Making, Marking, Mattering: What We Can Learn about Writing, Rhetoric, and Technology from a Makerspace

Ann Shivers-McNair

A dissertation

submitted in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

University of Washington

2017

Reading Committee:

Anis Bawarshi, Chair

Juan Guerra

Candice Rai

Program Authorized to Offer Degree:

English

University of Washington

Abstract

Making, Marking, Mattering: What We Can Learn about Writing, Rhetoric, and Technology from a Makerspace

Ann Shivers-McNair

Chair of the Supervisory Committee:
Professor Anis Bawarshi
English

This dissertation draws on data from a year-long ethnographic case study of a makerspace in Seattle to argue for and model a theoretical and methodological apparatus for studying making as mattering, and I offer accounts that explore acts of making at three levels: 1) the ongoing making and re-making of the research(er) apparatus, which involved integrating myself into the knowledge, social relations, and practices of the makerspace, as well as integrating theory and findings; 2) the ongoing making and re-making of bodies (human, cyborg, machine), relations, and the makerspace itself as localized practices; and 3) the connections among the local makerspace, the global maker movement and international professional practice, and maker-inspired digital rhetorics pedagogy.

The results of my study speak both to growing interest in makerspaces as well as to ongoing conversations about the entanglement of bodies, technologies, and communication in rhetoric of science, material rhetorics, and cultural usability studies. I highlight the ways in which neither "maker" nor "space" is a given in a makerspace, the ways in which writing is both entangled with and marked as different from other forms of making, and the ways in which work toward diversity and access in technology is a highly localized practice, even in an increasingly global movement. I also offer implications for teaching writing—including a reminder that makerspaces and maker culture, even when we import them into our classrooms, can privilege certain kinds of making and bodies.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

My thanks to Dave Sheridan for introducing me to makerspaces and the growing conversation about the maker movement in our field. I am grateful to Eric Renn, CEO of SoDo Makerspace, for welcoming me into the makerspace as a researcher, and to all the makers who participated in this study, especially Clarissa San Diego, Tony Loiseleur, Alex Cheker, and Richard Albritton. My special thanks to Clarissa, with whom Chapter Five is coauthored, for her friendship and wisdom. And I am grateful to all my students in the two sections of English 382 I taught at the University of Washington, and especially to Joy Phillips, Alyse Campbell, Hanh Mai, Alice Yan, John Forrest Macy, James Wenlock, Savannah Fry, and Yishan Guan, the students who co-authored the in-progress manuscript referenced in Chapter Six.

For their invaluable guidance and feedback, I would like to thank Huatong Sun and Guiseppe Getto, editors of a special issue of *Technical Communication* in which a version of Chapter Five appears, as well as my anonymous reviewers, and Matthew Vetter and Kristi McDuffie, editors of *Kairos* PraxisWiki, in which a version of Chapter Two appears, as well as my reviewers, Crystal Van Kooten and Shelley Rodrigo. I am grateful to my friends and colleagues for their intellectual and emotional support as I worked on this project, especially AJ Burgin and Tesla Schaeffer, for their empathy and encouragement, and Laura Gonzales, my dear friend and intellectual role model. I am very grateful to my committee and mentors, Anis Bawarshi, Juan Guerra, Candice Rai, and Mark Zachry, for challenging, guiding, and supporting me and for modeling the kind of scholar I aspire to be. Anis, especially, has been generous, patient, supportive, and an incredible mentor as I prototyped and refined this project. Finally, and importantly, I am deeply grateful to my family for believing in me, supporting me, and bearing with me, especially my Seattle family, Diane and

Juan Guerra and Amy Feldman-Bawarshi and Anis Bawarshi; my grandmother, Catherine Clark; my sister, Sarah Clark; and my parents, Beth and Jerry Shivers. Most of all, I am grateful to my partner, Daniel McNair, for his sacrifices, support, creativity, and generosity.

Chapter 1. BOUNDARY MARKING AND THE ETHICS OF MATTERING

Distinctions and boundaries are never disinterested: when someone is named as a witch, a factory worker, a rustic, or an illiterate, someone else profits from that distinction. When images are distinguished from texts, someone profits. . . . no body is disinterested. And that is why this work is central to rhetorical studies, which has always taken the study of partisanship as its province. – Sharon Crowley (1999)

Introduction

Attention to materiality is not new in rhetoric, technical communication, and writing studies, but there has been an increasing interest in materiality that troubles the boundaries of bodies, modes, media, technologies, writing, and rhetoric. These approaches share a commitment to attending to how rhetoric, rhetors, writing, and writers are *made*; to troubling the boundaries between discursive and material and between human and nonhuman; and to recognizing that such distinctions are *drawn* (and redrawn) rather than *given*. Indeed, these approaches challenge traditional approaches that rely on Western humanist notions of subjects and objects as pre-existing entities in favor of dynamic, phenomenological, constituting relations. This is what distinguishes (relatively) new materialist approaches from their roots in historical and cultural materialism: new materialist approaches locate materiality *in* boundary markings, while traditional material approaches have proceeded from more-or-less a priori boundaries around materialities in order to make a case for attending to the material *in addition to* the rhetorical. Thus, in new materialist frameworks, as in cultural and decolonial rhetorics, boundary marking is a material-rhetorical act, and the marking of boundaries makes some bodies and some things matter—in both a material and a semiotic sense—at the exclusion of others. In other words, how we mark boundaries is what we make matter. To understand how writing or rhetoric is made,

then, we need to understand boundary marks and what matters and what is excluded from mattering.

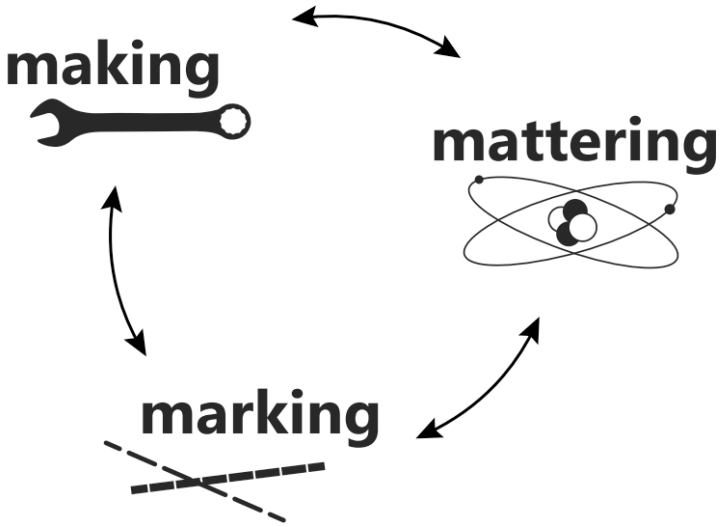


Figure 1. A model of the entangled relationship among making, marking, and mattering

But such commitments present methodological challenges: how do we account for the complexity of mattering in more-than-(Western) human(ist), more-than-symbolic acts? How do we account for the dynamic marking of boundaries in these acts? How do we account for acts of mattering in ways that do not rely on Cartesian geometrics that distance subjects and objects, mediator and mediated? As Brian McNely, Clay Spinuzzi, and Christa Teston (2015) observe, "scholarship in the material turn has troubled how researchers should bound off and study objects and practices" (6)—and, I would add, media, modes, and bodies. Work in feminist and decolonial rhetorics has offered us useful concepts, approaches, and cases that do just that (and long before new materialism raised these questions).

My theoretical-methodological apparatus for studying making, mattering, and boundary marking builds both on feminist and decolonial approaches and on material approaches, as well as traditions of digital rhetoric research and social justice research. My theoretical-

methodological apparatus is also informed by—even as it also informs—my study of making, particularly in makerspaces and the maker movement, as well as maker-inspired pedagogy in composition and technical communication. Part of an international maker movement that overlaps with trends toward DIY/DIO, makerspaces are warehouse-style spaces full of traditional and emergent fabrication technologies, from woodworking tools and sewing machines to 3D printers and laser cutters, where creativity and entrepreneurship are valued. By its own account—and despite efforts to the contrary from some within the movement—the maker movement skews heavily toward college-educated, male-identified people with a median household income of more than $100,000 (Maker Media, 2015). Interest in making and makerspaces is growing in rhetoric, writing studies, the digital humanities, and professional and technical communication—evidenced in the work of scholars such as David Sheridan (2010), John Sherrill (2015), Jentery Sayers (2015), and Sarah Fox, Rachel Ulgado, and Daniela Rosner (2015)—and makerspaces offer a fruitful site for examining the ways in which boundary marks, namely what counts as "making" and who counts as a "maker," make certain bodies and traditions matter at the exclusion of others, which in turn shapes what gets made, by whom, and for whom. In what follows, I examine how materiality and mattering has been addressed in rhetoric, technical communication, and writing studies, and I build on these traditions to argue that in order to understand making (including how writing is made), we need to understand boundary marks and who and what those boundary marks make matter, and what and what are excluded from mattering.

Materiality and Mattering

As Jack Selzer (1999) explains in his introduction to *Rhetorical Bodies*, a collection (edited with Sharon Crowley) that articulates a project of materiality in (Western) rhetoric, the

interest in materiality is a response to the so-called "rhetorical turn" across the sciences and humanities that can, in its extremes, reduce material things to functions of language. As he puts it, "words have been mattering more than matter" (4). Likewise, Carole Blair (1999), in her contribution to that collection, notes that the "obstinacy of the language of symbolism" in referencing rhetoric of any kind (as well as in the lingering effects of liberal humanism) is a significant challenge for the material project. As Selzer acknowledges, the rhetorical turn has productively encouraged scholars across disciplines to examine their practices of knowledge-making through language, but it also has the potential to elide the materiality of language and discourse. And while Selzer and Crowley's collection marks a turn to the material, we might more productively think of this as a *return*, since, as scholars like Debra Hawhee (2004, 2009), Janet Atwill (1998), Malea Powell (2012), Angela Haas (2007), and Michael Calvin McGee (2009) have argued, materiality has long been part of rhetorical traditions. While the increasingly mainstream (re)turn to bodies and matter is opening up new possibilities for knowing, doing, and teaching making, we must take care not to elide the often-marginalized voices of feminist and indigenous scholars whose work has long been concerned with marks on bodies and mattering.

