 2.2: A selection of engagement artifacts and modes for Leah Ceccarelli and Bridie McGreavy

I have selected Ceccarelli and McGreavy specifically because their respective profiles highlight contrasting approaches to ERSTM. Both scholars have

collaborated with extradisciplinary experts and both have published in venues with readership beyond their disciplinary community. In addition, Ceccarelli has authored a few op-eds for more general audiences, such as her opinion piece on the "frontier metaphor of science" in the *Seattle Times* (2014c). Further, McGreavy's publication in the *Journal of Environmental Studies and Sciences* is a good example of a dual-coded artifact. The transdisciplinary, problem-oriented curriculum for sustainability science the authors describe emerged from McGreavy's collaborative work and represents a significant attempt to incorporate a rhetorical-humanist perspective into STEM pedagogy. In addition to describing this pedagogical effort, the article is dissemination because it was published in an extra disciplinary venue. This artifact also illustrates the need for the "elements of rhetoricity" taxonomy. Under the rubric of "rhetoric as theory," this artifact (and much of McGreavy's work) would not likely be included. This taxonomy emerges from a more inclusive, multifaceted sense of rhetorical inquiry and practice. I will discuss the implications of such an approach for ERSTM at length later, but I now offer the results of my praxiographic coding.

Results: ERSTM Across the Discipline

With a more detailed understanding of each mode and characteristic of engagement, I now discuss the results of my praxiographic coding in order to explore engagement practices. In a report of her 2013 analysis, Ceccarelli noted that an impressive number of rhetorical studies of science and

technology are being published in a variety of venues (e.g. technical communication, media studies, public address, and composition) before lamenting the passive nature of the implied reader.

> "But what kind of work is it that we are doing? In most cases, the reader implied by these articles is a fairly passive one, seeking primarily to "understand" (e.g. Applegarth, 2012, p. 453) or gain "insight" (e.g., Kelly & Hoerl, 2012, p. 127) about something that the author will "illuminate"…Such language suggests that the intellectual quality of detection, or the ability to discern, is most valued in the academic communities toward which these journal articles are directed" (2013, p. 2)

My results align with Ceccarelli's 2013 analysis in some ways and diverge in others. While Ceccarelli offers publication in technical communication, composition, or speech journals as evidence of extra-disciplinary value, I chose to exclude venues likely hosted by scholars in our home departments, with the exception of those focused on environmental or science communication. Rather, my dataset consists of artifacts further from rhetoric's departmental homes of Communication, English, or Writing Studies. Nevertheless, the results in Table 2.3 suggests a similarly impressive engagement record.

Modes of Engagement	
Dissemination of Rhetoric to Public	11
Dissemination of Rhetoric to Non-Rhetoric Experts	321
Science Public Relations / Communication Consulting	37
Science Communication / Public Relations Pedagogy	13
Rhetorical-Humanist Pedagogy	14

Problem-Oriented Rhetorical Catalysis	12
Characteristics of Engagement	
Collaborative with Experts	86
Upstream / Policy-oriented	281
Grants	50

Table 2.3 Aggregate results of praxiographic coding for modes and characteristics of engagement.

To be sure, the numeric results in Table 2.3 overlook important activities that could be considered engagement while also accounting for some that rhetoricians of a certain persuasion would not count. In spite of these limitations and grey areas, my appraisal suggests that ERSTM is both active and diverse in its practices. In less than a decade, the dozen rhetoricians studied have embraced a variety of modes at impressive frequencies. With only Ceccarelli's 2013 article as a basis for comparison, I hesitate to make any claims as to whether this is a recent development. Yet, these data certainly suggest aims beyond the "passive" efforts to "understand" and "gain insight" that Ceccarelli identifies as primary to rhetorical practice. Rather, RSTM is securing grants, speaking to the public, and developing courses aimed at both effective and ethical science communication. In addition, these scholars are collaborating with other expert publics and working on policy-oriented projects. While science communication and rhetorical-humanist pedagogical practices were not highly represented, I find these numbers impressive given that classroom teaching and guest lectures were excluded from the analysis. In addition to the variety of classes ERSTM

scholars are teaching, there were numerous instances of guest lectures in a wide range of courses within and beyond the humanities. Also impressive is the number of successful grants. Many of these were for hundreds of thousands of dollars, and while they were typically collaborative, the number of grants in the dataset still serves as a strong signal that the work of ERSTM scholars is valued beyond the discipline.

Perhaps most intriguing, however, is the frequency of dissemination to experts outside of the discipline. It is important to note, the majority of collaborations with non-rhetoric experts also resulted in dissemination to non-rhetoric experts. In other words, partnering with social scientists, scientists, issue advocates, or policymakers tended to lead to publications, presentations, and reports to a range of external expert publics.

Discussion: Engagement and Rhetoric as Polysemous

The high frequency of expert-oriented dissemination in my analysis either suggests improvement in this area (perhaps in response to Ceccarelli) or significant methodological differences between my assessment and Ceccarelli's. In what follows, I entertain the latter. In the beginning of this chapter I made note of Ceccarelli's argument about the importance of public outreach for rhetoric as well as her criticism of particular collaborations with scientists (Ceccarelli, 2013; 2014). Shortly after the time period at which my analysis begins, Ceccarelli lamented the lack of outreach, arguing,

"the people we *should* be addressing with a report of our findings are not the people we *are* addressing with our most valued work, and we have no established apparatus to facilitate the translation of our most valued academic work to the empowered stakeholders who could benefit from it" (2013, p3).

My analysis paints a much more positive picture of engagement, which I suggest is the result of not insignificant methodological differences between my approach and hers—differences that I argue emerge from differing conceptions of both "engagement" and "rhetoric." Ceccarelli's response to the 2013 ARST panel on collaborations between rhetoricians and scientists offers insight along these lines. Her chief critique was that while rhetoricians were collaborating with scientists, it was unclear to her how the roles those rhetoricians were playing were "distinctly rhetorical." Drawing on Gross (1996), Prelli (2013), and Fahnestock (2013), Ceccarelli locates the rhetoricity of a given collaboration (or lack thereof, in these cases) in a distinctive sensibility and analytic vocabulary to examine inventional choices—a perspective and set of tools that focuses on scientific texts as persuasive communication—that scientists can't get from scholars in science communication or the science studies domains of history, philosophy, or anthropology. In presenting about argument and controversy to epidemiologists, publishing on genome metaphors in *The American Journal of Bioethics*, or writing an op-ed about the 'frontier of science" metaphor in the *Seattle Times* (2014c), Ceccarelli's engagement efforts are consistent

with her concern for "distinctly rhetorical" contributions. This sense of

rhetoric undergirds "rhetoric as theory" in the rhetoricity taxonomy.

In her own report of efforts to engage in public outreach for rhetoric,

Ceccarelli describes her attempts to "instruct scientists by summarizing the

findings of rhetorical studies of their discourse" (2014, p. 6). More

specifically, she recounts a failed attempt to introduce the concepts of

litotes, metaphor, hyperbole, and metastasis. Ultimately, she arrives at a

crossroads:

> Can we introduce scientists to specific concepts and findings that
> are distinctly rhetorical, and in so doing, have a positive
> influence on those scientists…Or is this the wrong question to
> ask? Is there another way that we should be thinking about what
> rhetoric is and what its broader impact should be? (2014, p. 7).

While I share Ceccarelli's passion for classical rhetorical terminology as well

as her concern for preserving it, I wonder if McGreavy's practices might

represent the alternative Ceccarelli alludes to. Under Ceccarelli's definition of

rhetorical, nearly none of McGreavy's activities would count. To be sure, in

examining McGreavy's grants and publications, rhetoric is seldom

mentioned. Rather, McGreavy repeatedly leverages the language of

communication, problem-solving, effective decision making,

interdisciplinarity, and complex problems. Although this lexicon does not

immediately stand out as distinctly rhetorical, I argue that most of the

practices I analyzed nevertheless take rhetoric as the object of inquiry.

Whether determining and articulating the attitudes and preferences of local

stakeholders to policymakers or establishing rhetorically-informed communication training as central to the education of scientists, McGreavy's work aligns with a pragmatic, deliberative rhetorical lineage and is consistent with the insights and aims of RSTM. In addition, the collaborative nature of most of McGreavy's engagement as well as her impressive funding record would seem to indicate a certain level of success at establishing a role for rhetoric in the practice of science.

In addition to the significant differences in content, it's worth noting the audiences each scholar has targeted. Ceccarelli is one of only a handful who has explicitly worked to engage the "broader public," while McGreavy is one of only a handful who have targeted interdisciplinary policy-oriented publication venues and regulatory/policy-making agencies. These two axes—audience and content—are useful in thinking about what rhetoric is *as a discipline* and what its broader impact should be. Taken together, ERSTM's interventional aspirations and the argument that RSTM has a responsibility to leverage its expertise to improve scientific and science-policy practices (ethical rationale) suggest greater focus on the audience—the stakeholders or communities of practice who are in a position to enact change. Indeed, this sentiment echoes STS scholars' Collins and Evans' argument that humanistic scholars of science and technology should embrace "upstream" work that "attempts to affect the flow of the river of history, rather than examining its turns and eddies (2002, p. 241). In contrast to reflecting upon

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or critiquing sociotechnical decision-making after the dust has settled, working upstream would seem to require (pro)active engagement with scientific and policy publics *as* they work. To what extent, then, is core rhetorical theory useful in this type of upstream research? What of the distinctly rhetorical content Ceccarelli finds absent in discussions of ERSTM? Said another way, how does this tension between preserving traditional approaches to rhetorical criticism and intervening upstream play out in dissemination to experts outside rhetoric, ERSTM's primary mode of engagement?

One way of answering these questions is to examine the ways research is articulated and enacted. Although much criticism of ERSTM seems to identify explicit use of core rhetorical terminology or theorists as the primary marker of distinctly rhetorical scholarship, here I pursue a more generous reading. Specifically, I draw on three elements of rhetoricity that emerge in my dataset: rhetoric as theory, rhetoric as object of inquiry, and rhetorical praxis. In drawing these distinctions, I work not to demarcate what is and is not rhetorical, but to advance a vision in which these interconnected practices inform each other and enrich RSTM.

> ***Rhetoric as Theory.*** "Rhetoric as theory" best resembles what Ceccarelli describes as she grasps for the "distinctly rhetorical" contributions of RSTM. This element of rhetoricity is defined by the application of concepts and theories from a core rhetorical tradition to specific cases and texts to refine rhetorical theory and/or illuminate the rhetorical practices of science. Indeed,

most work in RSTM's relatively short history falls into this category.

Rhetoric as Object of Inquiry. Rhetoric as object of inquiry emerges from a broader conception of rhetoric—one that seeks to understand the ways communities form and negotiate life, usually with an emphasis on the role language plays in those processes. Whereas "rhetoric as theory" indexes its rhetoricity primarily to application of canonical concepts and theories, "rhetoric as object of inquiry" emphasizes the phenomena of interest and leverages a variety of methods and theorists.

Rhetorical Praxis. Rhetorical praxis, then, refers to the (rhetorical) practices and processes that rhetoric as theory and rhetoric as object of inquiry study and suggest. In regard to ERSTM, rhetorical praxis helps account for engaged activities that at first glance do not appear to be rhetorical inquiry so much as rhetorical action, but nevertheless respond to arguments for upstream intervention.

Although arguments about what defines the discipline of rhetoric often rely on these distinctions and any given study, project, or practice could be placed as primarily one over another, the boundaries are porous. These elements of rhetoricity come in and out of focus as rhetorical scholarship is examined and represented. In other words, a focus on the explicit application of theory or transmission of distinctly rhetorical concepts in engaged practices may obscure the presence of one or more of these elements in a given engaged project. For example, Ceccarelli's canonical study of Dobzhansky, Schodinger, and Wilson is rhetoric as theory insofar as it seeks to advance rhetorical theory by applying traditional rhetorical methods and concepts, rhetoric as object insofar as works to understand the

formation of interdisciplinary fields of study, and rhetorical praxis insofar as she leverages her knowledge of rhetoric to share insight with her readers in rhetoric, STS, and science communities.

I argue that the same could be said of all artifacts in my dataset. Given the braid-like quality of these three elements, I suggest engaged practices must be evaluated not on the basis of a single presentation, article, or even project, but across many over time. Take, for example, McGreavy's work in Frenchman Bay, Maine (McGreavy, 2016; Stormer & McGreavy, 2017). Frenchman Bay shapes and is shaped by McGreavy's engaged research. Textual traces of Frenchman Bay are scattered through artifacts in my dataset, from her ARSTM award-winning article *Resilience as Discourse* (2016) in which she draws on Frenchman Bay to triangulate her analysis of resilience discourse in socio-ecological systems literature to a technical report on stakeholder perspectives in written directly to the Frenchman Bay Steering Committee. Rather than treat these artifacts as distinct practices— one research and one praxis—I read them here as reciprocally entangled. Maintaining a strong distinction between inquiry and praxis or inquiry and engagement forecloses certain approaches to both engagement and rhetoric and suggests others. More specifically, if rhetoric is defined as theory or concepts that must be translated and disseminated, much of the exciting work in my dataset no longer "counts," no matter how enriching it may be

for RSTM or the external publics involved. Instead, engagement risks becoming a post-hoc process of one-way information dissemination.