Thus, my own orientation to a material (re)turn in rhetoric draws upon both material rhetorics and decolonial and cultural rhetorics, because *mattering* is material-cultural. As Ellen Cushman (2016) reminds us in her articulation of decolonial rhetoric, epistemologies come from and inscribe bodies in places (in and outside colonial matrices). And as Malea Powell, Daisy Levy, Andrea Riley-Mukavetz, Marilee Brooks-Gillies, Maria Novotny, and Jennifer Fisch-Ferguson (2016) explain, "rhetorics [are] always-already cultural and cultures [are] persistently rhetorical" (n.p.). Powell and her colleagues also take care to point out that their definition of "cultural" is not the static, object-oriented approach taken up in much of Western humanities and

social sciences: "By 'object-oriented,' we mean scholarship that identifies 'culture' as an *object* of inquiry, one that can be isolated from other human, economic, political, geographical, historical frameworks that exist around and within it. In addition to the false stability this imposes on the dynamic rhetorical phenomenon within cultural communities, this object-oriented approach to understanding culture also erases the human bodies involved in their makings" (n.p.). In other words, treating the "material" and the "cultural" as separate and/or static categories is a limiting and potentially harmful approach; instead, my aim is to attend to the dynamic making and remaking of bodies, boundaries, matter, and rhetorics. This is particularly important, for example, in considering how the technologies and environment at SMS are entangled with who makes and what gets made there. As SMS co-founder Clarissa San Diego explained to me in a conversation about diversity in SMS, environment matters immensely to fostering inclusivity in makerspaces and in the technology industry. For people who are not white men, "It really helps to have someone similar to you" in the space. In other words, if a makerspace—the arrangement of bodies, furniture, materials, things—feels like a "total dudefest" (to use the words of a white man in the makerspace who was lamenting that fact), then some possibilities for making and mattering are opened up for some bodies, while others may be closed down for other bodies.

Attention to materiality has also figured prominently in work in digital rhetorics and new media, where the boundaries of writing, rhetoric, and media are productively contested. As scholars like Cynthia Selfe (2009), Jason Palmeri (2013), Geoffrey Sirc (2012), and Diana George (2002) have shown us, attending to the material has been part of the work of the field from its beginnings, if not part of its mainstream practices. Indeed, as Adam Banks (2011) and Angela Haas (2007) remind us, digital composing practices that may seem relatively new to the

field, like remixing or even hypertext, have roots in the embodied rhetorical practices of people of color. And as Laura Gonzales (2015) has shown, linguistic dexterity (specifically, the unique dexterities of multilingual writers) is entangled with modal dexterity in ways that demand our attention. Other conversations that highlight the embodied, material nature of composing—many of which overlap with rhetoric and PTC—have focused on, for example, design thinking (George, 2002; Marback, 2009), making (Shipka, 2011, 2016; Sheridan, 2010; Sherrill, 2015), hacking (Ballentine, 2009; Cummings, 2009), tinkering (Sayers, 2011; Craig, 2014); crafting (Prins, 2015), the materiality of uptake, genres, and transfer (Bawarshi, 2016; Dryer, 2008; Nowacek, 2011), digital rhetoric (Eyman, 2015; McKee and DeVoss, 2007), visual rhetoric (Wysocki, 2009; Murray, 2009; Fleckenstein, 2010; Gries, 2015), and multimodality (Selfe, 2009; Lauer, 2009; Selber, 2004; DePalma, 2015; and Arola, Ball, and Sheppard, 2014). The proliferation of technologies for writing and making in the twenty-first century and increasing interest in multimodal and three-dimensional composition means the time is right, as Jody Shipka (2011) exhorts the field, to expand our "theorizing, researching, and improvement of written discourse to include other representational systems and ways of making meaning" (p. 131).

But just how to approach this expansion remains contested. While much of the scholarship on multimodality draws on work by Gunther Kress (2005) that defines modes in terms of bodily senses (see, for example, Alexander and Rhodes, 2014; Sheridan, Ridolfo, and Michel, 2013; Lauer, 2009; Selfe, 2009), Paul Prior (2005) and Anne Frances Wysocki (2005) criticize what they see as the binary and container-esque nature of Kress' conceptions of modes (for example, in the distinctions between image and text), and in the logic by which "affordances" are treated, as Prior puts it, as "highly determinative, mutually exclusive, and

binary" (p. 26). (Prior offers Jay Bolter and Richard Grusin's (1999) *Remeditation* as a counterhistory of mediation.) Wysocki (2012), in her introduction to *Composing (Media) = Composing (Embodiment)*, argues for a phenomenological approach to embodiment and mediation: "our bodies—our primary media, to draw on the first sentence and observation of this section—are not fixed; they are mutable. We come to be always already embedded—embodied—in mediation" (4). Furthermore, sensory anthropologist Sarah Pink (2011) points out that the five-senses-tied-to-five-sense-organs model that Kress draws on is a Western, not a universal, model and that senses are more entangled than the multimodal tradition allows for, which limits multimodality as a framework for research. And just as the boundaries of senses and modalities are contested, so, too, are the boundaries between bodies and media. Slattery (2005) examines the relationships between human communicators and their tools (software, media, existing documents), noting that the supposedly higher order rhetorical skills (which, I would add, are associated with a liberal humanist notion of rhetoric) are in fact entangled with supposedly lower order technological skills (which, I note, are less "human" in that they can potentially be automated and in that they involve interacting with nonhuman machines).

Indeed, I have found that the continual boundary-blurring between bodies and media at SMS demands a more entangled approach that treats "media" and "modes"—and, for that matter, bodies and technologies and rhetoric—not as starting points but as dynamic, localized products of interactions. In other words, the definitions of "media," "modes," "bodies," technologies," and "rhetoric" are not pre-existing or static, but are ongoing, situated, contingent boundary markings that make some bodies and possibilities matter at the exclusion of others. For example, I watched makers operating machines not so much as tools but as extensions of their own bodies, their proprioception encompassing the appendages and movements of 3D printers and laser cutters. I

saw 3D printers print their own replacement parts or parts for new 3D printers, carrying out quite independently a set of instructions delivered to them by their human supervisor. As I learned to use the machines myself, I learned new ways of communicating that involved movement, spatial relations, multiple bodies (human, machine, cyborg), and programming languages, as well as new meanings and new (to me) ways of writing, like carving letters into wood with a CNC (computer-numerical control) milling machine and finishing them with a torch. Outside SMS, my daily writing practices look more like alphabetic words on paper or on screen (alongside images, video, and other visualizations), but I still find it useful to think of my writing body, the genres and media and modes and meanings I produce, and the users and usability of my writing not as starting points but as dynamic results of local actions and interactions, because it is a way of being accountable for what and who matters, and what and who are excluded from mattering, at every turn. After all, accountability for boundary marks as a way not only of describing but also intervening in making and mattering is at the heart of this project.

In addition to drawing on material and cultural/decolonial rhetorics, I situate my accountability to the ethics of boundary marking and mattering in the tradition of activist/participatory and social justice researchers who call attention to the ways in which particular material contexts—socio-economic, cultural, linguistic, embodied—shape the research apparatus for researchers who see themselves as not simply observing but also participating in the communities they research (see, for example, Agboka, 2013; Blythe, 2012; Faber, 2002; Grabill, 2012; Walton, Zraly, & Mugengana, 2015). As Natasha Jones and Rebecca Walton (forthcoming) argue, social justice research in technical communication demands "a collaborative, respectful approach that moves past description and exploration of social justice issues to taking action to redress inequities" (n.p.). Similarly, Sun (2012) calls on researchers and

practitioners working across cultures to account for localized user practices and needs, and Gonzales and Zantjler (2015) extend this framework to argue that the practice of translating (specifically, across languages) is similarly localized and contextual. And scholars such as Walton, Zraly, and Mugengaga (2015) and Fleckenstein, Spinuzzi, Rickly, and Papper (2008) highlight the materiality of the research apparatus itself by focusing not only on the phenomena researched but also on research processes, drawing attention to entanglements, decisions, and boundary markings in research and practice. I would add, furthermore, that boundary marking practices in our research practice include not only the bodies and technologies we define, include, and exclude in our data collection, but also the theoretical concepts and traditions we draw upon.

Accountability

In constructing my theoretical-methodological apparatus, I take up work in new materialism alongside work in material and cultural rhetorics, but I do so with particular attention to the traditions that new materialism—as it is taken up in rhetoric, writing studies, and technical communication—can elide. Recently, scholars have taken up interdisciplinary work in new materialism—object-oriented ontology, phenomenology, Latourian symmetry, Jane Bennett's (2009) thing-power—to consider, as Ehren Pflugfelder (2015) puts it, "what rhetoric is like as we move beyond the humanist symbolic arts" (p. 443). And as Laurie Gries (2015) points out, new materialism is both an ontological and a methodological project, one that demands "new kinds of empirical investigations that foreground distributed relations and attend to the nonlinear processes of materialization" in order to "make sense of our contemporary existence" (p. 6). While some scholars have turned to classical concepts like *hyle* (Pflugfelder, 2015), *chiasm* and *pathos* (Barnett, 2015a), *techne* and *phusis* (Barnett, 2015b), and the *chora* (Rickert,

2013) to enact a new materialist rhetorical criticism, others draw on newer concepts: Jenny Edbauer (2005) posits ecology as an alternative to the rhetorical situation, Clay Spinuzzi (2015a) advocates for the value of Latourian symmetry as a methodological move for writing studies, Byron Hawk (in a talk at the 2015 Indiana Digital Rhetoric Symposium) offers gesture as an ontological alternative to genre, and Gries (2015) traces consequentiality sparked by a viral visual campaign. Jay Jordan (2015) and Jody Shipka (2016) each synthesize work in translingualism (particularly as articulated by Min-Zhan Lu and Bruce Horner [2013]) and transmodality (as articulated by Bruce Horner and Cynthia Selfe [2013]) with new materialist approaches to distributed, more-than-human, more-than-symbolic meaning making. As Shipka (2016) argues, drawing on Laura Micicche, "what we need to pursue are more robust concepts of materiality and nonhuman involvement and agency, something that would, in turn, allow us to redefine translingual and multimodal collaborations 'as partnerships that include and exceed intentional ones established between people'—partnerships that involve the merging of 'various forms of matter' (Micciche 498)" (qtd. in, p. 254).