In contrast with a linear outreach model in which engagement is conceptualized as a translational event that occurs once rhetorical inquiry is complete, engagement as inquiry-praxis is a problem-oriented, iterative process. This distinction parallels the gap I highlight in chapter one between 1) the recommendations of science communication scholars and avowed stance of science organizations and 2) the engagement practices of scientists. While scholars and science organizations increasingly promote a cultural shift in which science and society, so to speak, are brought in to dialogue early and often, broader impact activities in practice remain largely post-hoc and transmission-oriented.

Post-hoc Engagement

Rhetorical theory, concepts, insights → Expert publics

Engagement as inquiry-praxis

Rhetorical theory, concepts, insights

Embedded inquiry and praxis

Engagement with publics, places, problems
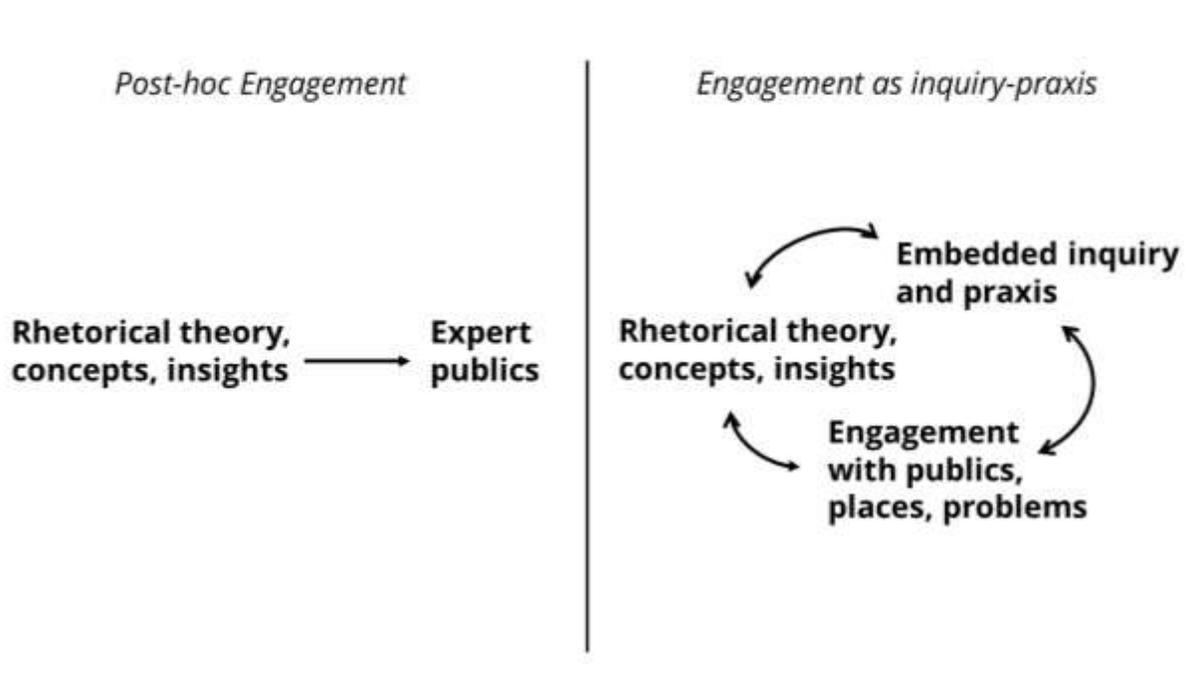
Figure 2.1: Diverging conceptualizations of engagement

As Herndl notes in his discussion of the emergence of ERSTM, "disciplines change in response to intellectual development, but also in response to contextual exigencies like our impending ecocide, the shift in institutional priorities at universities, and the emergence of new metaphors such as "matters of concern," "things," and "working upstream" (2017, p.3). Indeed, Ceccarelli compellingly demonstrates the emergence of research programs that shift or go beyond traditional disciplinary boundaries. In analyzing Theodosius Dobzhansky's 1937 *Genetics and the Origin of Species* and Erwin Schrodinger's 1944 *What is Life? The Physical Aspect of the Living Cell*, Ceccarelli identifies two rhetorical strategies that helped spur interdisciplinary alliances and approaches: "conceptual chiasmus" and "polysemic textual construction" (2001). In each case, the rhetor works to appeal to different interpretive communities at once. The former promotes a conceptual shift by articulating the concepts, tools, or objects of inquiry from one discipline to the concepts, tools, or objects of inquiry of another, and the latter encourages positive, but diverging readings of the same text by different interpretive communities.

Ceccarelli's careful analysis illustrates the tremendous insight her approach to rhetorical scholarship can yield, but it does not exhaust the expertise of rhetoric as a discipline or RSTM as a subfield. Rather than ask, "where's the rhetoric?", this chapter asks "what can rhetoricians do?" During the course of answering that question, I have documented a variety of

practices that have the potential to advance the subfield and promote productive relationships among publics and scientific practice. In her critique of collaborations with scientists, Ceccarelli pushed for detail on the specific language and concepts rhetoricians used so as to further best practices for engaging with scientists. In analyzing the engaged practices of scholars in my dataset, I see a promising answer to Ceccarelli's calls. While many of these practices may seem devoid of rhetoric, I wonder what we might find if we read them as Ceccarelli reads Dobzhansky and Schrodinger. More specifically, if we view engaged efforts not as attempts to translate distinctly rhetorical concepts and instead view them as *part of* and *emergent from* a transdisciplinary process of inquiry and praxis, might we read McGreavy's National Science Foundation grant for "multi-scale, coupled systems research on social, economic, and ecological tradeoffs in decision making about dams" not as devoid of rhetoric, but as a deployment of conceptual chiasmus or something like it?[4] An attempt to enact and further study Ceccarelli's insight while also working to shift decision-making practice in a more satisfactory direction?

Such a close reading is beyond the scope of this chapter. However, in chapters three and four I further explore the polysemous quality of "rhetoric" and "engagement" in two semi-autoethnographic case studies of engaged projects in which I participated. While this chapter provides a useful

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[4] I address this question more fully in subsequent chapters.

framework for thinking about engaged rhetorical scholarship and identifies

key tensions, the subsequent chapters contain a more detailed analysis of

embedded research and the theoretical and practical insights and challenges

it presents.

CHAPTER 3: STAGING TRANSDISCIPLINARY INTERVENTION WITH/AS RHETORIC

In the previous chapter, I built a schema for examining ERSTM. In applying this schema, I illustrated a variety of approaches RSTM scholars have taken and might embrace going forward. In so doing, I worked to respond to Ceccarelli's twin concerns for on one hand ensuring the broader impacts of RSTM scholarship and on the other maintaining a "distinctly rhetorical" essence. I argued that these concerns, taken together, suggest a particular vision of both rhetoric and engagement—one that defines 1) rhetoric by the use of canonical concepts and theorists and 2) engagement as the one-way dissemination of basic research. In response, I advocate an entangled model of engagement in which a problem, not a discipline, is primary. Under such a model, the publics involved and the approaches used emerge from a shared matter of concern. This shift in emphasis blurs commonplace academic distinctions between inquiry and praxis, basic and applied.

In this chapter and the next, I work to further illustrate the ways in which these distinctions break down and explore the implications of that breakdown for ERSTM. To do so, I offer two case studies of engaged projects in which I participated during the course of my rhetorical training. As a member of the research team, I acknowledge some inevitable biases. However, I believe my participation in the projects uniquely situates me to

conduct a critical re-reading of the project through the lens of ERSTM. I conduct these case studies to examine the projects' aims and outcomes, the methodological choices made, and my own experience as an engaged rhetorician of science, technology, and medicine. So while one of my goals in this and the subsequent chapter is to contribute additional cases to the growing list of models for ERSTM, I also hope to address some of the tensions that emerged in the previous chapter.

To that end, in this chapter I describe a collaborative effort to "catalyze transdisciplinary action to address cancer-obesity comorbidity and risk coincidence." In what follows, I draw on my personal experience of the project as well as analysis of project materials including timesheets, observation notes, emails, and project deliverables. I have organized the chapter into four sections. In the first, I briefly review RSTM literature on interdisciplinary coordination. In the second, I examine the project as an enactment of ERSTM, discussing the project's characteristics, motivations, and methods. In the third section, I describe the resulting conference in order to demonstrate how the theoretical backdrop and initial phases of the project shaped the intervention. Finally, I argue that the practices of staging and calibration represent fundamentally rhetorical contributions with the potential to extend RSTM inquiry.

Staging Transdisciplinary Action

The "catalyzing transdisciplinarity" project under analysis in this chapter was heavily influenced by RSTM's long-standing concern with disciplinary specialization and the challenges it presents vis-a -vis coordinating across knowledge communities. Indeed, the research team indicates in an article published on the project, "Extensive subdisciplinary education often locks researchers and practitioners into very specific intellectual paradigms, defined by particular uses of technical vocabulary, relatively narrow ranges of accepted methodologies, and well-delineated theories of the body, health, and care" (Graham, et al., 2016, p. 1). In fact, some in RSTM locate the emergence of the field itself as a response to Kuhn's theory of paradigm change, which made incommensurability between intellectual paradigms a key site of conflict in the development of science. Regardless the motivation, scholars in RSTM have spent considerable energy documenting the intellectual paradigms of expert communities and the challenges to coordination they present, in many cases theorizing strategies for overcoming them (Ceccarelli, 2001; Harris, 2005; Graham & Herndl, 2013; Graham, 2015; Gross, 2004; Prelli, 2005; Wilson & Herndl, 2007).

For example, in the previous chapter I briefly mentioned Ceccarelli's study of Dobzhansky. Ceccarelli's careful treatment of Dobzhansky's *Genetics and the Origin of Species* provides a rich account of the disciplinary tension between the Mendel-inspired geneticists and Darwinian naturalists,

two camps that eventually found a way to work together under a common

set of "interdisciplinary presuppositions" (p. 21). In contrast to a Kuhnian

story of triumph in which one discipline displaced the other on the back of a

novel scientific insight, Ceccarelli argues that the "evolutionary synthesis"

between geneticists and naturalists was a "movement that reorganized

disciplines, overcoming intellectual and professional barriers that were

keeping scientists in different areas from working together…a conceptual and

polititcal understanding that resulted in collaboration between disciplines" (p.

21).

In working to understand how Dobzhansky's book contributed to the

evolutionary synthesis, Ceccarelli rhetorically analyzes the text and its

reception. As she notes, in light of significant theoretical and practical

differences between naturalists and geneticists, Dobzhansky's book needed

to break down conceptual barriers in order to unite the fields. For example,

Ceccarelli examines Dobhzansky's use of a topographic map of populations

and gene combinations. This map and the accompanying prose leveraged an

adaptive landscape metaphor that reconceptualized genetics and natural

history such that both camps were able to see their respective phenomena

of study from their counterparts' perspective. Ceccarelli dubs this strategy—

accommodating the conceptual frames of diverse audiences in order to

encourage each to see their work in the others' terms—*conceptual chiasmus*.

Similarly, Graham suggests "cross-ontological calibration" as a representational practice capable of fostering interdisciplinary alliances. Working within a new materialist idiom, Graham provides an account of an interdisciplinary pain management organization's efforts to transcend disciplinary differences in order to better address the problem of pain. Much like Ceccarelli's study of naturalists and geneticists, Graham finds fundamental differences in conceptualizing, defining, and managing pain among nurses, psychologists, chiropractors, anesthesiologists, and general practitioners, to name a few.

Taking a praxiographic approach, Graham argues that the practices of these specialists enact different ontologies of pain, resulting in not one pain that is treated from different perspectives, but multiple *pains*. Each of these pains emerges from different metaphysics of pain, theories of the body, and practical engagements with patients. Yet, the group at the center of Graham's study is committed to working together to establish a new approach to pain science and medicine. Through his study of the group's practices, Graham demonstrates how representational activity, broadly construed, "circulates within and contributes to a deeper ecology of practices in which those acts of representation are embedded" (p. 69). Cross-ontological calibration, then, refers to a form of representational practice that "serves to navigate the boundaries among divergent ontologies" (p. 69).

Though their sites and modes of inquiry differ in important ways, both Ceccarelli and Graham offer rhetorical studies compelling accounts of how rhetorical activity can align seemingly incommensurable disciplines around an interdisciplinary agenda. Most relevant in the current context, however, is Wilson and Herndl's study of interdisciplinary cooperation at the Los Alamos National Laboratory (2007). Indeed, the research team of the project under analysis in this chapter drew explicitly on this work, adapting Wilson and Herndl's "systems ethnography and qualitative modeling" (SEQM) as their methodological framework. SEQM is Wilson and Herndl's solution to the need to coordinate aeronautics engineers, intelligence analysts, and military strategists, to name just a few, in the face of emergent military threats. They observed the various experts and conducted targeted interviews before developing a "knowledge map"—a visual schematic that identifies what different groups know and how that knowledge relates to other knowledge in the context of achieving a broad goal. Wilson and Herndl argue that the knowledge map functions as a boundary object that encourages understanding and productive coordination among different experts. The project that is the subject of this chapter extends this insight in important ways, especially with regard to ERSTM. I offer a detailed account of *Catalyzing Transdisciplinarity* in what follows as I work to make this case.

Catalyzing Transdisciplinarity as ERSTM

"Catalyzing Transdisciplinarity: Cancer-Obesity Comorbidity as a Wicked Problem in Urban Milwaukee" (hereafter "*Catalyzing Transdisciplinarity*") was a multi-thousand dollar, interdisciplinary project funded through UWM's Center for 21st Century Studies "Transdisciplinary Challenge Award," which funds collaborations between the humanities, social sciences, and natural sciences. Dr. Graham (English) served as PI and three additional faculty members served as Co-PIs (Communication, Public Health, and Medicine). As a grant-funded project, *Catalyzing Transdisciplinarity* resulted in me and six other Master- and Doctoral-level students in the Communication and English Departments the opportunity to work on the project. In total, we were financially supported for nearly 1,400 project hours. We were trained in interview and ethnographic techniques, involved in project design and implementation, and subsequently embedded in cancer and obesity treatment and prevention activities across greater Milwaukee.

It was only the second semester of my Master's coursework when I was asked to serve as a research assistant on *Catalyzing Transdisciplinarity*. After completing a BA in English with an emphasis in "Writing and Rhetoric," I had found myself pursuing a Masters in at the University of Wisconsin – Milwaukee. My interest in rhetorical theory, writing centers, and writing program administration had led me to apply to the English department's program in composition and rhetoric, but I was admitted on a funding line

for a research assistant the Scientific and Medical Communications Laboratory. During that first semester of my graduate work, I was surprised to find myself out of the library observing and sometimes even talking with people. I didn't realize rhetorical studies could involve so little text and so much moving about. I certainly didn't expect I would be emailing everyone in the greater Milwaukee area involved in cancer or obesity treatment and prevention.

The project was largely conceptualized by Graham. A primary foci of the project was to stimulate transdisciplinary engagement and drew heavily on SEQM. The aforementioned article by Wilson (a former collaborator) and Herndl (the chair of Graham's dissertation) was distributed to research assistants (myself included) as a required preparatory reading. Though I was not present for the writing of the grant, the resulting project suggests that the researchers were motivated by emerging data on risk coincidence and comorbidity among certain cancers and obesity. As the researchers write in an article published in *Qualitative Health Research* that resulted from the project (Graham, et al., 2016),

> Over the past decade, there has been an increasing body of epidemiological evidence indicating significant risk coincidence and comorbidity among certain cancers and obesity (American Cancer Society; 2015; Renehan, Tyson, Egger, Heller, & Zwahlen, 2008) A recent study in *Cancer Detection and Prevention* has indicated that as many as 6% of new cancer cases may be directly attributable to obesity (Polednak, 2008), a number that is expected to rise given current national obesity

trends. Furthermore, being overweight or obese has been shown to increase cancer mortality and is estimated to explain approximately 14% of all cancer deaths in men and 20% of cancer deaths in women (Calle, Rodriguez, Walker-Thurmond, & Thun, 2003). In particular, recent research points to obesity as a significant factor for increased risk of breast, colon, endometrial, esophageal, gallbladder, pancreas, rectal, and thyroid cancers (National Cancer Institute, 2012).

Some of the sources cited in the paragraph above were also distributed to research assistants in the early stages of the project. In addition to the link between cancer and obesity, the research team established disproportionate rates of both cancer and obesity in low-socioeconomic status (SES) and minority communities, specifically, as an issue of concern. As they note in the grant proposal, a number of factors lead to SES and racial/ethnic disparities in cancer and/or obesity prevalence, including decreased access to nutritious food and healthcare, limited access to recreation facilities, and environmental exposures, to name a few. Establishing a gap in research, they write:

> Despite the increasing recognition of obesity-cancer risk coincidence and comorbidity as well as evidence of SES-related causes of obesity and cancer, little research has been conducted to document the exact manner in which SES factors combine to increase the risks and prevalence of both conditions or how to intervene on these factors to reduce risk. We believe the dearth of research on SES, obesity, and cancer ignores the socioeconomic and environmental determinants that may strengthen the association between obesity and cancer in underserved populations. Obesity and cancer are each long-

standing, intractable, and wicked problems. The close associations between poverty (a wicked problem in its own right), urban food deserts, and urban environmental injustice will require simultaneous interventions from a wide variety of experts in medical, public health, and sociological areas

These two motivations—the cancer-obesity link and the low-SES/minority links with each—are paired in a larger "wicked problem," establishing the need for coordination. As such, rhetorical research on transdisciplinarity, social scientific research on low-SES and minority community risk factors, and epidemiological data on cancer and obesity risk coincidence and comorbidity served to frame the project for research assistants, who were all graduate students pursuing Master- or Doctoral-level degrees in Communication and English.

The resulting study was designed to proceed over the course of many months, culminating in a conference the research team would plan and host. The conference was to be modeled after a "consensus conference," which was developed in Denmark to foster productive science-policy deliberations. Based on the grant proposal and discussions among the research team, the conference associated with this project would be attended by project participants and involve presenting a knowledge map the research team had generated. The map would then be refined, generally following the approach Wilson and Herndl used at LANL (2007). The Gantt chart below (Figure 3.1) has been excerpted from the grant proposal to illustrate the general project design and timeline.
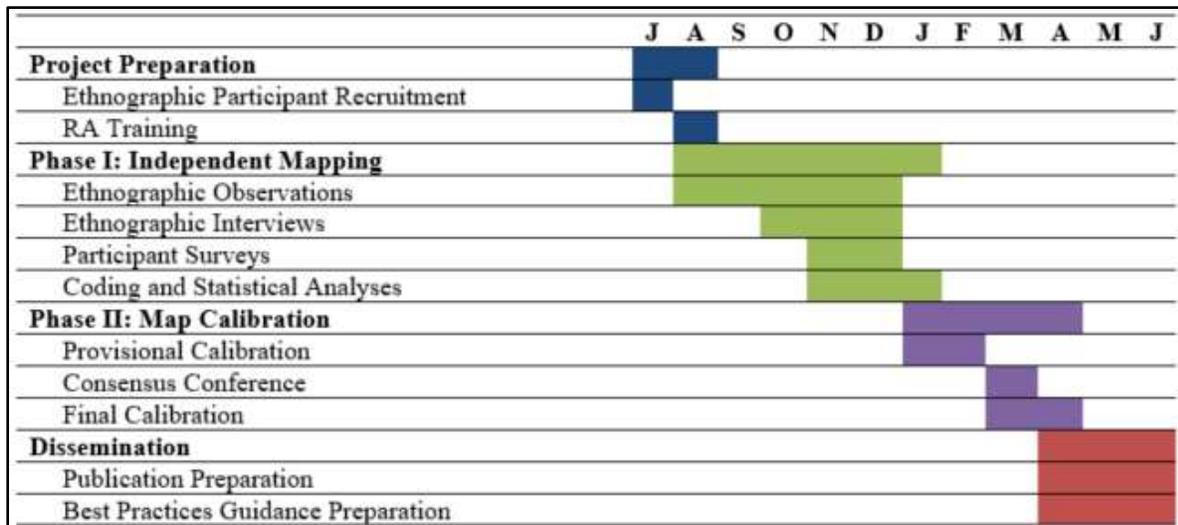
Figure 3.1: "Plan of Work" Gantt chart for *Catalyzing Transdisciplinarity*.

My sense as a participant-observer is that the primary goal of Phase I was to help the research team develop a preliminary understanding of cancer and obesity treatment and prevention in the greater Milwaukee area and subsequently develop a draft knowledge map. As such, the research team was to recruit participants such that the map would provide a rich account of "cancer and obesity treatment and prevention in Milwaukee," broadly construed.

To guide recruitment efforts, the research team developed a site-based grid. The grid consisted of four quadrants, though it was later adapted to include a fifth area. Initial subjects were identified and recruited from each of the five resulting domains: 1) hospital/clinical cancer care, 2) hospital/clinical obesity care, 3) primary care, 4) cancer community health education and screening, and 5) obesity and healthy living community education.

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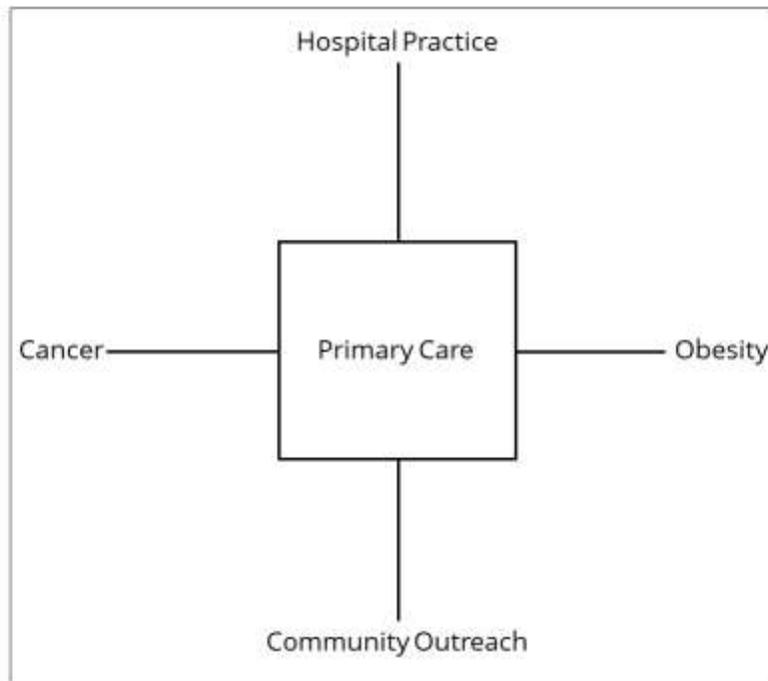
Figure 3.2: Illustration of participant selection grid. The original grid sketched on the whiteboard of the seminar room in which the research team met did not include "primary care," which was added later in response to initial observations.

Research assistants began recruitment by emailing a short list of contacts that the PIs collaboratively generated. At the same time, members of the research team searched for Milwaukee-based medical institutions and community groups whose people would fit into the subject selection criteria and subsequently sending them requests to participate in the study. These requests indicated that the study was about "healthy living and disease management/prevention," and the purpose of the study was to "document the manner in which providers counsel patients and community members about healthy living choices in the contexts of cancer and/or obesity management and prevention." In addition, the requests stated that

participation would involve a member of the research team observing and taking notes on "daily professional activities" for a total of 10-20 hours as well as a one-hour recorded interview.

Before observation, the research team was trained in ethnographic techniques and specifically instructed to focus on the sites and practices of each domain in addition to taking more open-ended notes. Further, observers were instructed to document notable events and insights as well as potential barriers to and opportunities for trans-domain collaboration. In other words, team members were instructed to document anything that would provide insight into the practices of the research subjects, e.g. their workspace, daily interactions, and the technologies they used.

Research assistants involved in recruitment compiled a list of subjects who agreed to participate and worked to identify convenient times for someone from the team to observe. Research assistants then used that list to sign up for observations, in some cases making many short trips to the same location until they had reached 20 hours with that subject and in other cases attending day-long events. Over the course of the project, I personally observed a general practitioner in a low-income scaled-fee clinic, a radiation oncologist at a major regional medical center, a breast cancer screening advocate, and a nutrition educator at a community health center. Upon return from each observation, research team members were expected to promptly digitize their notes so as to ensure their observations were

documented while fresh in their mind. In total, the six research assistants

conducted approximately 110 hours of observation across the target

domains. Table 3.1, which has been adapted from a publication that resulted

from the project, provides a sense of the observational sites and informants

that were observed.

Domain	Hours	Site	Informant
Hospital/clinical cancer care	40	Regional cancer center	Radiation oncologist
Hospital/clinical obesity care	15	Endocrinology special practice	Endocrinologist
Primary care	20	Primary care clinic in a low SES urban area	Primary care physician
Cancer community health education and screening	20	National advocacy organization focused on promoting cancer screening	Community screening educator
Obesity and healthy living community education	15	Education/outreach division of a low-income community clinic	Community health educator

Table 3.1: Examples of observational sites and informants.

As observations with a given informant were completed, a research team

member would schedule and conduct a semi-structured interview. These

interviews were designed to gather additional information about the sites

and practices of each domain as well as possible barriers to and

opportunities for collaboration. For example, the interviewer would ask

specifically about barriers to collaboration with practitioners in other

domains, but might also ask about a specific practice or event they

observed. The research team member would record the interview, which

would then be transcribed for later analysis.