A growing number of rhetoric and writing scholars working in new materialism draw on the work of transdisciplinary feminist scholar Karen Barad (2007), who refuses to treat distinctions between human and nonhuman or subject and object as a given. Scot Barnett (2015b) emphasizes the ways in which Barad calls into question the seemingly-given differential markings of "human" and "nonhuman," and other rhetoric and writing scholars emphasize her retheorizing of agency as matter's entanglement across humans and nonhumans (see, for example, Gries' [2015] emphasis on the consequentiality of things, Rickert's [2013] description of rhetoric as ambient, and McNely, Spinuzzi, and Teston's [2015] emphasis on the "potentially formidable role of objects" [6]). But what I do not see getting taken up as much from Barad's

work is her insistence on the ethics of mattering as an intersectional concern. Barad is careful to point out, *pace* Latour, that simply including nonhumans alongside humans, or distributing agency across humans and nonhumans, misses the ways in which, as Judith Butler puts it, "the construction of the human is a differential operation that produces the more and the less 'human,' the inhuman, the humanly unthinkable (1993, 8)" (qtd. in, p. 59). As Barad argues,

> Some science studies researchers are endorsing Bruno Latour's proposal for a new parliamentary governmental structure that invites nonhumans as well as humans, but what, if anything, does this proposal do to address the kinds of concerns that feminist, queer, postcolonial, (post-)Marxist, and critical race theorists have brought to the table? Nonhumans are in, but the concerns of this motley crew of theorists and activists seem not to have been heard, let alone taken into account. (p. 58)

In other words, the differential markings of more or less human—which have long been the focus of intersectional approaches—are as important as the markings of human and nonhuman. Boundary marks matter, both in the sense that they *come to matter themselves* (as practices within the differential markings of more or less or not human, or more or less or not writing) and in the sense that they *make things, bodies, and meanings matter*—often at the exclusion of others. The making and remaking of more or less human bodies also entails the making and remaking of possibilities that are opened up and closed down by being marked more or less or not human. (Or, for that matter, more or less or not rhetoric/writing.) In expanding the possibilities of rhetoric to include objects, machines, and animals, we must also account for the ways in which our marking and remarking of "rhetoric" and the "rhetorical tradition" makes some (human) bodies and traditions matter more than others, which then affects who gets to make what, when, how, and for whom. Accountability for boundary marking practices, then, is essential.

Barad's explication of diffraction (drawing on the work of Donna Haraway) is a useful tool for accounting for boundary marking practices. Diffraction, Barad explains, is "the way

waves combine when they overlap and the apparent bending and spreading out of waves when they encounter an obstruction" (p. 28). Diffraction, like reflection, is an optic metaphor, but whereas reflection relies on a black-boxing (to borrow Latour's phrase) of light as a ray approximation, diffraction attends to the nature of light itself—and the fact that whether or not light behaves as a wave or particle is entangled with the measuring apparatus itself. Where reflection, as an optic metaphor, proceeds from assumptions of distance, priorness, and sameness (however mirrored, triangulated, or mediated), diffraction proceeds from the assumption that differences are marked *within* phenomena, that "subject" and "object" emerge *in* intra-action. For Barad (and for Haraway), diffraction is not only a way of describing how difference is marked, but also a methodology for theorizing difference that attends to "interference" patterns of waves from multiple sources (in this case, multiple theories and even disciplines), rather than privileging one perspective or discipline. Key to this approach is the understanding that

> diffraction does not fix what is the object and what is the subject in advance, and so, unlike methods of reading one text or set of ideas against another where one set serves as a fixed frame of reference, diffraction involves reading insights through one another in ways that help illuminate differences as they emerge: how different differences get made, what gets excluded, and how those exclusions matter. (p. 30)

Diffraction is useful not only as a transdisciplinary methodology, but also, as Sharon Stevens (2004) and Katrina Powell and Pamela Takayoshi (2012) have shown, as an orientation to specific methods. Stevens draws on Haraway to articulate a diffractive ethnographic approach (aligned, despite both Haraway and Barad's deep skepticism of the optic metaphor of reflection, with traditions of reflexive ethnography) that has a goal of making a difference—not only in its impact, but also in the sense that the knowledge it makes is new, not a reflection of some pre-existing reality. Powell and Takayoshi similarly acknowledge the potential of Barad's articulation of diffraction to push feminist epistemologies of reflexive practice even farther by

highlighting complicated relationships and specific material entanglements, as well as patterns of difference.

Thus, I argue that a project that attends to boundary marking should attend not only to the markings of more-or-less human, more-or-less rhetoric, more-or-less writing, more-or-less objects, but also to the marking of the research(er) apparatus—be it a concept or an empirical study (both of which are material, both of which matter). This involves accounting for what matters and what is excluded from mattering in the intellectual lineages and concepts we construct and in our methodological approaches to the making of knowledge. Researchers and their bodies are not excluded from the "data," the "objects," or the "participants." Our findings in our research are entangled with our research apparatuses: the theoretical and methodological lineages we trace, the spaces and places we come from and research, the bodies and technologies we bring to research and the bodies and technologies we count in our research. The researcher, critic, or rhetor is entangled in, not exterior to, the phenomenon (or rhetorical act), and therefore, as Barad argues, ethics and responsibility are not a choice but are inherent in the act of boundary marking.

Feminist and decolonial scholars in material rhetorics and cultural rhetorics have long argued for an accountability to the ethics of mattering, of boundary marking. As Sharon Crowley (1999) argues, "Distinctions and boundaries are never disinterested: when someone is named as a witch, a factory worker, a rustic, or an illiterate, someone else profits from that distinction. When images are distinguished from texts, someone profits. . . . no body is disinterested. And that is why this work is central to rhetorical studies, which has always taken the study of partisanship as its province" (363). Indeed, as Malea Powell (2012), Angela Haas (2014), and Sundy Watanbe (2014) argue, restricting definitions of "rhetoric" or "literacy" to the realm of the alphabetic is

harmful to indigenous peoples whose rhetorical and literate practices involve multimodal, embodied ways of meaning. For Jennifer Sano-Franchini (2015), accountability for the ethics of mattering means accounting for what is privileged and what is silenced in the intellectual lineages we construct: "rather than building the rhetorical tradition around Aristotle or Kenneth Burke," she argues, "we [could] start with American Indian or Asian American or working-class intellectual traditions because the very centering of particular theorists says something about whose intellectual traditions are valuable and whose are not" (p. 23-24). For example, scholars working to move beyond Cartesian notions of subject, object, mind, and body could, instead of or in addition to turning to Latour or reimagining classical concepts, draw upon feminist and decolonial work that highlights non-Western-European approaches to relationality. And scholars working to move beyond the realm of the alphabetic and discursive could build not only from work in digital and other new media but also from indigenous rhetorics that have long attended to more-than-alphabetic ways of making.

Indeed, even the "new" in "new materialism" is a boundary marking practice that is not without consequences: Sara Ahmed (2008) takes feminist work in new materialism (including, specifically, Barad's) to task for calling itself "new," pointing out that calling something "new" risks eliding the very work upon which it builds. Carl Herndl and Scott Graham (2015) similarly acknowledge that Latourian new materialism is not so much new as it is resurgent, and Eileen Schell (2012), in acknowledging the diverse ways that materiality has been taken up in rhetoric and composition, calls for scholars to account for the different traditions from which their understandings of materiality proceed. Similarly, the "new" in new media and multimodality studies often elides the long histories of multimodal making practices of people who have been marginalized by the (predominantly white) academy: Adam Banks (2006) points to the

multimodal practices in Black culture in the eras of slavery and Civil Rights in the U.S., and he also notes (2011) that the supposedly new practice in composition of the remix assignment is rooted in, but not credited to, the practice of Black DJs. Angela Haas (2007), likewise, has shown how practices of hypertext in Wampum weavings far pre-date the emergence of contemporary digital hypertext.

Accounting for boundary marking in the construction of concepts, lineages, methodologies, and the research(er) apparatus itself *as well as* in the marking of boundaries in the phenomena we study (human/nonhuman, rhetoric/not-rhetoric, writing/not-writing, new/not new) can give us richer, more satisfying accounts of rhetorical phenomena by attending to the complexities not only of *what* we study but also *how* we study. More than simply describing our theoretical and methodological commitments and approaches, we can account for what matters and what is excluded from mattering in our specific entanglements in specific phenomena or material arrangements. This is an ethical move, and it is also a transdisciplinary move. I mean transdisciplinary (rather than interdisciplinary) in the sense described by Debra Hawhee (2009), who draws on Irene Dölling and Sabine Hark: interdisciplinarity, she explains, is "marked by disciplinary affinity—closely allied fields," while transdisciplinarity "calls for 'continual reexamination of artificially drawn and contingent boundaries and that which they exclude' ([Dölling and Hark] 1197)" (3). Hawhee explains that "the difference is a matter of sharing methodologies (something interdisciplinarity does quite well) versus broadening perspective, one of the main goals of transdisciplinarity" (3).

Accounting for the research(er) apparatus—along with other boundary markings—is a reworking of "objectivity" that does not equate objectivity with the representationalism of the scientific method; instead, such a reworking of "objectivity" troubles and transcends traditional

distinctions between sciences and humanities, theoretical and experimental, quantitative and qualitative. Scholars like Pflugfelder (2015) have argued for "moving beyond the 'size of things'"—namely the debates between "big" rhetoric (expanded persuasion) and "small" rhetoric (intentional, discursive, human communication)—by means of a shift in ontology that positions rhetoric "as an emergent, material force" (445). But, as James Jasinski (2009) observes, these debates are also about differences in theoretically-driven criticism and methodologically-driven criticism. Perhaps moving beyond these big/little, theory/method debates requires more than a shift in (or toward) ontology. Indeed, Barad rejects the distinction between epistemology and ontology as itself a false binary, arguing instead for an "onto-epistem-ology—the study of practices of knowing in being" (185). Such an onto-epistem-ology that accounts for the markings of concepts *and* methodologies, *as well as* the marking of the nature of rhetoric (or writing, or making) itself, offers us a way to trouble dichotomies and boundaries in our approaches.

Stories, Genealogies, Apparatuses

Accounting for boundary markings and matterings in this way demands what Malea Powell (2012), drawing on Lee Maracle, calls stories that create shared (onto-)epistemological space: "When I say 'story,' I don't mean for you to think 'easy.' Stories are anything but easy. When I say story, I mean an event in which I try to hold some of the complex shimmering strands of a constellative, epistemological space long enough to share them with you" (p. 384). Similarly, John Law (2002), in modeling a story-based approach to sociological examination, describes his process as a gathering, as a creative act: "I try to make something, to *create* it rather than simply telling about it. For this book explores complexity, heterogeneity, and interference not simply by talking about them, but also, and maybe more importantly, by trying to perform them" (p. 4). He describes his work as "growing different stories alongside one another" rather

than delivering a unified narrative or account. The result, he explains, is that "we create and make visible interferences between the stories. We bring new and unpredictable effects into being, effects which cannot be predicted or foretold from a single location. New forms of subjectivity. To do this is to alter the character of knowing and writing. It is to render them multiple, decentered, or partially centered, in this place that refuses both modernism and postmodernism" (p. 5). Though Law does not use the word "diffraction" to describe his approach, the optic metaphor of creating interferences and making them visible certainly could describe diffraction, and he emphasizes the function of the story itself—the writing—as an apparatus for the making and remaking of knowing in being (to use Barad's phrase). In other words, for both Powell and Law, stories are an onto-epistemological apparatus.

Story, as an onto-epistemological apparatus, is similar to the genealogical approach that Barad advocates for. Specifically, Barad calls for "genealogical analyses not only of the multiple apparatuses of bodily production that come to matter but also of the changing nature of the dynamics itself" (p. 242). Barad is drawing on and qualifying Foucault's notion of genealogy as a method. She explains:

> Genealogies, in Foucault's account, differ from historical narratives in that they are not a search for origins and do not presume the primacy of the consciousness of individual subjects, a linear progressive unfolding of events in history, the stability and continuity of events or the coherence, regularity, and uniformity of history. Genealogies do not seek to uncover the truth of the past but rather are interested in the conditions of possibility of truth making. In particular, genealogical analyses investigate rather than presume those notions that seem to be without a history (like truth, origins, and subjects). (p. 474, n. 68)

She goes on to note, however, that Foucault's approach to genealogy sometimes takes humanist notions of space and time as a given, which limits his conception of genealogy. Furthermore, as Stuart Ching (2003) points out, genealogies can also reify patriarchal conceptualizations and practices. Ching describes the ways in which a Chinese family tradition of constructing a

genealogy is blended with a feminist patchwork approach (as Hawaiian poet and scholar Donna Tanigawa describes it) that "stitches together enabling feminist and cultural narratives of self" (p. 180).

Feminist scholars Kathy Ferguson (1991) and Allison Stone (2005) trace Foucault's and Deleuze's approaches to genealogy back to Nietzsche, and as Ferguson points out, what unifies these and other poststructuralist approaches is their orientation to genealogy as "more of an activity than a theory in the interpretive sense in that it takes up a posture of subversion toward fixed meaning claims" (p. 324). Stone traces Butler's use of genealogy—which, she argues, takes up the anti-essentialism of Foucault's approach but not Nietzsche's "ontology of active body forces" (p. 5)—in order to argue for a materialist recasting of Butler's feminist genealogical approach that foregrounds an "ontology of corporeal activity and plurality" (p. 21). Both Barad and Stone, then, emphasize accounting for the (non-linear) materiality of bodies in genealogical approaches. Lucy Suchman (2002), in troubling boundaries between technology design and technology use, advocates for a feminist approach that "reframes the locus of objectivity from an established body of knowledge not produced or owned by anyone, to knowledges in dynamic production, reproduction, and transformation, for which we are all responsible" (p. 92). Knowing and being takes place in dynamic, non-linear spatial relations. And genealogies, like stories, are themselves onto-epistemological apparatuses: even as they account for boundary marking practices in a phenomenon, they are also entangled in the making of the phenomenon and knowledge about the phenomenon.

Accountability in Research and Teaching

Attending to boundary marking in our research apparatuses means accounting not only for what matters and what is excluded from mattering in what we observe and construct, but also

attending to the ways in which those apparatuses themselves are produced and changing. And the methods proceeding from a methodology oriented to mattering must attend not only to the differential embodiments of the people, machines, objects, and rhetorics we study, but also to our own embodiments as researchers or critics and to the entangled work of knowledge making. This has implications for how we study and teach making (be it alphabetic writing or 3D printing) beyond my study of a makerspace.

Indeed, I see diffractive genealogies as a powerful tool for *un*-black-boxing the complexities of boundary marking and differential mattering that cannot be explained by approaches that rely on reflection-based approaches to understanding rhetorical making. Such approaches include studying or assessing writing or rhetoric (in any linguistic or modal form) by treating the writer/rhetor's written or spoken (and often after-the-fact) reflections *as reflections in the optic sense*—as *representations* of (prior) process or intention or learning—rather than as difference-making, difference-marking phenomena that entangle writer/rhetor, writing/rhetoric, and reader/assessor/user, and from which a past, present, and future emerge. Of particular concern to me is that even when we treat reflection as a knowledge-making practice (Yancey, 2016) rather than a passive mirror of some reality, even when we treat reflection as an active intervention or agentive choice (Horner, 2016), and even when we move reflection out of alphabetic text into other media and modes (Clark, 2016; Silver, 2016), we are privileging a certain way of knowing and being. As Asao Inoue and Tyler Richmond (2016) argue, teachers' implementations of and assessments of reflections can unintentionally privilege whiteness as an invisible and "false universal" of academic discourse and the reflection genre, without giving students of color space "to name whiteness as part of the standards they are attempting to meet"

and "a vocabulary that can help them locate possible tensions in their own language use, material conditions, and writing" (p. 132).

I worry, additionally, as I argued in my contribution to a 2016 Computers and Writing Conference roundtable on composing beyond a single language/single modality framework, that using written or verbal reflections (delivered in more or less "standard" academic English and academic genres like writer's memos, heads-up statements, or reflection letters) to assess work that incorporates other or multiple languages and modes unintentionally exoticizes or fetishizes the "other." And as a research practice, privileging spoken or textual words over embodied, emplaced, three-dimensional meanings and actions can limit the bodies and meanings that come to matter in what we find. I do not mean to suggest that reflection-based approaches are somehow untrue or not valuable; clearly these approaches have real explanatory power, and we have gained many useful insights from them. My point is that diffractive, genealogical approaches to studying boundary marking—what matters and what is excluded from mattering—in acts of making can offer us a powerful way to grapple with, be accountable for, and intervene in the complexities of boundary marking, mattering, and making.

Chapter Overview

Because, as I have argued, studying entangled, distributed, material-discursive making requires entangled methodologies, I articulate in Chapter Two a diffractive, genealogical approach, in the tradition of critical ethnography, to accounting for what and who matters and what and who is excluded from mattering in the production of knowledge and in the makerspace. I account for the selection of my study sites: 1) SoDo Makerspace in Seattle and 2) two sections of English 382 (a special topics course in multimodal composition that I taught as a making-

focused digital rhetorics course) at the University of Washington in Seattle. I also account for the unfolding development of my research questions, methods, and writing apparatuses over time.

In the second portion of my dissertation, I offer two genealogies of mattering that enact a diffractive approach to accounting for material-discursive entanglement (including my entanglement as researcher and genealogy-maker) in SoDo Makerspace. In the tradition of critical/diffractive ethnography, I offer these genealogies as my participation in, rather than observation or representation of, the construction of patterns of differences. Each genealogy begins with a particular moment that came to matter to me and to the people I was interacting with, and then I trace how that particular moment came to matter: not only the prior interactions that informed my understanding of and participation in that moment, but also the ways in which that moment changed how I understood past and future interactions. Chapter Three is about integrating into systems, and Chapter Four is about breaking systems. And while the sequence of these two chapters might suggest a linear causality (that one must integrate into a system in order to break a system), I want to emphasize, instead, that "integrating into" and "breaking" are two frames for looking at (possibly) the same phenomenon. Thus, the frames themselves are boundary marking practices that are attempting to describe boundary marking practices in different ways.

Chapter Three is a genealogy of the ways in which many levels of spatial manipulations—playing with a 3D printed toy, the process of going from idea to object, making space in a makerspace, and the entanglement of ways of meaning and making—came to matter to me. I focus on the ways in which my own work to make space for myself (or integrate myself into) in the makerspace is entangled with how I understand what I experienced in the makerspace (particularly the efforts of Tony, a freelance writer and self-proclaimed "novice maker," to make

space for himself in the makerspace). Chapter Four traces the complex function of disequilibrium, or breaking systems, in making processes in SMS: from human errors and machine malfunctions to the amateur ethos of the space (and the maker movement) and systems of production. I noticed that many of the makers in SMS allow for and even cultivate a relatively high tolerance for disequilibrium as an inventional practice, in the forms of hacking and troubleshooting, failing often and fast, and a "ready, fire, aim" philosophy. Thus, this genealogy traces disequilibrium as both a marking of boundaries *and* a site for intervening in boundary marking. The two main threads of this genealogy focus on two of the most prominent fabrication technologies in SMS, the laser cutter and the 3D printers, as a way to examine and account for disequilibrium-as-boundary-marking in machine operation and maintenance, in prototyping and design, in the ethos of the space, and in production systems.

In the third and final portion of my dissertation, I turn to practical implications that operate on three levels: 1) collaborative knowledge making, 2) professional practice, and 3) teaching. The first level—collaborative knowledge-making—is embedded in both Chapter Five, which focuses on professional practice in the maker movement and intersecting technology industries, and in Chapter Six, which focuses on a making-focused digital rhetorics course I taught, because both these chapters involve collaborative knowledge making with my research participants and account not only for *what* we found in our collaborative analysis but also *how* we found what we found. In other words, just as Chapters Three and Four account for the making of my research(er) apparatus in SoDo Makerspace, these chapters account for the boundary marking practices involved in collaborative knowledge making for professional practice and for teaching. Thus, I argue that the diffractive methodology I enact in this project

can be useful not only for theorizing but also for (professionally) *doing* and *teaching* writing as complex, entangled, material-discursive acts of making.

Chapter Five examines the ways in which my evolving goals and relationships were part of the research apparatus for this project and how my vision for and enactments of activist/participatory research were made and continually remade: from my initial vision of how I might contribute to the makerspace by helping with external communications, to an interview with Clarissa San Diego, one of the co-founders of the makerspace, that turned into a collaboration. This genealogy diffracts scholarship in cross-cultural, community-based communication with Clarissa's years of experience in international community strategy work to examine issues of diversity in hardware and maker industries, in order to examine the rhetorical-material challenges of cultivating meaningful, culturally situated access to fabrication technologies and of advocating for diversity—as practitioners and as researchers—in hardware and the maker movement. Clarissa and I offer an account both of our collaborative knowledge-making methods and of our findings about the intersections of community, technical communication, and user experience. We also offer implications for research and professional practice.

In Chapter Six, I turn to implications for teaching. I describe an in-progress study coauthored with students from the two sections of the making-focused digital rhetorics course I taught in 2016, in which we analyze the ways we individually and collectively took up usability and user-centered design in our work. I account for my design of the course—which integrates user-centered design and usability testing at every level of the course design, from readings and assignments, to in-class work, to feedback and assessment—as a social justice-oriented approach to teaching accountability to boundary marks as a research and composing practice. I also offer

implications for pedagogy and further research. I conclude by discussing limitations of the dissertation study and articulating next steps for my study of making.