Once the observations and interviews were completed, members of the

research team analyzed observational notes and interview transcripts,

looking for themes and relevant relationships. A few team members were

asked to generate initial maps. These initial maps were brought to a meeting

with the purpose of creating the knowledge maps that would be presented at

the conference. As figure 3.3 illustrates, the initial maps were complex and

somewhat difficult to follow. Research team members struggled to determine

how best to represent practices, sites of practice and the connections among

them in the context of the larger goals of treatment and prevention. In

particular, there was some disagreement as to whether the maps should be

more person-based or site-based.
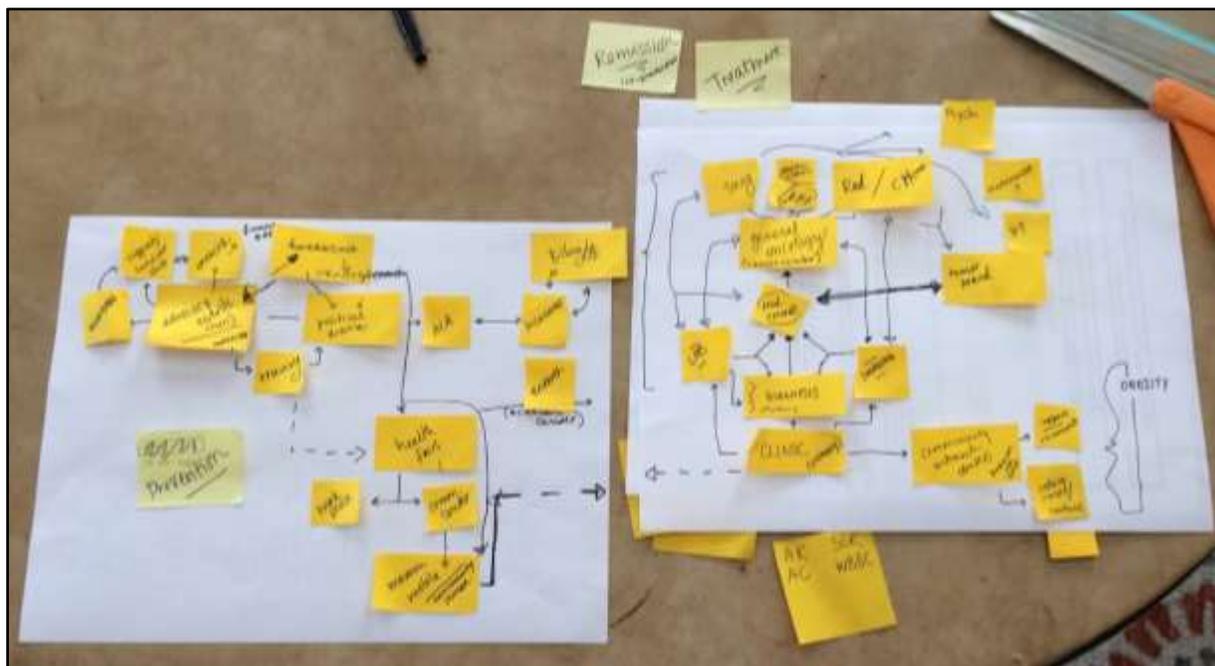
Figure 3.3: An early representation of obesity treatment and prevention.

After a series of small and large-group discussion and mapping exercises, the team produced provisional knowledge maps for each domain. Much like Wilson and Herndl's, the provisional maps focused on the primary mission and relevant stakeholders, sites, and activities of each practical domain. Figure 3.4 (below), a map of cancer treatment and prevention, was an intermediary draft between the map above and the version presented at the conference. The map illustrates how the research team conceptualized cancer treatment and prevention after observations, interviews, and additional background research.
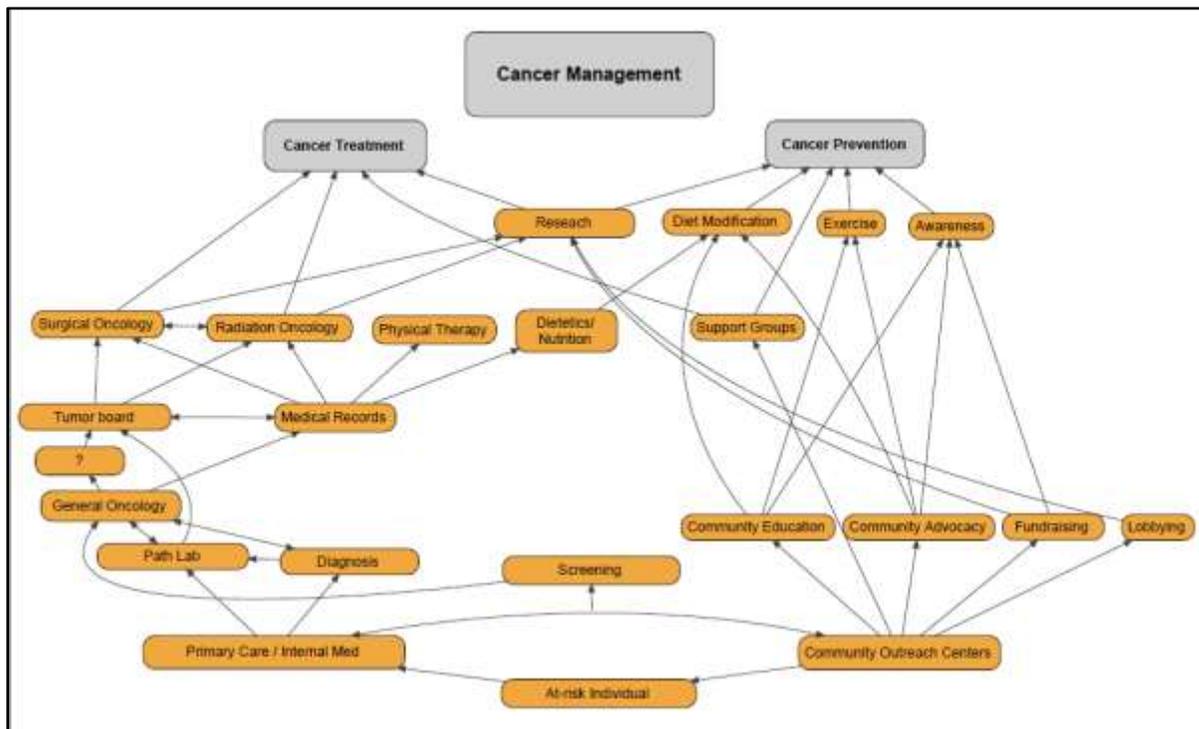
Figure 3.4: Intermediary map of cancer treatment and prevention.

The research team chose to organize the map around patient treatment pathways, with an "at-risk individual" at the bottom and the possible paths through the treatment and prevention system illustrated above. For example, an individual may be diagnosed in primary care or they may be sent to a specialist for screening. In addition, the may or may not simultaneously be referred to an outreach center, depending on the practice of the individual practitioner. In this, the team attempted not only to map the articulations they observed, but promote the identification of new articulations that could be made.

While some members of the research team were refining the maps for presentation, others were planning the conference. They recruited participants from the larger subject pool, booked a venue and catering, and created materials to be distributed to attendees at the beginning of the conference. Potential participants were sent formal requests for participation indicating that the subject would "engage in structured dialogue with other educators and providers" and "discuss presented finding from earlier parts of the study and discuss possible new approaches to simultaneously addressing cancer and obesity" (Sample recruitment letter). In addition, potential participants were informed that if they agreed to participate in the daylong conference, they would receive a $400 stipend and lunch for their time. The research team successfully recruited approximately 20 conference participants.

As a novice ethnographer with a background in composition and rhetoric and limited understanding of transdisciplinarity, cancer, obesity, or the treatment and prevention practices in Milwaukee, I did not realize at the time exactly what I brought to the project or how it would fit into my development as a teacher and researcher. Make no mistake, many research subjects during those initial observations were also curious why someone from the English department was watching them explain the difference between radiation and chemotherapy or teach Spanish-speaking families in the Southside how to make quinoa. But after over 250 hours distributing surveys, recruiting observation participants, observing, conducting interviews, analyzing data with fellow members of the research team, designing and facilitating the conference, and contributing to a manuscript eventually published in *Qualitative Health Research*, I cannot stress enough how much I learned about what rhetoric is and what it can do. That funding, and the wealth of experience it afforded me, was absolutely critical in my development as a teacher and scholar. And though I can't speak for my fellow research assistants, this project surely catalyzed a transdisciplinary attitude in me.

In addition to providing funding and training so critical to my graduate study, the project was thoroughly collaborative. The grant featured Co-PIs from UWM's Public Health, Communication, and English departments as well as the Medical College of Wisconsin. As both Cagle (2017) and Drushke

(2014; 2017) have argued, such collaborative work allows opportunities for mutual exchange of expertise. Certainly, this was an important outcome of the project on two levels. Given the project's focus on transdisciplinarity, it served as both enactment of and inquiry into collaboration across disciplinary and institutional boarders. Of course, as a single project for the research team and a single event for the participants, it is difficult to really measure the value of the collaborative experience. While I can attest to significant changes in my personal approach to my work, I lack strong evidence that the Co-PIs or participants underwent any dramatic transformation. Though it was beyond the scope of *Catalyzing Transdisciplinarity,* future attempts at such work might incorporate a longitudinal assessment. Yet, I will conservatively suggest that the research team's modest effort to *catalyze* transdisciplinarity was successful insofar as it provided the financial incentive and linguistic and conceptual resources required to bring people together to discuss an issue they otherwise wouldn't.

Staging Dialogue as Intervention

Although the majority of project hours were spent observing and interviewing specialists in the target domains, the primary outcome of those activities was to inform the design of a conference—to find the right people, bring them together, and structure an event that would yield productive discussion about the barriers to and opportunities for collaboration at the

nexus of cancer and obesity in Milwaukee and similar low-socioeconomic areas.

The research team structured the conference around a series of large and small group discussions. Participants were provided personalized folders containing schedules that instructed them which breakout sessions to attend based on their domain and primary disease affiliation, copies of the preliminary knowledge maps, and a fact sheet on "cancer and obesity risk coincidence" containing epidemiological statistics and a list of factors that constitute an "obesocarcinogenic environment." The first session consisted of a welcome to the participants followed by a presentation by Graham. The presentation explained the motivation of the project, leveraging much of the epidemiological and social scientific data cited in the grant proposal and fact sheet. In a sense, the presentation established the "science behind" the cancer-obesity link as well as the gap that motivated the research team. Graham concluded the presentation with a brief overview of how the rest of the day would proceed and suggesting that he was hopeful that the discussion would be productive and insightful for all involved.

9:30-10:00	REGISTRATION & BREAKFAST
	Valley Room
10:00-10:55	WELCOME & INTRODUCTIONS
	Valley Room
11:00-11:55	DOMAIN-SPECIFIC BREAKOUT
	*See breakout assignment
12:00-1:00	LUNCH
	Provided in the Valley Room
1:00-1:55	BARRIERS TO COLLABORATION
	*See breakout assignment
2:00-2:15	BREAK
2:15-3:10	INTERVENTION OPPORTUNITES
	*See breakout assignment
3:15-4:00	INTEGRATED GROUP DISCUSSION
	Valley Room

Figure 3.5: Conference schedule, excerpted from materials given to participants at the conference.

The research team decided that the first breakout section would be organized by domain. Following the individual schedules they were provided, participants made their way to one of two rooms in the conference venue.

Practitioners involved primarily in obesity treatment and prevention were gathered in one room, while practitioners involved primarily in cancer treatment and prevention went to another. Each room was assigned a facilitator (Co-PI or other faculty member) and three research assistants, each assigned to serve as one of three roles: cartographer, ethnographer, or audiographer. The research assistants were to take notes about potential revisions to the map, document the conversation, and record the conversation, respectively. During the session, which lasted approximately an hour, participants were given preliminary knowledge maps of their respective domains and guided in discussion of three questions: 1) what strikes you as right about this map, 2) what makes you uncomfortable about this map, and 3) what would you change. The research team designed these questions with the goal of eliciting feedback that could be used to revise the maps and might provide insight into potential barriers to and opportunities for collaboration.

Without going into too much detail, the research team did in fact document conflicting views about how the maps should look, which made difficult the cartographer's efforts to revise and combine the two domain maps into an integrated map of both cancer and obesity treatment and prevention over the lunch hour. Research team members assigned to cartography attempted to incorporate that feedback as they produced a "transdomain" map, which was printed and distributed to participants at the

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beginning of the second breakout session. This session followed a similar format to the first, but this time participants were grouped by setting, not disease (e.g., practitioners from community settings involved in both cancer and obesity were grouped). In this session, the research team aimed to foster discussion about barriers to collaborating with practitioners outside their setting, e.g. community practitioners with hospital practitioners and vice versa. The research team prompted participants to discuss barriers that prevent them from collaborating, providing them with broad categories such as scheduling issues, incompatible approaches to care, or institutional barriers. The research team subsequently asked how collaboration could be improved and whether anyone had experience collaborating with members of the other domain. In this, the research team tried to identifying existing collaborations as well as interventions that could promote new ones.

In the final breakout session, the research team asked participants from each of the four groups to discuss potentially fruitful collaborations in light of everything that had been discussed. Specifically, they asked: 1) What do you bring to possible collaborations that is uniquely valuable? 2) What do you counterparts across the table bring to possible collaborations that is uniquely valuable? And 3) if there were no obstacles (you have all the time and money in the world), who would you be working with that you aren't already and what would you do? After this session concluded, the research team gathered all participants together in a single room to recap

some of the insights from the day, highlighting discussion themes and thanking everyone for attending.

Here, the differences between multidisciplinary, interdisciplinary, and transdisciplinary are instructive. In multidisciplinary work, knowledge from different disciplines leveraged, but the contributors stay within their disciplinary boundaries. Interdisciplinarity involves synthesizing the insights of multiple disciplines, much like the "evolutionary synthesis" described in Ceccarrelli's work and discussed at the beginning of this chapter. Transdisciplinary, in contrast, emerges from a question that transcends the traditional boundaries of a single discipline, requiring new approaches. These three versions of cross-discipline collaborations lie along a continuum. In chapter 2, I drew a distinction between transactional, post hoc engagement and problem-oriented, iterative engagement. This distinction also maps onto the continuum of collaboration. The problem-orientation of *Catalyzing Transdisciplinarity* attempted to catalyze a transdisciplinary approach among participants—one that transcended the domains and expertises of the participants. Further, the project strove also to enact transdisciplinarity among the research team. As a transdisciplinary effort, the project as a whole—its research questions, methods, etc.—is likely not recognizable as distinctly "rhetorical," or as emerging from any single disciplinary origin or concern. Yet, I see in the project a distinctly rhetorical contribution that is

particularly relevant for the broader discussion of ERSTM, a point I develop fully in the next section.

Staging and Calibration as Rhetorical Catalysis

As I hope my discussion of the project illustrates, SEQM represents a promising methodology for fostering collaborative solutions to wicked problems. Much like the problem of rapidly responding to an emergent military threat, effective intervention in cancer-obesity treatment and prevention involves a range of practices, expertises, and sites of activity. Targeted interviews and ethnographic observation are well-suited provide insight into such phenomena. Yet, as my analysis in Chapter 2 suggests, locating the rhetoric in ERSTM is important in light of concerns about the discipline's core expertise. In this section, I take up this task. Under the "public outreach for rhetoric" model, this project may appear to have little to offer. The goal, or at least the primary goal, was not to disseminate "rhetorical" concepts or insights in a strict sense. Extra-disciplinary collaborators or project participants were not introduced to "topoi," "kairos," or even "rhetoric." In fact, the project also eschewed the common science communication goal of disseminating the results of scientific inquiry. Rather, the mode of engagement that best captures the overt aims of this project is PRC.

The choice to use the insight of the interviews and observations to hold a conference, as opposed to disseminate findings via a report, signals

an embrace of dialogue over deficit. While the conference did feature a presentation involving statistics about cancer and obesity, the core aim was to facilitate a productive conversation about not only the facts of the matter, but the mangle of practice from which those facts emerge. This choice, I argue, is best understood as an extension of RSTM research on interdisciplinary coordination. For example, Ceccarelli suggests the use of conceptual chiasmus is an effective strategy to forge interdisciplinary alliances around a new problem and Graham identifies various "modes of calibration" that function similarly. In a sense, the research team responsible for *Catalyzing Transdisciplinarity* took their advice, anchoring the study in a "wicked problem," a term used by Horst Rittel and Melvin Webber to highlight the complex, multicausal and often value-laden nature of public planning problems (1973). In contrast to tame problems, which have correct and incorrect solutions, wicked problems resist solution. Rather, the best one can hope for in wicked problems is resolution, an action-for-now in the face of uncertainty and lack of consensus. Figure 3.6 illustrates a contrast between tame and wicked formulations of cancer-obesity risk co-incidence.
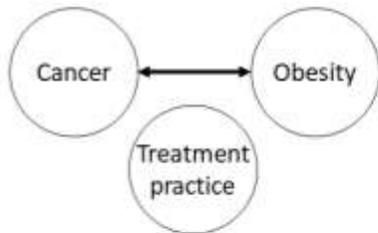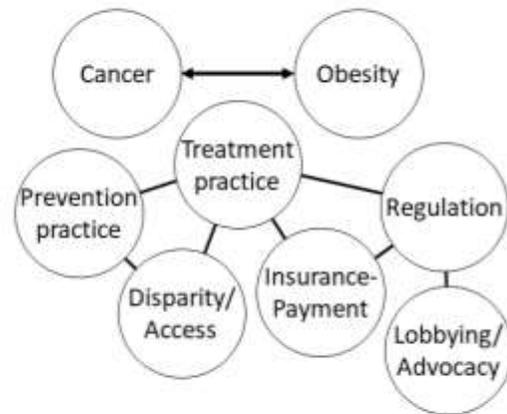
Figure 3.6: Tame and wicked representations of the cancer-obesity link.

Consider the questions asked in Figure 3.6. The question in the tame formulation—can we identify and disrupt the biological mechanisms at play in the link between cancer and obesity coincidence?—will surely affect treatment practices. The important difference between the two formulations is that the latter 1) emphasizes the entire systems of practice involved and 2) recognize the value-laden nature of deciding among alternative solutions, i.e. technical solutions do not translate directly to ethical decisions.

Accordingly, formulating a wicked problem is in itself a problem because initial formulations orient us toward a certain set of solutions and information needed. In addition to using the language "wicked problem," the research team in the presentation at the conference and the fact sheet

provided to participants paired epidemiological data on cancer and obesity with social scientific and humanistic data on social and environmental factors. The research team's use of the phrase "obesocarcinogenic environment" in this context strikes me as an attempt to calibrate data from disciplines with different accepted methodologies and phenomena of interest so that each would see the problem anew.

If problem understanding and problem resolution are inextricably linked, staging the problem becomes a key contribution. Further, staging as "wicked" expands the scope of problem and solution beyond a single discipline or specialty. Yet, it does so in a way that practitioners in all the target communities could see their work as relevant. The research team's choice to stage the problem as wicked draws attention to social, economic, and environmental factors in addition to the biomedical focus on characterizing and targeting biological mechanisms. In other words, intervening in cancer-obesity *as a wicked problem* implies the necessity of many disciplines and subspecialties, including not only biomedical researchers but also healthcare professionals, community health educators, and health-policy professionals. And staging that wicked problem, in this case, was enriched by the expertise of RSTM.

In addition, recall that the research team indicated in requests sent to potential study participants that the study was about "healthy living and disease management/prevention." In pairing, "healthy living and disease"

and "management/prevention" the team worked to frame the study such that practitioners from each of the four quadrants deemed their work relevant to the larger effort. Perhaps most interesting, however, is the process of knowledge mapping. While Wilson and Herndl's specialists at least shared the same employer, participants in *Catalyzing Transdisciplinarity* came from very different institutions and backgrounds. The research team presented the participants with a single map and subsequently asked them to help refine it. I understand this choice to be an effort at cross-ontological calibration—an effort to stage the practice of teaching healthy cooking alongside encouraging cancer screening and administering chemotherapy. In fostering discussion about the map, the research team not only staged these diverse practices as part of a whole in common, but also encouraged participants to engage in their own acts of calibration.

Taken together, I read the project as an attempt to manifest a matter of concern—to articulate a concerning state of affairs and gather the right people around it. Although Latour (2004) primarily argues for a shift in the critical approach of humanistic scholars in anthropology, history, philosophy, etc., I find a synthesis among his "gathering," dialogic approaches to sociotechnical decision-making, and rhetorical insight into coordination among distinct communities of practice. As my review of the literature demonstrates, rhetoricians of science offer significant insight into the barriers to coordination disciplinary inculcation can present as well as how

those barriers can be overcome (Wilson & Herndl, 2007; Ceccarelli, 2001; Graham, 2015). In approaching the cancer-obesity risk as wicked and adopting a broad, inclusive project description, the research team provided the linguistic and conceptual resources required to initiate a transdisciplinary synthesis around cancer and obesity risk coincidence and comorbidity in urban Milwaukee, in a sense enacting Ceccarelli's conceptual chiasmus or Graham's cross-ontological calibration. Further, I read the choice to convene a conference and adopt deliberative, dialogue-oriented mapping exercise as a critical dimension of this effort.

CHAPTER 4: RHETORICAL ENGAGEMENT WITH SCIENCE (COMMUNICATION)

In chapter 3, I discussed my participation in a recent attempt to "catalyze transdisciplinarity" around cancer and obesity risk coincidence and comorbidity. I analyzed the project as an effort to facilitate intervention in a matter of concern, as PRC—one of the six modes of engagement identified in chapter 2. In so doing, I illustrated that as a transdisciplinary effort in its own right, the project as designed did not fit neatly into the accepted concerns, methods, or theories of any single discipline. Rather, the problem required an approach that spanned accepted disciplinary concerns and methods. In spite of this transdisciplinary approach, I nevertheless traced in the project a rhetorical lineage and critical rhetorical contribution. In a sense, I built a case that PRC has something important to offer RSTM—that even though it may seem the province of social scientific science communication, it nevertheless presents an opportunity for RSTM scholars to extend their core intellectual interests. More specifically, I argued that problem staging—assembling people, objects, practices—is a fundamentally rhetorical practice enriched by RSTM's tradition of inquiry into coordination among distinct communities of practice.

Building on the work of Chapter 3, in this chapter I describe a collaboration between RSTM researchers and a small team of researchers in

UWM's School of Freshwater Sciences. As a participant-researcher, I again draw on personal experience and project materials as I advance "Minimizing Impacts" as an additional example of PRC. Whereas in chapter 3 I focused on the family resemblance shared by rhetorical scholarship on cross-disciplinary coordination and PRC, in this chapter I contrast PCR with scholarship on public participation. In so doing, I position PRC as a distinctly rhetorical contribution to science communication as dominantly practiced.

Engagement as Information Transaction

Thus far, I have situated PCR as response to Latour's notion of matters of concern and ERSTM's commitment to intervention. In this, I have provided a theoretical and normative vision for what can loosely be described as a public participation mechanism. In Chapter 1, I established a trend toward public participation in or engagement with science as science organizations and policymaking bodies increasingly accept the failure of deficit-model knowledge dissemination approaches. I further suggested that in spite of this ostensible embrace of dialogue, the deficit model persists in the broader impact and engagement activities of NSF-funded and AAAS scientists. Of course, there are many "engagement mechanisms" that have been studied and implemented. For example, Rowe and Frewer (2005) in a widely cited article extract over 100 "participation" mechanisms from over 30 scholarly articles and practitioner-oriented publications. I draw on this article here because it provides insight into the assumptions that often drive

public engagement practice in the context of science communication and as such represents a useful inroads to how PRC differs.

Rowe and Frewer ground their systematic review in three overarching types of public engagement involving "public representatives" and the sponsor of the event: communication, consultation, and participation. "Communication" is defined by the flow of information from sponsor to public representatives. "Consultation" is defined by the extraction of information from public representatives. And "participation" is defined by the bi-directional flow of information. They also identify key variables by which mechanisms differ, e.g. participant selection method, facilitation, information medium.

Information Flow Model for Public Participation	
Engagement Types (information flow)	Communication
	Consultation
	Participation
Mechanism Variables	Participant Selection Method
	Facilitation
	Response Mode
	Information Input
	Information Transfer Medium
	Facilitation of Aggregation

Table 4.1: Rowe and Frewer's Types and Variables

From these types and variables, the authors delineate 14 engagement "classes" under the three information flow categories. For example, "Communication 2" is characterized by uncontrolled participant selection,

flexible information input, and its face-to-face format, e.g. a public hearing

or meeting. In contrast, "Consultation 4" is characterized by controlled

participant selection, facilitated information elicitation, an open response

mode, and its face to face format, e.g. a focus group. As they argue, these

are the variables that influence the effectiveness of any given engagement

effort. In their attempt to measure effectiveness, Rowe and Frewer explicitly

leverage an "information flow perspective." As they note,

> "according to such an information flow perspective, an exercise's
> effectiveness may be ascertained by the efficiency with which
> full, relevant information is elicited from all appropriate sources,
> transferred to (and processed by) all appropriate recipients, and
> combined (when required) to give an aggregate/consensual
> response" (2005, p. 251, emphasis mine).

This information flow model, I suggest, relies on 1) an instrumental

view of communication that harkens to the much maligned Shannon and

Weaver transmission model and 2) deficit model assumptions about science.

In the context of a broad typology, it is slightly unfair to expect Rowe and

Frewer to fully address the nuance and complexity of particular cases.

Nevertheless, it is worth noting that little attention is paid to normative

rationales for engagement, how "relevant" is determined, or what sources or

recipients are "appropriate." In establishing efficiency as key metric and

information transaction as the desired activity, it would seem that Rowe and

Frewer neglect the normative and constitutive dimensions of deliberation.

Framing the activity as the exchange of information presupposes that all

nothing new will emerge—that all relevant information is possessed by the actors and simply needs to be transmitted efficiently. Certainly, "information" is more akin to matters of concern than "facts," but the notion that engagement writ larger should be conceptualized and evaluated in terms of information transfer and processing is worrisome, at best. It is easy to see how would-be engagement practitioners might fall into fact-based information transfer to the "lay public," despite their efforts to heed the call for democratic, dialogic engagement. In other words, such a model risks encouraging what STS scholar Brian Wynne calls "hitting the notes but missing the music"—ostensibly embracing dialogue, but without abandoning the deficit model's underlying assumptions. Ultimately, I sympathize with Rowe and Frewer's attempts to offer standard definitions and an overarching framework for evaluation, but I worry that their emphasis on formal characteristics and reliance on a transmission-inspired information flow model implicitly stages engagement as information transaction, science as a set of facts, and public as the lay others.

A Postplural Alternative for Engagement

In contrast to efficient transmission of information, PRC is animated by postplural theories of technoscientific practice and more specifically what Graham and Herndl call "postplural rhetoric of science" (2013). While a significant body of scholarship in RSTM and allied fields has traced scientific conflict to epistemological incommensurability, postplural theories are

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indebted to case studies demonstrating that seemingly incommensurable

fields can and routinely do communicate and cooperate across difference. In

addition to epistemic conflict, these studies attend to the practical exigencies

that shape technoscientific practice. For example, Bazerman and De los

Santos document cross-pollination and cooperation among toxicology and

ecotoxicology despite significant methodological and conceptual conflict:

> It is the complexity of nonscientific life that creates changing
> exigencies of concerns, changing definitions of problems and
> changing domains of interest, and complex multiple areas of
> engagement and activity. These complexities leave seemingly
> overlapping sciences and theoretical perspectives alive, side by
> side, each accomplishing their work and respecting the work of
> the other insofar as it fits their needs and interests (2005, p.
> 428).