Chapter 2. MAKING KNOWLEDGE

Introduction

In this chapter, I attend to the making (and continual remaking) of the research apparatus for this study, with particular attention to the intersections of the theoretical-methodological apparatus (as described in Chapter One) with the research questions and commitments of this particular study, the sites of the study, the methods I used in the field, and the way I constructed the genealogies of mattering that constitute the data chapters (Chapters Three through Six) of this project. I begin by describing the site of my research, including how and why I chose SoDo Makerspace for my primary field site. I then describe the emergence of my research questions over the course of several months, as my fieldwork and theoretical-methodological apparatus took shape. Next, I describe my qualitative, ethnographically-informed case study approach to fieldwork and offer a detailed account of the 3D interviewing apparatus I developed for the study. Finally, because I see (and experienced) the processes of question (re)formulation, study and instrument design, data collection, data analysis, and results write-up as not merely *recursive* and *overlapping* but in fact *concurrent* and *entangled*, I offer an account of how I developed the genealogies that comprise the three data chapters of this project.

Field Context

Two questions I often encounter when I describe my work are 1) What is a makerspace? and 2) Why is studying a makerspace relevant to writing? I answer these questions here as a way of contextualizing the physical and digital sites of my study and as a way of showing how my ongoing work toward answering these questions is entangled with the emergence of the research questions and commitments of this project. Indeed, my own journey toward understanding makerspaces and the maker movement and articulating their relevance to writing (as well as

rhetoric and PTC) reveals the extent to which these questions are—for me, and for this project—entangled.

Makerspaces are part of an international maker movement that overlaps with larger trends toward DIY (do-it-yourself)/DIO (do-it-ourselves), crafting, and hacking. In addition to makerspaces, the maker movement is manifested in Maker Faires (local conventions with booths for local makers to demonstrate their work) and in *MAKE Magazine* and Maker Media, though certainly not all makerspaces are affiliated with these companies, and feminist hackerspaces and makerspaces have emerged to counter the practices of a male-dominated movement (Maker Media's [2015] own research on Maker Faire participants shows that the constituency skews overwhelmingly male-identified, highly educated, and middle-to-upper class.) Also called maker labs and fab labs, makerspaces are warehouse-like spaces with traditional and emergent fabrication tools and technologies—from 3D printers and laser cutters to CNC routers and sewing machines—where collaboration, creativity, tinkering, and entrepreneurship are valued and made possible.

While makerspaces' emphasis on fabrication and entrepreneurship may seem more obviously connected to engineering, design, and business disciplines, humanities scholars are also engaging in making and makerspaces: for example, Jentery Sayers directs the Maker Lab in the Humanities at the University of Victoria, which blends "a humanities research lab with a collaborative makerspace" (Maker Lab, 2015). Indeed, makerspaces have attracted scholarly and pedagogical interest across disciplines, including, in addition to the digital humanities (Sayers, 2015), education (Sheridan et al., 2014), computer-supported cooperative work (CSCW) (Fox, Ulgado, and Rosner, 2015), library and information science (Clark, 2014) and writing studies (Craig, 2014; Sherrill, 2015). Here at the UW, President Ana Mari Cauce, in her first university-

wide email after her appointment, mentioned makerspaces as part of how UW prepares its students to be "engaged global citizens" (19 October 2015). And the CoMotion MakerSpace on the Seattle campus aims to "foster a cross-disciplinary design and fabrication community, as well as providing entry-level workshops and events open to all, while connecting users to other campus shops when more specialized capabilities are required" (CoMotion, 2015). As universities and researchers engage with, study, and create makerspaces, I see my project as participating in our emerging understanding of makerspaces and offering not only theoretical and methodological tools and practical applications but also a framework for ethical considerations. In the field of writing studies, a study of making in a makerspace can productively contribute to our understanding of creativity as well as a general interest in production, including the entangled relationships between humans, technologies, and objects (differential markings) that increasingly occupy the field's interests. In the field of rhetoric, a study of making in makerspace can afford us new insights in emerging work on 3D rhetoric (Sheridan, 2010) and posthumanist or new materialist rhetoric (Gries, 2015). And in the field of professional and technical communication, a study of making in a makerspace can highlight localized, cross-modal and cross-cultural communication practices in what Spinuzzi (2015) calls the "all-edge adhocracy." Indeed, studying making in a makerspace requires new methods for studying making that account for dimensional, dynamic interactions. In other words, this study contributes not only to our understanding of making, but also to our understanding of how to study making, in ways that I will further describe in the rest of this chapter.

I first learned about makerspaces and the maker movement at the Cultural Rhetorics Conference at Michigan State in October 2014. At the time, I was co-writing (with my mentors Candice Rai and Kimberlee Gillis-Bridges) an application for funding to form an

interdisciplinary discussion group at our university to discuss multimodal composition across disciplines—and particularly to challenge a definition of "multimodal" that privileges digital and other "new" media by focusing on engaging bodies in a variety of modes and media, both old and new. Eager to learn more about how other programs were engaging interdisciplinarity and multimodality, I met with Dave Sheridan during the conference to talk about his implementation of multimodal pedagogy and the multiliteracy center he runs in MSU's Residential College of Arts and Humanities. When he described makerspaces to me—these collaborative spaces full of traditional and emergent fabrication tools—my immediate reaction was "what a perfect metaphor for our interdisciplinary group on multimodal composition!" On my way home from the conference, I searched for makerspaces in Seattle and discovered the website for SoDo Makerspace. Inspired by the language on their website (at the time) emphasizing collaboration and community engagement, I wrote makerspaces into our application as a metaphor for our interdisciplinary collaboration and our work to engage multiple modes and media—old and new—for composing.

Our project was not funded, but I was still fascinated by the idea of makerspaces. I first visited SoDo MakerSpace (SMS) in February 2015 on a Saturday, during an open tour advertised on the website. When I arrived and met Eric Renn, the founder of the makerspace, I was caught off-guard by his first question: "So, what do you want to make?" I didn't know what to say at first, and eventually I managed to say something about writing and research. After the tour, I left dazzled by all the machines and objects I'd seen and determined to learn more, but I was especially preoccupied with Eric's question, which he asked of everyone who showed up for the tour. After all, that question resonates with questions that teachers and researchers in rhetoric and writing studies have been asking for a long time. As I read more about makerspaces and spent

more time in SoDo MakerSpace (SMS), I learned that the question, "what are you making?" is something of a mantra in the fast-growing international maker movement, which claims among its goals an aim to democratize innovation by making "makers" of people who might not otherwise have the training, access to technologies and tools, or inspiration (Hatch, 2014). And because I had just finished reading Karen Barad's *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, I was eager to explore the ways in which acts of making (3D objects, bodies, systems, and discourse) were also acts of mattering (in the material-discursive sense Barad puts forth).

Figure 1. Eric Renn, founder of SoDo MakerSpace. Photo by Daniel McNair.

With the encouragement of my dissertation director, Anis Bawarshi, I began conceptualizing a possible dissertation study with SMS as my primary field site, and quickly makerspaces became less a *metaphor* for multimodality and interdisciplinarity (or, more accurately, transdisciplinarity, in the sense I described in Chapter One) and more a fruitful site for studying and enacting making and transdisciplinarity in a way that can reshape how we think about, study, teach, and do writing and rhetoric. Indeed, I found that a makerspace setting demanded that I attend to acts of making and boundary marking that include bodies, machines, knowledge, rhetoric, writing, space, networks, and objects. And as interest in making and, specifically, makerspaces grows in rhetoric, writing studies, the digital humanities, and PTC—evidenced in the work of scholars like David Sheridan (2010), John Sherrill (2015), Jentery Sayers (2015), and Sarah Fox, Rachel Ulgado, and Daniela Rosner (2015), interest in makerspaces is also growing in other academic disciplines—including business (Wang et al., 2015; Lindtner & Li, 2012), education (Sheridan et al., 2014), library science (Clark, 2014)—and universities (including my own) are increasingly making their own makerspaces on campus (CoMotion Makerspace).

In light of this interest, it is important to investigate *what matters*—both in a physical sense of bodies, objects, and actions, and in a semiotic sense of who and what count as makers and making—in the phenomenon we are importing into our classrooms, writing centers, libraries, and universities—particularly when, by its own account—and despite efforts to the contrary from some within the movement—the maker movement skews heavily toward college-educated, male-identified people with a median household income of more than $100,000 (Maker Media, 2015). When I first asked Eric for permission to study the space in March 2015, I told him a) that I was developing a potential dissertation project on the relationships among

writing, rhetoric, and (3D) making; b) that I planned to use ethnographic methods, including interviews, textual and physical artifact collection, and observation (with a heavy emphasis on the latter, particularly at first); and c) that I wanted to be useful to SMS by helping, if help was needed, with communication and by documenting and sharing the unfolding history of SMS. (I describe the ethnographic traditions in which this project is situated later in this chapter.) I spent much of my first few months in the space learning the history of SMS (which had opened its doors in September 2014), learning the people and projects of SMS, and learning to understand and even use the entirely unfamiliar (to me) fabrication technologies in SMS.

Founded by self-described "serial entrepreneur" Eric Renn in 2014, SMS is located in Seattle's industrial SoDo neighborhood, near the Stadium District. The physical hub is in two warehouse spaces on Occidental Avenue, though Eric and the co-founders of the makerspace are also exploring partnerships to share additional spaces nearby in SoDo and in Kent. Currently, the main space, known as the Community Classroom, is a 2,000 ft^2 open warehouse space that is full of machines, tools, art, materials, and projects (most unfinished). The appearance of the space changes almost weekly, as do at least some of the people and projects in the space. Currently, the space is anchored by its fabrication technologies: a suite of 3D printers, a laser cutter, a soft goods lab with industrial sewing machines, a small electronics lab, mini-CNC (computer-numerical control) routers, a collection of tools, and a collection of refurbished computers. (A large CNC mill and other woodworking and metalworking tools are housed in a warehouse space across the street from the Community Classroom.) There is a small hydroponics system with basil and other herbs, which replaced (in 2016) a larger system that was installed (in 2015) after the 3D printers moved away from the entrance (see Figure 3) to the wall by the laser cutter. On the wall opposite the 3D printers and laser cutter, there are whiteboards that are sometimes

completely covered in writing and drawings, and sometimes almost completely blank. Near these whiteboards are two adjacent tables where people meet, work, play games, teach, and learn, though these may eventually be replaced with modular desks that can be separated into individual stations for co-working (a revenue source that Eric is exploring) or joined together for a conference-style table.