Rather than two competing fields locked in an epistemological stalemate,

Bazerman and De los Santos document disciplinary adaptation in response

to new problems, shared concerns, and practical constraints. This focus on

the practices of each field and attendant attention to political, institutional,

and normative drivers is a core feature of postplural inquiry. As Graham and

Herndl note, this focus on situated material practice represents a significant

shift from theories of incommensurability:

> Incommensurability describes epistemological differences based
> on different paradigms that provide competing perspectives on a
> stable reality. Postplural theory of multiple ontologies, by
> contrast, describes differently situated material activities that
> produce different objects. One is a theory of seeing and

knowing. What you see or know is determined by the theoretical position or paradigm from which you look. The other is a theory of doing and being. The reality you engage is determined by the kinds of actions you habitually perform and the material contexts in which you act. (2013; p. 110)

In maintaining that multiple objects emerge from situated practices, they suggest that the important task for rhetorical science studies is no longer diagnosing incommensurable epistemological differences, but rather to study staging by tracing differences in practices and the objects they enact. Although Graham and Herndl do not go so far, I suggest a postplural approach has important implications for science communication and more to the point, public engagement and sociotechnical decision-making. Rather than information transmission outlined by Rowe and Frewer or mediation between conflicting perspectives a la incommensurability studies, the rhetorical activity in a postplural framework is staging a problem and fostering calibration of the objects, practices, and people from which that problem emerges.

In the remainder of this chapter, I illustrate the affordances of a postplural approach to engagement. I first discuss *Minimizing Impacts*, tracing its origin and subsequently describing the project. In this, I offer an additional example of PRC. I also analyze the role of staging and calibration in *Minimizing Impacts*, and subsequently suggest that PRC serves as a rhetorically-informed alternative to dominant approaches to science

communication and public engagement, one uniquely suited to wicked,

emergent problems.

Tracing "Emergent Contaminants of Concern"

The case at the center of this chapter is a paired symposium and workshop

entitled "An Integrated Solutions-Based Approach Towards Minimizing

Impacts from Pharmaceuticals in the Environment." Much like *Catalyzing*

Transdisciplinarity, *Minimizing Impacts* was a collaborative project involving

RSTM scholars. The project was jointly developed by Dr. Graham and Dr.

Klaper, a researcher in UWM's School of Freshwater Science. Not long before

the collaboration began, researchers in Klaper's lab tested for 54

pharmaceuticals and personal care products (PPCPs) at varying distances up

to two miles from the wastewater treatment plant near the shore of Lake

Michigan.[5] They detected 38, many of them endocrine disruptors. The most

widely detected was the antidiabetic drug Metformin. In a follow-up study,

they exposed fathead minnows over a full life cycle to a concentration of

Metformin they had detected in Lake Michigan. They were interested in

seeing what impact the amount of the chemical they actually saw in the lake

might have on its inhabitants. As it turns out, after long-term exposure the

minnows demonstrated significantly higher rates of intersex that those not

exposed to Metformin.

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[5] For a detailed account of this research, see "Evaluation of a model for the removal of pharmaceuticals, personal care products, and hormones from wastewater" in Science of the Total Environment (Blair, et. al, 2013).

Consequently, Klaper's team grew concerned about the potential for ecosystem wide impacts. In early briefings among the transdisciplinary team, she expressed interest in figuring out how to ensure that their findings would inform meaningful action on what she saw as an emerging problem. Among other things, she wanted to explore policy change as one potential avenue of intervention—what regulations are in place? How might they be adapted to better address the impacts our lab has identified? Graham oversaw an initial study of environmental assessment with regard to pharmaceuticals, which raised additional questions and concerns. In an attempt to answer some of those questions and hopefully foster some sort of action, the research team applied to host a symposium and workshop entitled *An Integrated Solutions-Based Approach Towards Minimizing Impacts from Pharmaceutical in the Environment* at the National Conference and Global Forum on Science, Policy, and the Environment.

Facilitating "An Integrated Solutions-Based Approach Towards Minimizing impacts from Pharmaceuticals in the Environment"

The conference was hosted in Washington D.C. by the National Council for Science and the Environment (NCSE), a non-profit organization that "aims to improve the scientific basis for environmental decisionmaking" ("About NCSE," 2017). With the theme "Integrating Environment and Health," the conference sought to address issues of environmental and social justice, water quality, reducing impacts of toxic chemicals, and risk assessment, to

name a few (NCSE 2017 conference program). The conference's primary

sponsors were U.S. regulatory agencies, including the EPA, USDA, USGS,

and NASA.

In light of Klaper's research on emerging contaminants and the

subsequent exploration of the policy process, the transdisciplinary team was

motivated to intervene in what they saw as a complex and concerning

environmental issue. As the proposal argued:

> The solution to the problem of pharmaceuticals as emerging
> contaminants requires a multi-pronged approach that involves
> not only wastewater treatment organizations but pharmaceutical
> and other chemical companies, government agencies,
> economics, policy experts and organizations involved in the
> distribution of these chemicals (pharmacists, doctors etc.), as
> well as citizen groups.

In advancing this "multi-pronged approach," the team suggested that the

symposium and workshop would discuss:

> the potential for alternative control points in the exposure
> pathway including drug development, safety testing, approval,
> medical practice, prescription, use, waste and treatment, and
> recycling to determine what steps could be taken at each stage
> may make the greatest impact on reducing pharmaceuticals in
> the environment.

The symposium featured four presentations: two about environmental

impacts of pharmaceuticals (Klaper & Graham; Brooks), one about FDA-

CDER's environmental assessment process (Laurenson), and one about how

pharmaceutical companies approach environmental regulation compliance

(Smith). See Figure 4.1 for the complete conference program listing for the symposium.

> **SC₁. An Integrated Solutions-Based Approach Towards Minimizing Impacts from Pharmaceuticals in the Environment** –*Arlington*
> ***Organizers and Speaker:*** **Dr. Rebecca D. Klaper**, Professor, School of Freshwater Sciences and **Dr. Scott Graham**, Associate Professor, University of Wisconsin-Milwaukee
> ***Additional Speakers:***
> - **Dr. Bryan Brooks**, Professor, Department of Environmental Science and Institute of Biomedical Studies and Director, Environmental Health Science Program, Baylor University
> - **James Laurenson**, Environmental Officer, Center for Drug Evaluation and Research (CDER), U.S. Food and Drug Administration (FDA)
> - **Charlotte A. Smith**, Senior Regulatory Advisor, PharmEcology Services
>
> *Tracks: Toxic Substances, Green Chemistry, Water and Sanitation, Endocrine Disruptors, Students*

Figure 4.1: Complete symposium listing, excerpted from conference program

The symposium resembled a traditional session at an academic conference. Klaper and Graham made some initial remarks before starting their presentation, then each of the next three speakers presented in succession. The session concluded with a short, cross-cutting panel discussion of potential solutions to the problem of pharmaceutical contamination, with time for questions from the audience. Taken together, the speakers provided accounts of environmental impacts, the impact of wastewater treatment technologies, the pharmaceutical regulatory process, and industry efforts to mitigate impacts. The integration of these distinct, but related practices set the stage for the workshop, which audience members were encouraged to attend after lunch. Figure 4.2 contains the complete conference program listing for the workshop.

Figure 4.2: Complete workshop listing, excerpted from conference program.

The workshop, then, featured initial remarks again by Klaper and Graham. The morning presentations were briefly summarized, but these remarks focused on establishing the need for a multi-pronged approach to minimizing the impacts of pharmaceuticals—an approach that involves not only wastewater treatment organizations but pharmaceutical and other chemical companies, government agencies, economics, policy experts and those involved in distribution (doctors, pharmacists), as well as citizens and advocacy groups.

Each presenter briefly presented a few main points and ideas about their area of practice, and then the moderator (Graham) invited additional discussion topics from the speakers and audience participants. Topics for discussion were established, including solutions in drug development, safety testing, drug approval policy and regulation, drug prescription and dispensing practices, public behavior and education, and wastewater treatment technology, in addition to discussion of economic implications, implementation pathways, and likely challenges for any given solution.

Once topics were established, the research team divided participants into four groups of four to seven participants. Each group was assigned a moderator (a member of the research team), who then distributed informed consent forms. Participants were informed that the research team was interested in identifying "promising scientific and policy solutions for emerging pharmaceutical contaminants" and adding to existing research on "effective communication practices for science-policy deliberation." Once informed consent was attained, moderators began recording their groups' audio and subsequently began the conversation with a brief overview of the task at hand. The recordings were later transcribed for analysis. The conversation lasted approximately 70 minutes. Discussion focused on opportunities for and barriers to intervention at various sites of practice, e.g. drug prescription, wastewater treatment. At the end of the small group discussions, a large group discussion was initiated. Moderators from each group took turns summarizing their group's discussion and outlining the group's thoughts on the most promising interventions before the session was concluded.

Staging and Calibration in *Minimizing Impacts*

This chapter follows Graham and Herndl's lead in two ways (2013). First, I believe my account of *Minimizing Impacts* suggests significant coordination and collaboration in light of obvious disciplinary differences among researchers. In addition, *Minimizing Impacts* as an example of PRC extends

postplural RSTM into the realm of public engagement. Staging and calibration—activities core to postplural inquiry in RSTM—permeate the development and implementation of *Minimizing Impacts*. In other words, both inquiry and engagement require one to assemble people, objects, practices, and problems (staging), and subsequently align those assembled in particular ways toward particular ends (calibration).

In tracing the multiple sites and practices in which pharmaceuticals are done, it becomes clear that efforts to address intersex fish in Lake Michigan involve more than wastewater treatment plants or environmental assessment policies. Drugs like Metformin are tested in a research and development lab, assessed in a clinical trial, regulated, prescribed, covered by insurance, marketed, sold, bought, metabolized, and disposed. Each of these activities represents a potential site in which Metformin might be "done" differently. As these sites of practice are traced, the problem appears to grow, but a rich understanding of those sites of practice, their relationships with each other, and the actors, their motivations, and institutional structures that shape their activity is critical in defining and addressing the problem of emerging contaminants (see Figure 4.3).
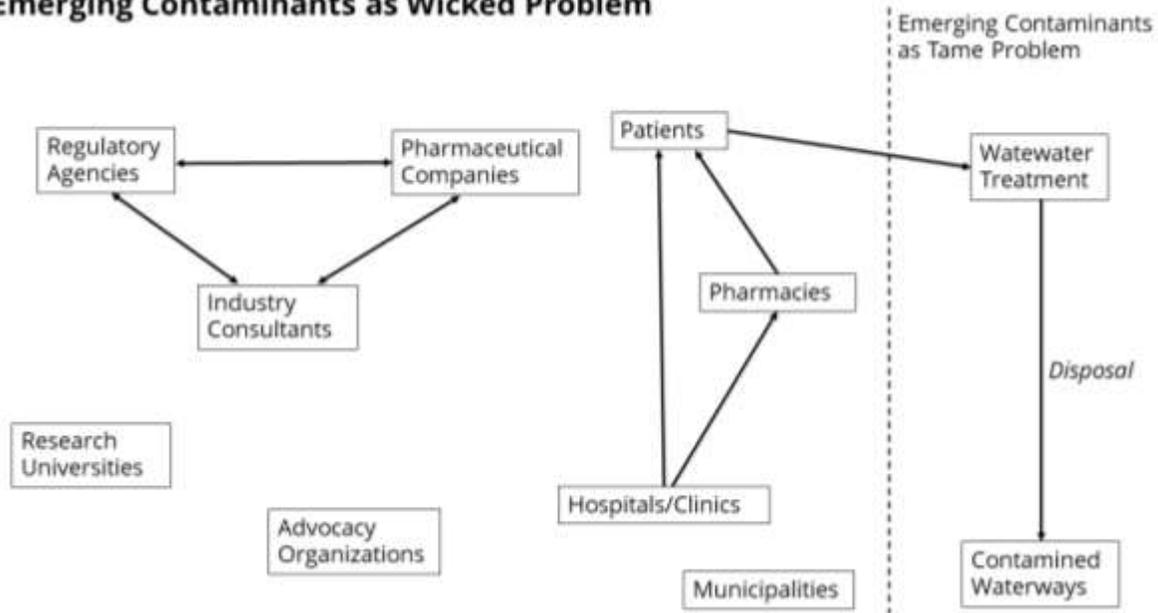
Figure 4.3: Mapping emerging contaminants of concern

For example, the proposal for *Minimizing Impacts* indicated that the goal of the workshop was to develop an outline for a white paper or peer-reviewed article that presents and action-oriented and integrated approach towards pharmaceuticals in the environment. As postplural inquiry and engagement praxis, the project accomplished two additional, though overlapping goals: 1) study the institutional, economic, and regulatory practices that result in contamination and shape environmental assessment/regulation, and 2) identify and promote interventions including, but not limited to policy change. In advocating a "multi-pronged approach" and tapping into an already interdisciplinary public, the research team was able to convene experts from diverse sites of practice, including regulation, compliance, ecological research, and wastewater treatment. In this, the project as staged allowed the team to simultaneously trace from cradle to

grave the practices from which pharmaceutical contamination emerges, while also making those practices visible to relevant participants.

Yet, the effort was not conceptualized as a transfer of scientific knowledge and the "audience" was not "the public" or even a policymaking public. In isolation, the symposium resembles the "dissemination to expert" mode of engagement, but the research team articulated those presentations to the overarching goal of the workshop: "minimizing impacts." They emphasized uncertainty about what harms may be caused by contaminants, and instead of transmitting the certainties, they asked, "How should we invest resources to yield the greatest protection to the environment and human health from these emerging contaminants in the face of uncertainty?" (session proposal). Much like cancer and obesity risk coincidence as a wicked problem, the staging here expands the scope of the problem beyond the expertise of any given discipline and beyond the technical. Indeed, a "multi-pronged approach" implies not a right or wrong answer, but better and worse solutions that represent part of a broader intervention. In other words, in asking participants to identify and discuss "realistic, cross-cutting solutions" that could be implemented, the research team was able to identify and refine a list of potential interventions, while also observing how different stakeholders weighed each approach, essentially gathering in situ feedback on each intervention. In staging divergent practices as part of an overarching matter of concern and

subsequently fostering calibrational activity, dialogue here functioned as a valuable site of inquiry into the extra-scientific factors that shape pharmaceutical contamination and by extension environmental assessment and regulation.