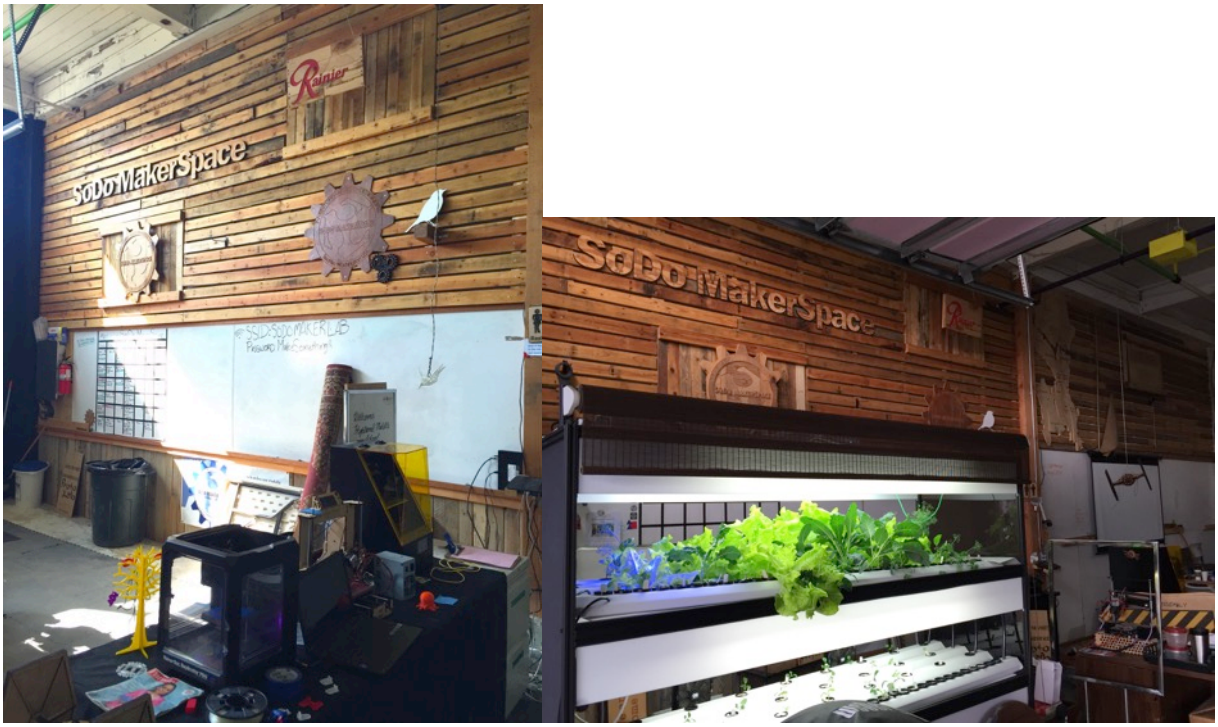


Figure 2. Entryway in May 2015 (left) and in November 2015 (right).

Toward the back are the workstations of the people (all but one of whom, as of 2016, are men, and all but two of whom are white) who have invested in the space and are part of its regular operations. These people frequently teach certification classes on the various machines in the space and offer workshops on techniques ranging from small electronics to laser cutting and CNC milling (both sources of revenue), and once people are certified on a machine, they can pay for time on that machine for their own projects, or (as is often the case), they partner with the makerspace to exchange time on machines for help with maintaining the space or a cut of their

profits on what they make. One of the founders, Jon Madamba, manages the educational and community-focused mission of SMS, which focuses particularly on at-risk youth and children from underserved communities in the Seattle area, which is funded by the makerspace's for-profit endeavors. (I have noticed an increasing tension between the for-profit endeavors and the outreach mission as the makerspace works to expand its revenue sources.) Eric also teaches before-school classes in electronics, robotics, and fabrication at his son's school in West Seattle.

Eric and his colleagues have welcomed my presence in the space as a researcher and as someone who is interested in learning more about fabrication technologies, and they ask for my help from time to time with written communications intended for audiences outside the makerspace. I plan to contribute my accounts of making in SMS to Eric and his colleagues, and I am also committed to being useful (Grabill, 2013) by producing models from my data that help not only researchers and teachers but also the maker community understand, practice, and teach making (both with words and with 3D materials).

Research Questions

As I discuss in Chapter One, as a researcher and as a teacher, I am interested in the boundary marking practices by which some practices count as "writing," "rhetoric," or "making," and others do not, and the practices by which some bodies count as "writers," "rhetors," or "makers," and others do not. Such boundary marking processes have long been the concern of scholars in decolonial rhetorics (Haas, 2007; Powell, 2012) and feminist rhetorics (Crowley, 1999; Hallenbeck, 2011), and questions of what counts as writing and who counts as writer are also central to work in multimodal composition (Selfe, 2009; Sheridan, 2010; Wysocki, 2012) and in technical communication (Mara & Hawk, 2009; McNely, Spinuzzi, & Teston, 2015; Slattery, 2005). Boundary marks are not static; they are dynamic and contested,

which is precisely what makes them a rhetorical concern. The ongoing marking and re-marking of the boundaries of what and who count is a central concern in my research on SMS. How do we account for boundary-marking practices in a space where objects, machines, and makers are continually being made and re-made; where (at least for most of my fieldwork) most of the regular makers are men, despite the group's commitment to being an inclusive space; and where much of the rhetorical work is not confined to written or spoken words or even to humans?

As I wrote in a blog post for the Digital Rhetoric Collaborative, over the last year, I've watched SMS, which had only been officially open a few months when I first visited, grow and evolve. I've learned the stories of the makers, machines, and projects in SMS, and I've experienced the exhilaration of "going from idea to object"—as Eric describes the process of iteration—using technologies I'd never imagined I'd use, like a laser cutter or a 3D printer. And these experiences have changed the way I think about writing and rhetoric, and about my own project. For example, practices of rapid prototyping I've observed and discussed with makerspace participants have given me useful ways to approach writing about my research in my dissertation.

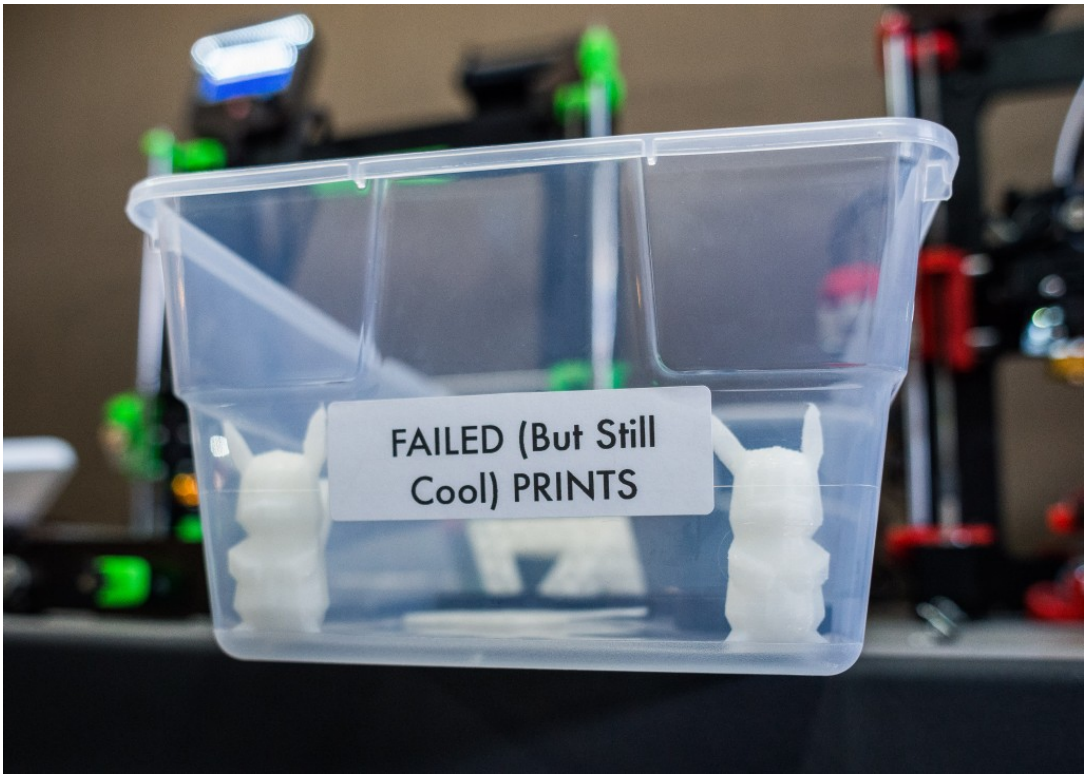


Figure 3. I've learned that failures can be useful, necessary, and even cool. Photo by Daniel McNair.

I have also seen my own thinking about the relationship of writing and rhetoric to other forms of making change. When I first began fieldwork, I was thinking about how makerspaces might inform or even transform how we teach and study writing and rhetoric. I wondered how studying the making and transfer of knowledge across 3D fabrication tools in a highly collaborative, creative space might help us better theorize and teach rhetorical dexterity as students compose across media, genres, and languages. I wondered how teaching 3D printing alongside alphabetic writing might help students transfer rhetorical skills across modalities and media. At the same time, as I have talked about my project with colleagues and mentors, I've been asked many times how and why studying a makerspace is relevant to composition. These were the initial questions with which I approached my dissertation research, and my work toward answering these questions has led me to more questions. These new questions are the questions that I considered as I wrote the data chapters:

- *How can we better study the entanglement of writing with other forms of making? How can we study the entangled and differential processes by which things like "human" and "maker" and "rhetoric" come to matter?*
- *What sites, in addition to makerspaces (which represent only certain kinds of making), can help us seek out and study that entanglement?*

Figure 4. (Literally entangled) 3D printer filament waste being sorted for recycling. Photo by Daniel McNair.

One thing I've been struck by, in my conversations with people in SMS and in my research on conversations in the maker movement, is the tension between goals to democratize access to fabrication technologies and the reality that SMS, like the maker movement, tends to skew male and white (Maker Media's own research on maker faire participants confirms this). Eric and his colleagues at SMS are aware of this issue and have expressed from the beginning a commitment to making the space inclusive for women and people of color. Clarissa San Diego, a co-founder of SMS and an international community strategist specializing in growth hacking and community management for hardware, IoT, and maker industries, is passionate about diversity in

tech. She believes the lack of diversity in hardware—including the 3D fabrication technologies associated with the maker movement—is an issue of environment, of "seeing someone like you." (Sylvia Martinez [2015] made a similar observation.)