While this is an important outcome, I also argue that guiding participants, both speakers and attendees, in an open, solution-oriented discussion is valuable on an individual level. Although the research team did not attempt to measure any knowledge, attitude, or behavior changes in participants, those potential outcomes are worth mentioning. By positioning the workshop as an attempt to map possible interventions and discuss barriers and promising opportunities, the research team encouraged participants to collectively (re)define the problem—to calibrate their activity to that of other participants, including the research team. For example, in exploring possible upgrades to wastewater treatment infrastructure, the technical limitations of available technologies as well as the budgetary constraints of municipalities are made manifest. This in turn suggests the possibility of financial incentives, prompting the question of who could/should pay—pharmaceutical companies? The federal government? Private donors? In this, *Minimizing Impacts* as staged prompts calibrational practice that spans the technical and normative dimensions of resolution—a move STM rhetoricians are well-suited to foster.

PRC as Engagement Beyond Transmission

Animated by Latour's matters of concern and postplural RSTM's emphasis on staging and calibration, PRC is a normative model that differs in important ways from deficit-style public participation. In tracing technoscientific and policy practice, PRC looks "upstream" to the spaces in which science and policy are shaped. Such an approach affords the opportunity to define and address problems proactively. As such, PRC eschews the expert-lay or scientist-public dichotomies that public engagement more broadly presumes. Rather, relevant actors are determined not exclusively by credentials or some sense of a general public, but by their practices and the situation at hand. Said another way, whereas public participation takes for granted the relevance of actors and tends to assume certain categories, PRC strives for representation of practices involved in a given problem and likely solution. As practices are traced and the problem takes shape, relevant actors are implicated. In a classical idiom, staging a wicked problem requires attunement to *kairos*, both in the sense of identifying a situation that invites response and in using that situation to create an exigency. In this, staging is an inventional process that works to assemble what is given by experience so as to facilitate action.

Accordingly, PRC is attuned to the relationship between problem definition and resolution. In seeking a robust account of wicked problems, a postplural orientation stages problems that span disciplinary expertise and

technical and normative dimensions and subsequently fosters calibrational activity toward resolution. Frameworks that aim for information transmission tend to presume that the problem emerges from a lack of knowledge and subsequently work to remedy the perceived deficit. PRC avoids this assumption, instead asking what is the problem, where does it come from, and how should we respond in light of available information and options? Importantly, this is not an outright rejection of knowledge-deficit explanations or knowledge sharing practices, but rather a commitment to holistic, problem-oriented inquiry and problem-specific intervention. Though the research team did not explicitly use classical language, a rhetorically-informed problem-intervention framework fosters calibration within and across multiple *stases*. While science communication interventions often remain in the conjectural stasis, calibration in PRC recognizes that a matter of concern involves but is not contained by questions of fact.

After learning of Metformin's potential ecological impacts, the research team had myriad science communication or public engagement options. In tracing practices, assembling relevant actors, and staging a problem, PRC privileges calibrational activity in which people, practices, and objects are aligned so as to redefine a problem and foster resolution. *Minimizing Impacts* illustrates such calibrational activity on two levels. First, members of the transdisciplinary team worked to calibrate their knowledge, concerns, and values over the course of the collaborative effort, ultimately settling on

an intervention—a symposium and workshop. And second, that intervention was not only the result of calibration, but was itself a calibrational activity—an effort to engage participants in mutual exploration of states of affairs and possible future worlds.

Ultimately, this chapter is in a sense itself a calibrational effort. In light of emerging, wicked problems such as those addressed in *Catalyzing Transdisciplinarity* and *Minimizing Impacts*, there is a pressing need for interventional approaches capable of accounting for complexity. Major scientific and governmental organizations have recognized this need, but science communication and public engagement as dominantly practiced are not well-suited for upstream engagement. Given the persistence of deficit-model approaches, PRC represents a needed corrective to transmission-oriented implementations of "public engagement with science"—one attuned to the nuance of technoscientific practice, the entanglement of technical and normative, and the rhetorical practices of staging and calibration.

Finally, my attempt to calibrate the insights of rhetorical inquiry with the practices of science, science-policy making, or science communication is enriched by attention to staging and calibration broadly, but also by the particular choices I have made. In adopting the language of "problem-oriented inquiry" in this chapter and throughout the dissertation, I have attempted to create a common problem space capable of fostering cooperation among colleagues in rhetoric as well as those in social and

natural sciences. This choice is not mere rhetorical tactic, but rather stems

from my sense that pragmatist philosophy offers a framework that is

uniquely suited to address tensions between praxis and inquiry, sciences and

humanities, and deficit and dialogue. While my analysis of *Catalyzing*

Transdisciplinarity and *Minimizing Impacts* offers a preliminary illustration, I

take up this point more fully in the final chapter.

CHAPTER 5: TOWARD A SCIENCE OF PRC

This dissertation began with a sense that the problems we face are increasingly wicked—multifactorial, systemic, and complex, both technically and normatively—and subsequently traced the emergence of reconstructivism broadly and ERSTM specifically. Concern for impending ecocide, the crisis of public trust in science, and the institutional prioritization of STEM over the Humanities are all elements in this story. So too are concerns about disciplinary rigor, autonomy, and expertise. ERSTM has situated itself as a response to these ecological, institutional, and disciplinary concerns, but as Herndl (2017) suggests, it remains a nascent program in need of further examination. In this conclusion, I first reiterate the insights of the dissertation before making a brief detour through pragmatism in an effort to reflect on those insights as well as limitations. I end by drawing on an emerging "science of science communication" as a potential avenue by which to ensure the broader impacts of rhetorical and inquiry more broadly.

Mapping Agents of Change

In response to Herndl's call to survey the "sites, types, and styles of work that ERSTM does," I identified multiple modes of engagement by which rhetoricians work to address ERSTM's goals. In so doing, I argued that ERSTM as practiced suggests two diverging conceptualizations of

engagement: 1) post-hoc engagement in which core rhetorical theories or concepts are explicitly communicated after inquiry and 2) engagement as an iterative process in which divisions between rhetorical inquiry and rhetorical praxis are blurred. I further argue that this distinction maps on to diverging approaches to science communication—one that aims for *dissemination of science* and another that aims for dialogic engagement as a *part of science*.

In muddying the distinction between inquiry and praxis, I suggested ERSTM explore the affordances of entangled engagement. Toward that end, I offered two case studies of PRC. In each case, I provided a detailed description of the projects motivations and methods so as to demonstrate 1) each projects rhetorical lineage and 2) alignment with ERSTM's strategic, ethical, and onto-epistemological aims. In each case, I argue that PRC requires attunement to the rhetorical practices of staging and calibration. More specifically, in Chapter 3 I make the case that staging and calibration are practices enriched by RSTM inquiry. In tracing the rhetorical roots of staging and calibration, I suggest PRC represents a compelling avenue by which to extend rhetorical inquiry both in terms of traditional and emerging concerns. Subsequently, in Chapter 4 I argue that science communication and public engagement as dominantly practiced lack attunement to the rhetorical practices of staging and calibration—an attunement that is essential if dialogic engagement is to become part of technoscientific practice. As such, PRC as a mode of ERSTM represents a distinctly rhetorical

alternative to deficit-style science communication and public engagement—one with the potential not only to extend RSTM's core areas of inquiry but also broaden RSTM's impact.

A Pragmatist Detour

In adopting the language of collective inquiry and shared problem-solving, I am deeply indebted to pragmatist philosophy, most notably that of John Dewey (1927; 2002. Dewey, of course, was deeply invested in both science and deliberative democracy, and as such has much to offer PRC. For example, Keith and Danisch's read in Dewey's *The Public and Its Problems* "an attempt to outline the practical and intellectual conditions for community-based inquiry, both descriptively and normatively, as a method of channeling communicative practices for the benefit of society" (2014, p. 31). As Keith and Danisch suggest, although Dewey's twin preoccupations with science and deliberation are often treated as isolated from each other, they are better understood as two sides of the same coin. From a Deweyan perspective, "science, properly understood, is a democratic enterprise, and democracy is a scientific one" (34). In other words, on one hand Dewey thought that science was essentially a collaborative, deliberative, problem-oriented enterprise, deeply rhetorical through and through. This part, I think, is well-captured in Herndl, Druschke, and Cagle's argument for ERSTM and a driving assumption for PRC vis-à-vis science communication. Both *Catatlyzing Transdisciplinarity* and *Minimizing Impacts* presumed that

scientists and other practitioners would have no problem engaging in dialogue about emerging evidence and perhaps adapt their practices in light of new problems. But on the other hand, the notion that democracy is a scientific one deserves more attention. As Keith and Danisch suggest,

> "Dewey recognized that "what constitutes a problem, what constitutes a cause, and what constitutes a desired goal are ecologically interdependent, the 'real' social problem or cause will be the outcome of a deliberation in which we decide the best way to understand how they are related to one another." (2014. P. 36)

In this, I read Dewey to be advocating democracy as a systematic practice of deliberatively constituting and responding to societal problems. I have adopted this shift from "science" to "problem-oriented inquiry" throughout this dissertation. PRC is not about transmitting scientific knowledge or critiquing its production, per se. Rather, it is about bringing RSTM's expertise to bear on the problem definition and resolution in the service of "real" social problems. Our disciplinary history up to this point has positioned us as ideal participants in the dialogue in which problems, goals, and solutions are constituted. In addition, a Deweyan framework affords an expansive vision of "useful" scholarship and lays the groundwork for PRC's methodological pluralism. Yet, this inherent flexibility is both strength and weakness. This dissertation—its examination of ERSTM broadly and PRC specifically—works to establish PRC as a response to wicked problems. Complex in both technical and normative dimensions, wicked problems

require transdisciplinary approaches—collective inquiry and problem-solving. However, in surveying ERSTM, attending to the particularities of two case studies, and addressing PRC's rhetoricity, I fear I have established rhetoric's role in the practice of science without fully addressing science's role in the practice of rhetoric. In other words, while I have developed the argument that PRC extends rhetorical inquiry while also staging productive engagement among rhetoricians, scientists, and various other publics, I have only briefly discussed the impulse to assess PRC by the desired outcomes and preferred methods of natural and social scientists. In the remainder of this conclusion I begin to remedy this shortfall by exploring recent calls for a "science of science communication" (SoSC).

The Science of Science Communication

SoSC is an interdisciplinary research agenda sponsored by the National Academy of Sciences (NAS) that aims to advance state of the art empirical social science research on science communication. In this, SoSC is synthesizing and conducting empirical communication research and working to promote its use among scientists, policymakers, celebrities, and other thought leaders. The inaugural colloquium, which was held in 2012, featured five goals (Sackler Colloquia):

- To improve understanding of relations between the scientific community and the public
- To assess the scientific basis for effective communication about science

- To strengthen ties among and between communication scientists
- To promote greater integration of the disciplines and approaches pertaining to effective communication
- To foster an institutional commitment to evidence-based communication science

This initial colloquium spurred a special issue in the NAS press and subsequently a second colloquium in 2013 with a special emphasis on science-based issues of significant public controversy. This second colloquium resulted in a 138-page summary featuring topics such as "lay narratives and epistemologies," "responding to the Attack on the Best Available Evidence," and "How Scientists Talk to One Another About Their Science—And What the Public Hears" as well as an entire section on creating collaborations for communication (National Research Council, 2014).

This interdisciplinary agenda recognizes the complexity and importance of communication, and as such has devoted significant attention to amassing the "best available evidence" in a broad sense. The culmination of this effort is a 152-page book entitled *Communicating Science Effectively: A Research Agenda* (2017). *Communicating Science* is framed as an "agenda for science communicators and researches seeking to fill gaps in knowledge about how to communicate effectively about science, focusing in particular on issues that are contentious in the public sphere." Though RSTM scholars have expressed reticence to engage with and in social scientific research on science communication, there is much for rhetoricians to appreciate in this

agenda, including a debunking of the deficit model of science communication and special attention to uncertainty, trust, credibility, and misinformation. As I suggest in Chapter 1, such issues have been a mainstay in recent rhetorical science studies. Further, in synthesizing research and identifying remaining questions in each of these areas, the authors stress that the report is far from comprehensive, suggesting that "researchers need to use their technical expertise and partner…to identify the most useful detailed questions and feasible methods for addressing each of the major challenges specific to a domain of interest" (2017, p. 83). As the outline of a research agenda for both funders and scientists, this suggests a growing acceptance of common areas of rhetorical inquiry and accordingly an opportunity for ERSTM.