While Clarissa and her colleagues engage in the work of advocating for more diversity, others, such as Debbie Chachra (2015) and Amy Nguyen (2015), have pointed out that the privileging of the kinds of making associated with the maker movement and the tech industry in general is a gendered privileging of traditionally male practices. And as Sarah Fox, Rachel Rose Ulgado, and Daniela Rosner (2015) have observed, feminist hackerspaces are emerging to provide alternatives to male-dominated hackerspace environments. Furthermore, as Kate Losse (2016) has noted, "failing fast" and "failing upward" are entangled with privilege: especially being white, male, and connected to capital. This suggests to me that as we consider the exciting and expansive possibilities of exploring 3D fabrication in relation to writing, we should also consider the ways in which these technologies and the practices and values surrounding them are not neutral. This has led me to ask questions like

- *What and who matter, and what and who are excluded from mattering by the environments created around technologies of making?*
- *If increasing access to technologies of making is our goal, then how can we achieve the critical and transformative levels of access—beyond simply providing material access—that Adam Banks (2006) argued is necessary?*

Thus, I came to realize that while my dissertation has always been, in a general sense, about the relationships among writing, rhetoric, making, and mattering, the answers to and embodiments of these questions have emerged (have been marked and remarked) over the course of a year. Thus, the primary contribution of this project has become the theoretical-methodological apparatus for

studying dynamic, ongoing boundary marking practices—what and who matters (in a physical and in a discursive/semiotic sense) and what and who is excluded from mattering in acts of making, including acts of making knowledge about making.

Ethnography and Genealogies of Mattering

First, I want to clarify what I mean by "methodology." As Martin Hammersley (2011) observes, methodology can refer to techniques, philosophies, or a researcher's autobiography of approaches. Rather than seeing these as separate categories, my understanding of methodologies entangles all three, and while I also see methodology and methods as entangled, I think of methodology as the orientation to epistemology and ontology that constitutes and is constituted by the research approach. The theoretical-methodological apparatus of cultural rhetorics, new materialist rhetorics, and materiality in writing (particularly in multimodal and digital rhetorics) I have described in Chapter One and in this chapter—specifically, a genealogical, diffractive approach—is thus entangled with how I study boundary marking—what matters and what is excluded from mattering—in acts of making.

In this way, I am following scholars in cultural rhetorics like Jennifer Sano-Franchini (2015) and Malea Powell (2012), who attend to genealogies of boundary markings, and scholars like Sharon Stevens (2004) and Katrina Powell and Pamela Takayoshi (2012), who advocate for diffractive approaches to studying mattering. I also draw on (overlapping) traditions of critical/reflective and rhetorical ethnography (Herndl, 1991; Cintrón, 1997; Rai, 2016; Stevens, 2004), workplace ethnography (Winsor, 2003; Clark, 2007), and activist/participatory research (Blythe, 2012; Faber, 2002; Grabill, 2013; Gonzales and Zantjler, 2015; Walton, Zraly, and Mugengana, 2015), as well as feminist approaches to material ethnography (Fernandes, 1997) new materialist ethnography (Schadler, 2014), and rhetorical criticism (Schell and Rawson,

2010; Ratcliffe, 2005). While—as I discuss in Chapter Six—I believe that a diffractive, genealogical approach can be implemented in a range of research methods, teaching methods, and practical actions, I also agree with Candice Rai (2016), who argues that ethnography is "an ideal method not only for studying what rhetoric means but also what it does and how, as Carole Blair puts it" (p. 8). In my case, ethnographic methods were ideal for studying and learning to navigate an unfamiliar space, as I worked to trace ever-unfolding acts of making and mattering (including rhetoric).

Thus, I developed this project as a qualitative, ethnographically-informed case study of acts of (material-rhetorical) making in SoDo Makerspace in Seattle. Like Michael Williams and Brian Huot (2012), I have reservations about the usefulness of binaries like qualitative/quantitative. I use "qualitative" somewhat reluctantly, because of what it excludes from mattering, but in order to acknowledge a genealogy of qualitative researchers (see Creswell, 2007; Denzin and Lincoln, 2005; Hammersley, 2011; Lindloff, 1995; Seidman, 2013; Troman and Jeffrey, 2007; Miles, Huberman, and Saldaña, 2014). Similarly, I am somewhat reluctant to use "case study," since, as Robert Stake (2005) has observed, the very definition of "case study" is contested, and in some ways, my project stretches the definitions Stake puts forth, particularly regarding boundaries. I see "case" more as a useful way to describe an ongoing, iterative process of "bounding off" a study site and scope than as a way to describe a decision made at the beginning of a project. The making of a case—in the sense of a data case, and in the sense of a theoretical-methodological case—is the entangled work of an apparatus, which is itself entangled in the phenomenon it purports to measure or study. In this project, the case-making includes both the ongoing making and remaking of SMS itself—as a physical space, a digital community, and a network of human and nonhuman relations and activities—and the ongoing

making and remaking of SMS-as-case in my fieldwork, analysis, and writing. Accounting for the making of the case itself and for the making of knowledge as part of accounting for acts of making is a key methodological contribution of this project.

Indeed, in my study of acts of making, the boundary marking *is* the phenomenon: how subjects and objects get marked as such, how a past, present, and future emerges in acts of (meaning) making. As Barad (2007) argues (and as Donna Haraway argued before her), just as bodies-in-the-making are not separate from their apparatuses of bodily production, the phenomena we research are not separate from our research apparatuses (the material-discursive arrangements, from concepts to equipment). Similarly, Gabriel Raquel Ríos (2014) argues that, contra Nedra Reynolds' (mis)reading of Gloria Anzaldúa, space itself is entangled differently with different bodies: "Borderlands are not spaces of possibility inherently, nor are they spaces that function in the same way for *everyone* who inhabits them. Borderland culture emerges out of particular embodied relationships to particular histories of particular land bases" (p. 82). Thus, despite the name "makerspace," neither *space* (physical and relational) nor *maker* (more-or-less human and nonhuman) is a given—for me as a researcher, or for the bodies and things in and around the makerspace. My work, then, is to account for the making and marking of spaces and makers, objects and rhetorics, knowledge, my own embodiment, and the study itself.

Data Collection: Fieldwork

My first visit to SMS was in February 2015, and my first visit in a researcher capacity was in March 2015. From March 2015 until June 2016, I visited SMS as regularly as possible. My aspirational goal was to visit one day per week; the reality was that there were some months when that was possible and even some weeks when I could visit more than once, but there were also some months (particularly those involving travel for conferences or holidays) that I could

only visit once or twice. Still, I achieved my realistic goal, which was what Sarah Read (2011) calls a "low but steady level" of physical presence at SMS, which allowed me to "level the scope of my data collection at both the micro and macro levels without losing site of either one" (p. 46). After June 2016, my focus shifted more to collaborations, both with SMS cofounder Clarissa San Diego and with students in a maker-focused digital rhetorics course I taught in spring and fall of 2016. Both parts of my research—my fieldwork in SMS and my study of the digital rhetorics course—were examined and exempted by the Human Subjects Division at the University of Washington.

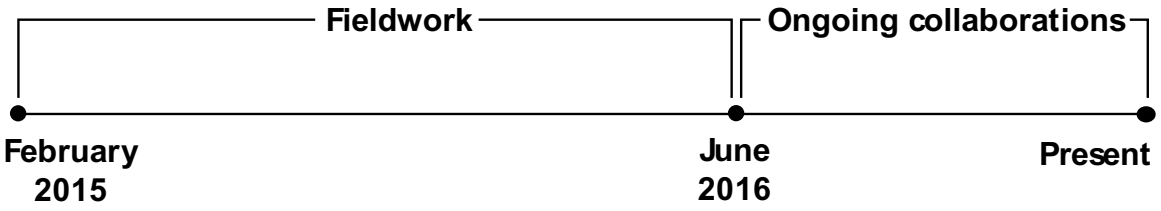


Figure 5. A timeline of my fieldwork in SMS (Chapters Three and Four) and ongoing collaborations with SMS cofounder Clarissa San Diego (Chapter Five) and students (Chapter Six).

Particularly in months when I was less physically present in SMS, I kept up with people and activities in the makerspace through social media (primarily Facebook and the SMS blog), the SMS Trello board (a web-based platform for organizing people and activities), the SMS Slack team, and through email correspondence with regulars (and former regulars) in SMS. Eric always began our face-to-face conversations by catching me up on what has happened in SMS since last I saw him, no matter how much time has passed. When I was physically present in SMS, I employed a specific method I developed for studying making (and mattering): 3D interviewing.

Data Collection and Analysis: 3D Interviewing

In this section, which is drawn from my article in *Kairos* (Shivers-McNair, 2017), I contextualize 3D interviewing in terms of my project and in qualitative research traditions in and beyond rhetoric and writing studies. I conclude by suggesting ways in which this method could be adapted for a variety of research sites and questions. As I have explained, a central concern of this project has been the question of how we account for boundary-marking practices in a space where objects, machines, and makers are continually being made and re-made; where (at least for most of my fieldwork) most of the regular makers are men, despite the group's commitment to being an inclusive space; and where much of the rhetorical work is not confined to written or spoken words or even to humans.

Clearly, focusing only on words would not give us the whole picture of the dynamic making and boundary-marking processes. Often, when people were talking to me or to each other, they were also engaged in various forms of 3D making, like 3D printing, laser cutting, sewing, or soldering. Inspired by the XYZ-axis movements of many of the machines in the space (including 3D printers), I began using the term "3D interviewing" (for which I am grateful to Anis Bawarshi) to help me describe my work to account for bodies, movements, spatial relations, and spoken and written words. But my initial focus on mostly human movements changed as I got to know the people and processes in the space; I eventually grew attuned as well to the movements and diffraction patterns of machines at work, the movements of constantly rearranged furniture, and the movements of rhetoric and ideas through networks beyond the space.

And I quickly came to realize that for all the bodies, machines, goals, and rhetorics that seemed to be moving and becoming in the space, there were also bodies, machines, goals, and

rhetorics that were not moving or becoming, or even present. Furthermore, there were times when a story I was tracing seemed to be not moving, or moving backward relative to other movements and marks in the space. However, when I zoom out to the view from a year's time, I can see that movement differently. And, crucially, the tracing of these stories and movements is not a linear process: my own understandings changed, so with every change in my own understanding and the understandings I shared with my participants, new past, present and future stories emerged. In other words, I needed to account not only for the marking of boundaries in the makerspace, but also for the changing research apparatus that accounts for and participates in those boundary marks.