That said, the final chapter, "Building the Knowledge Base for Effective Science Communication," may present a challenge for a discipline that often defines its work with the phrase "particular case." While rhetoric tends to privilege nuance over generalizability and certainty, in this chapter the authors lament the descriptive and correlational nature of most research on science communication and subsequently suggest a need to establish an evidence base capable of making strong causal inferences. They further suggest triangulation across multiple methods as the key to establishing "general, evidence-based principles for how to communicate science effectively and how to adapt science communication to particular audiences

and contexts to achieve specific goals." In pairing "general, evidence-based principles" with attention to "particular audiences, contexts, and purposes," SoSC would seem to be running the methodological and disciplinary gamut, seeking both the nuance of single case-studies and the causal power of randomized controlled trials. Although the thought of RSTM randomized controlled trials is surely anathema for most rhetoricians, I am sympathetic to SoSC's quest for evidence-based intervention. Much like the ethical argument for ERSTM, the authors cite the urgent need for people to "integrate information from science with their personal values…as they make important life decisions about medical care, the safety of foods, what to do about climate change, and many other issues." *Catalyzing Transdisciplinarity* and *Minimizing Impacts* work upstream of the "public sphere" decisions that animate SoSC, but we are ultimately wading in the same water. However, while I maintain that *Catalyzing Transdisciplinarity* and *Minimizing Impacts* were certainly evidence-based and attentive to nuances in audience, context, and purpose, it is unclear the projects as implemented would be considered "evidence" under a SoSC rubric.

Without minimizing the differences between humanistic and scientific modes of inquiry or uncritically accepting the desired aims of SoSC and attendant values and assumptions, I tentatively suggest that there is space here for calibration. RSTM scholars have already begun to quantify nuanced rhetorical phenomena and test rhetorical theory under the flag of postcritical

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scholarship (Graham et al., 2015; Graham et al., forthcoming, 2018). For example, Graham et al. assess patient inclusion efforts in the realm of federal pharmaceuticals policymaking. Such inclusion efforts are often warranted by the assumption that including patients will result in deliberation about patient experiences and accordingly decisions that better address those experiences. Yet, in measuring whether inclusion led to increases in content specific to patient experience, Graham et al. were unable to find a positive significant correlation between inclusion and content. While inclusion may lead to greater transparency in decisionmaking, it is unclear that inclusion alone leads to more comprehensive deliberation or alters the final outcome. This study raises questions about the efficacy of FDA inclusion as well as a core assumption of arguments for participation in policymaking more broadly.

For public engagement with science particularly, the SoSC agenda identifies two critical research questions: 1) What are the particular structures and processes for public engagement that enable science to be communicated effectively? And 2) To what degree do these approaches generalize or need to be tailored according to the diversity of the participants, the decisions to be made, and the nature of the topic? Here I read a shared concern around structure/process and the wide range of variables. As I hope I have demonstrated, RSTM is certainly attuned to deliberative practices and the many variables that play a role in any given

engagement. It would be easy to retreat to incommensurability—to suggest that social and natural science's desire for quantitative methods and those of rhetorical inquiry are simply incompatible. But ultimately, it seems untenable to simultaneously maintain that 1) PRC represents an improvement—a better way to do something, and 2) has no identifiable/measurable causal factors or mechanisms. To my mind, the interesting question is not so much whether to measure, but what to measure. And here I think is ERSTM's core contribution. Rather than continue working in isolation, ERSTM should work to calibrate rhetorical theory and its normative commitments with SoSC's goals and practices. As I suggest in my discussion of Rowe and Frewer, it is easy to see how "effective communication" can be reduced to "effective transmission of facts." Rather than reject SoSC on the premise that it is only interested in quantifying inputs and outcomes, RSTM can contribute to dialogue in which the "right" inputs and outcomes are decided. By adapting our methods, we can actually test the assumptions that warrant calls for deliberative approaches to engagement as in Graham et al.'s study of inclusion in pharmaceuticals policy. Going forward, we might attempt to measure a given process' capacity to foster calibrational activity and subsequently evaluate calibrational activity's relationship to outcomes such as mutual understanding, trust, or more comprehensive solutions. We might also bolster our claims that deficit-style engagement activities should be abandoned. As Graham et al. (forthcoming, 2018) argue "attenuating

rhetorical findings to the epistemic standards of extra-disciplinary audiences often requires re-engaging the insights of our work through quantitative methodologies that carry more value outside of rhetorical boundaries."

Doing such work in the realm of engagement is not uncomplicated, but by adapting and refining our questions and methods we can work to stage engagement and communication as more than instrumental—as effective and ethical, both multidimensional in their own right. Quantifying rhetoric is not without risks, but the alternative is not that rhetoric won't be quantified, but rather that rhetoricians simply won't be involved in the process. Engaging in this sort of work is an opportunity for RSTM to ensure the broader impact of rhetoric and indeed inquiry writ large. Given our wicked predicament, we need now more than ever to have a measurable impact—to become agents of change at the science-policy nexus.

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APPENDIX A: SAMPLE OF PRAXIOGRAPHICALLY CODED ARTIFACTS

Scholar	Artifact	Mode						Characteristic		
		DRP	DRE	SPR	SCP	RHP	PRC	CO	UP	GR
Herndl	Herndl, et al (2011). Talking sustainability: Identification and division in an Iowa community. *Jour. Sustainable Agriculture*		█						█	█
Druschke	Hychka, K. C., & Druschke, C. G. (2016). Barriers, Opportunities, and Strategies for Urban Ecosystem Restoration… US EPA.		█					█	█	
Goodwin	Cases for Teaching Responsible Communication of Science					█				█
Parks	"Team writing and institutional science documents." Poster at Science of Team Science (SCITS) Conference.		█							
Reif	John J. Rief et al. (2013). "Promoting Patient Phronesis: Communication Patterns in an Online Lifestyle Program Coordinated with Primary Care," *Health Education & Behavior*.		█					█		

		DRP	DRE	SPR	SCP	RHP	PRC	CO	UP	GR
Walker	International citizen science for tiger conservation. *Public Library of Science (PLoS) Citizen Science Blog*. April 1st, 2013.		▓					▓	▓	
Condit	Caulfield, T., & Condit, C. (2012). Science and the sources of hype. *Public Health Genomics*, 15(3-4), 209-217.		▓					▓		
Walsh	Guest appearance on *The Partially Examined Life* philosophy podcast. 2014.	▓								

DRP: Dissemination of Rhetoric to Public | DRE: Dissemination of Rhetoric to Expert | SPR: Science Comm and Public Relations | SCP: Sci Comm Pedagogy | RHP: Rhetoric-Humanist Pedagogy | PRC: Problem-oriented Rhetorical Catalysis | CO: Collaborative w/ Experts | UP: Upstream/Policy-oriented | GR: Grant

APPENDIX B: AGGREGATE PRAXIOGRAPHIC RESULTS BY SCHOLAR

	Hern.	Cecc.	McGr.	Drus.	Grah.	Good.	Parks	Reif	Walk.	Cag.	Cond.	Wal.
DRP	0	4	1	0	1	0	0	0	4	0	0	1
DRE	9	7	128	95	14	14	5	16	4	3	18	6
SPR	0	0	1	34	0	0	2	0	0	0	0	0
SCP	0	0	1	5	2	2	0	0	1	1	0	0
RHP	1	0	3	4	1	3	0	0	0	1	0	0
PRC	0	0	6	2	2	1	1	0	0	0	0	0
CO	3	1	59	12	1	1	1	2	1	0	5	0
UP	2	0	111	93	11	12	4	16	9	1	17	5
GR	3	2	17	17	5	3	1	1	0	0	1	0

DRP: Dissemination of Rhetoric to Public | DRE: Dissemination of Rhetoric to Expert | SPR: Science Comm and Public Relations | SCP: Sci Comm Pedagogy | RHP: Rhetoric-Humanist Pedagogy | PRC: Problem-oriented Rhetorical Catalysis | CO: Collaborative w/ Experts | UP: Upstream/Policy-oriented | GR: Grant

CURRICULUM VITAE

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Education

M.A., University of Wisconsin—Milwaukee, 2015
Major: English | Emphasis: Professional and Technical Writing

B.A., University of Wisconsin—La Crosse, 2011
Major: English | Emphasis: Writing and Rhetoric

Dissertation Title

Agents of Change: Scholarly Intervention at the Science-Policy Nexus

Publications

Card, D.J., Kessler, M.M., Graham, S.S. (2018). Representing without representation: A feminist new material exploration of patient experience in federal pharmaceuticals policy. In A. Booher & J. Jung (Eds.), Feminist Rhetorical Science Studies.

Graham, S.S., Kessler, M.M., Kim, S-Y., Ahn, S., & Card, D.J. (forthcoming, 2018). Assessing Perspectivalism in Patient Participation: An Evaluation of FDA Patient and Consumer Representative Programs. Rhetoric of Health and Medicine.

Graham, S.S., Kessler, M.M., Card, D.J., Olson, M., Ahn, S., Sang-Yeon, K. (2016). Conflicts of interest among patient and consumer representatives to FDA Drug Advisory Committees. Annals of Internal Medicine.

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Kim, S., Graham, S. S., Ahn, S., Olson, M. K., Card, D. J., Kessler, M. M., DeVasto, D. D., Roberts, L. R., Bubacy, F. A. (2016). Correcting biased Cohen's Kappa in NVivo. Communication Methods and Measures.

Miller, C. R., Walsh L., Wynn, J., Kelly, A. R., Walker, K. C., White, W. J, Winderman, E., Abeles, O., Bedsole, N. H., Belling, M., Brigham, M.P ., Card, D., DeVasto, D., Goodwin, J., Graham, S. S., Ingraham, C., Hartzog, M., Iwertz, C., Johnson, M. A., Johnson, N. R., Kamperman, S., Kessler, M., Lanius, C., Majdik, Z., Malkowski, J., Parks, S., Parrish, A.C., Pietrucci, P., Roudtree, A. K., Shepherd, D., Taylor, K., Tucker, B., Von Burg, R., & Wilson, G. (2016). The Great Chain of Being: Manifesto on the Problem of Agency in Science Communication. Poroi, 12(1), 1-16.

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Conference Presentations

Card, D.J. (May 2018). Rewriting resilience: Hybrid forum design as engaged rhetoric of science. Association for the Rhetoric of Science, Technology, and Medicine. Minneapolis, MN.

Card, D.J. (2017). Public inclusion 2.0: Regulations.gov and the value of computational analysis in technical communication. Association for Teachers of Technical Writing. Portland, OR.

Kim, S., Graham, S. S., Ahn, S., Olson, M. K., Card, D. J., Kessler, M. M., DeVasto, D. D., Roberts, L. R., Bubacy, F. A. (2016). Bias correction for overestimated Kappa in NVivo. Convention of the International Communication Association. Fukuoka, Japan.

Card, D. J. (2015). Agora 2.0: A data-driven assessment of public inclusion in GMO policymaking. National Communication Association. Las Vegas, NV.

Card, D.J., Kessler, M.M., DeVasto, D., Roberts, L., Olson, M.K. & Graham, S.S. (2015). Laboratories and lived experiences: Assessing patient inclusion in FDA pharmaceuticals regulation. National Communication Association. Las Vegas, NV.

Graham, S.S., Kim, S.-Y., Kessler, M.M., Card, D.J., DeVasto, D.M., Ahn, S., Olson, M., Bubacy, F., Roberts, L. (2015). The effects of differential inclusion on FDA pharmaceuticals policy deliberation. International Conference on Science in Society. Chicago, IL.

Graham, S.S., Keith, W., Johnstone, C., Kim, S-Y., Card, D.J., Kessler, M.M., Anderson, C. (2014). Innovation adoption following continuing education: A mixed methods pilot study of oncology-related meetings. Society for Academic Continuing Medical Education. Cincinnati, OH.

Kessler, M.M., Graham, S.S., Card, D.J., Keith, W.M., Anderson, C. (2014). Packaging risk of innovation adoption: A rhetorical ethnography of continuing medical education. Association for the Rhetoric of Science and Technology. Chicago, IL.

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Graham, S.S., Keith, W.M., Kessler, M.M., Card, D.J., Kim, S-Y. (2014). A data-driven approach to genre analysis: Statistical typification and argumentative outcomes modeling. Association for Teachers of Technical Writing. Indianapolis, IN.

Grants

National Science Foundation Innovation Corps (National)   2016
Co-PI for Responsive Writing Solutions | Award: $50,000

National Science Foundation Innovation Corps (Sites)   2015
Co-PI for Responsive Writing Solutions | Award: $2,400

Research in Progress

Card, D. J. (article draft). Agora 2.0: A data-driven assessment of public participation in sociotechnical policymaking via Regulations.gov.

Card, D.J. (article draft). Rhetorics of engagement: Assessing rhetoric of science's interventional agenda.

Teaching Experience

Business Writing | English 205
Technical Writing | English 206
Writing and Social Media for Careers | English 214
Writing, Speaking, and Technoscience in the 21st Century | English 310

Curricular Development

Writing, Speaking, and Technoscience in the 21st Century | English 310
Strategic Writing for Orgs | Certificate in Business & Tech Comm, UW Flex
Tech Comm & Org Leadership | Certificate in Bus. & Tech Comm, UW Flex

Service and Additional Experience

Web design consultant, Youthhaiti, 2017
Graduate Student Representative, UWM Prof & Technical Writing, 2016
Reviewer, Association for Rhetoric of Science, Technology, Medicine, 2016
Attendee, Assoc. of Teachers of Tech. Writing Methods Workshop, 2015
Attendee, Rhetoric Society of America Summer Institute, 2015, 2017
Judge, Undergraduate Public Speaking Competition, 2014
Judge, UW-System Undergraduate Public Speaking Competition, 2014
Student Director, Writing Center, University of Wisconsin-La Crosse, 2011
Tutor, Writing Center, University of Wisconsin-La Crosse, 2010-2011

Awards

Top Graduate Student Poster, Nat. Conf. for Science & Environment, 2017
Phase 3 Contestant, WI Tech Summit Governor's Bus. Plan Contest, 2016
Recipient, UW-Milwaukee Chancellor's Award, 2015