Therefore, attending to these boundary marking processes demands a three-dimensional account of rhetorical work—in words, objects, movements, bodies, and images. By "three-dimensional," I mean several things:

- XYZ coordinates in Euclidean space.
- Triangulation, particularly in the sense described by Norman Denzin (1970), which, as Paul Atkinson and Sara Delamont (2005) explain, is more than simply mixing methods and sources: it is a methodological move that recognizes multiple and simultaneous frames and modes (semiotic, embodied, social, material) through which phenomena emerge. Time (a fourth dimension) is also crucial to a multidimensional account of boundary-marking, because boundary-marking practices are dynamic and ongoing as well as localized.
- An attempt to go beyond the think-aloud protocol and resist an impulse to rely on language as the sole or even primary representation or maker of reality. This means

taking the act of making and what is made as seriously as what someone says about the act and product of making.

- Collapsing material-temporal distinctions among "interview," "observation," and "participation" (as well as "observation of participation") and, instead, focusing on acts of making as they unfold. This includes the making of knowledge and the making of the research itself, as well as the marking of boundaries such as "subject," "object," "making," "maker," and "space."

To be clear, I am not starting with the assumption of a Latourian parity between, for example, 3D printers and people, nor do I ignore what people say or write in favor of movements or objects. Instead, I use the 3D interview apparatus to help me account for the practices by which boundaries are marked and by which rhetorics, objects, and bodies are made. In my study, this looks like observing and interacting with people and machines as they engage in acts of making, also holding space for absent bodies and foreclosed possibilities. This sometimes takes me outside the physical space to interact, for example, with women who were once involved but had left the space. It also looks like accounting for my own involvement in and changing relationship to the space. To this end, I use a body-worn or hand-held digital camera that documents not only what I see and hear, but also the direction of my attention and my own body movements, as I explain below.

3D Interviews as Method

Just as David Sheridan (2010) built on a rich tradition of visual rhetoric to make a case for the practice of attending to and teaching 3D rhetoric, I draw on a tradition of visual research methods in rhetoric and writing studies (Brumberger, 2005; McKee & DeVoss, 2007; McNely, Gestwicki, Gelms, & Burke, 2013; Hawisher, Selfe, Berry, & Skjulstad, 2012) in my use of

digital video and photography (in addition to hand-drawn sketches and handwritten and typed notes) in 3D interviews. In addition to these digital methods—in the (contemporary) sense of "digital," as a reference to new media and technologies, and also in the (literal) sense of "digital" as a reference to an older technology, namely fingers (Haas, 2007; Eyman, 2015)—I also account for physical artifacts and embodied memories, as well as theoretical and methodological frameworks, as part of the specific 3D interviewing apparatus.

My approach to 3D interviews draw on a tradition of phenomenological qualitative interviewing (Van Manen, 1990; Seidman, 2013) and share elements of ethnographic field interviews (in that they draw on the relationships and knowledge I have built over time), think-aloud protocols (in that participants sometimes describe or comment on what they are doing without my prompting), and artifact-based interviews (in that many of the conversations are prompted by physical artifacts). 3D interviews also collapse material-temporal distinctions between interviewing and participant observations (and observations of participation, for that matter). In my research project, this looks like observing and interacting with people and machines as they engage in acts of material-discursive making. While my observations and interactions are certainly guided by my research questions—which include attending to the ways in which the technologies and making practices in a makerspace make some kinds of making and bodies matter more than others (Shivers-McNair, 2016)—as well as what I have learned in the makerspace over time, I typically do not prepare a structured interview protocol, instead letting the acts of making themselves and the participants shape the questions I ask.

3D interviews (which might more precisely be described as 3D intra-actions, in the sense Barad describes) are 3D in the sense that they attend to and diffract words, gestures, sounds, bodies, things, movements, space, and relations. Unlike a reflective methodology which proceeds

from an assumption of sameness (however mediated by mirrors—like elicitation in a traditional interviewing approach), 3D interviewing proceeds from a diffractive methodology that assumes differences are marked and made in interactions. Thus, accounts are not elicited but made in researcher-participant interactions. And rather than treating languages, gestures, sounds, words, humans (including the researcher), and nonhumans as pre-existing entities to triangulate or analyze *against* each other, I treat languages, gestures, sounds, words, and bodies as *marked* in interactions, and I analyze them *through* each other. Indeed, 3D interviews are also 3D in the sense that they draw attention to the dimensionality of the research(er) apparatus as entangled in the phenomenon. By this I mean not only the theoretical methodological apparatus, but also the material-discursive embodiment of the researcher, which includes spatial relations—the ways I position myself physically in the space and discursively in what I write, say, and make about the research, the researcher's material-discursive spatial relations—as well as the making and remaking of a researcher body that responds, acts, knows, recognizes, feels, remembers, and engages other bodies (human and nonhuman).

Consider, for example, a moment in my fieldwork in December 2015, when I observed Richard, one of the co-founders of the makerspace, using the laser cutter to make a dress form for displaying his cosplay creations (see Figure 6). The laser beam was moving toward a part of the plywood sheet that was warped, and because the machine is calibrated in a way that assumes the material is lying flat on the cutting bed, Richard used his fingers to press the warped edge of the plywood flat as the laser beam passed by.

Figure 6. A still from a video recorded 3D interview of Richard operating a laser cutter in a makerspace. Video URL: http://praxis.technorhetoric.net/tiki-index.php?page=PraxisWiki:_:3D%20Interviewing. See Appendix One for a transcript.

There are multiple layers of boundary marking at play here, and many of them exceed the verbal interaction Richard and I had as he worked. On the one hand, there are dimensions to this interaction that would be difficult to capture in words alone and are highlighted in the video, such as the sound of the laser cutter, the tone of our voices, the nuances of Richard's posture and movements, and my own placement and gaze in the interaction. On the other hand, there are dimensions to this interaction that could not be captured in the video. While Richard reminded me to "do as I say, not as I do," I realized that Richard's experiences operating the laser cutter for more than a year had given him a keen sense of how the machine worked, of the problems that would occur when the laser passed over warped material, and of spatial relations like the airflow space at the front of the machine (just wide enough for fingers) and where the laser beam moves (along the toolpath he had specified in the driver). Since Richard's expertise is acknowledged by his colleagues, no one else in the space reacted to Richard's risky move. In standard machine

certification trainings, however, people are told not to put their hands in the machine (indeed, even looking directly at the laser beam can damage one's eyes). In other words, what is *not* said in the video (no one, including me, tells Richard to stop or be careful) matters, just as the fact that he easily accomplishes his goal of flattening the board without being injured matters. The mark of a maker is not only the embodied, proprioceptive knowledge of machine movements, but also the shared recognition of one's expertise.

But there is another important boundary marking: my own involvement in the interaction. When I first began researching the makerspace, I was unfamiliar with the fabrication technologies in the space: I had never seen, much less operated, a laser cutter, 3D printer, or computer-numerical control (CNC) milling machine. I spent the first several months of my fieldwork learning to understand and communicate not only with the people in the space, but also with the machines. This moment with Richard happened nearly nine months into my fieldwork, by which point I had an understanding both of Richard and of the laser cutter. What the camera does not show is that as Richard put his hands in the machine, my eyes widened, because I knew the risk involved. But because I knew his ethos as a maker, I expressed my surprise as a joke ("Living on the edge!" as opposed to "What are you doing?!"). In other words, my own prior embodied experiences with the laser cutter and interacting with people in the space made it possible for me to know that Richard's maneuver was both risky and significant, and thus to comment on it. To account for these boundary markings in this interaction, I diffracted our verbal interactions, our gestures and movements, the marking (and re-marking) of our bodies in interaction with machines (laser cutter and video camera), and what was *not* said or done: I considered these elements together and traced the differences that came to matter.

3D Interviewing Techniques and Tools

While my observations and interactions are certainly guided by my research questions and commitments, as well as what I have learned in the makerspace over time, I typically do not prepare a structured interview protocol, instead letting the acts of making themselves and the participants shape the questions I ask. Because the majority of my 3D interviewing happened in SMS, I attended to and was guided by acts of making as they unfolded and as I experienced them. Often people explained terms, actions, or processes to me without my prompting, but I also asked questions, particularly when I did not understand something happening or being referenced. And as I got further into the construction of the genealogies in Chapters Three through Five, I occasionally brought up questions from my analysis, observations I had made, or conclusions I was beginning to draw with people involved in the genealogy as a way of conducting participant checks (Spinuzzi, 2015).

I did, however, conduct some more traditional interviews with participants who were no longer involved in the daily operations of SMS. I met with one participant, who was also a student at my university, on our university campus to ask her about her experiences at SMS and to check (or more precisely, diffract) some of my observations and conclusions with her sense of SMS. I also conducted periodic interviews over Skype and carried out conversations over Facebook Messenger and in person with Clarissa San Diego, a co-founder of SMS who was based in San Francisco for much of my fieldwork period but who has since returned to Seattle. I began by taking a similar approach to the interviews as I had with the student participant, but from these conversations a collaboration emerged (which I describe in Chapter Five).

Most of my 3D interviews in SMS were conducted without video or audio recording, for several reasons: first, many of the projects and designs in the makerspace are proprietary in

nature, and the people working on them often ask that these projects and designs, as well as some conversations about them, not be video, audio, or photo-recorded or described in detail. Furthermore, when clients (many of whom are one-time or occasional visitors to the space) are in the makerspace and have not had a chance to learn about why I am recording and make an informed decision about whether or not to be recorded, I do not record out of respect for their privacy (and in an effort to avoid potentially making clients uncomfortable, thus interfering in the work of SMS). In fact, I rarely used video in the first several months of my fieldwork, as I worked to build relationships and trust and to understand the machines and projects in SMS. And despite the fact that I have used video recording frequently, people do still sometimes behave differently when a camera is rolling, so I make sure on each field visit to use a range of recording techniques for 3D interviewing: including handwritten notes, hand-drawn sketches, photographs, embodied memories/actions/motions, and collected artifacts, as well as video recordings.

Still, I find that video recordings can be useful for orienting others—particularly those not familiar with SMS or with makerspaces—to the multidimensionality of the acts of making I study (and my own dimensionality as a researcher). In this way, I do not assume that my video camera is capturing a naturally-occurring reality but rather that its physical presence and my selections (when to switch on and off, whether to select a wide or narrow angle, where to aim the camera, what to get in the frame) are actively shaping and reshaping the research apparatus, including what people say and do, as well as what gets presented to audiences of my work. And while I do my best to keep the camera steady, attend to lighting, and frame shots in ways that are legible, I do not see myself as a documentary or anthropological filmmaker. While digital video is important to my work of 3D interviewing (both in terms of data collection and data representation and visualization), I am one researcher, working without a budget for a film crew

or extensive equipment. My approach to 3D interviewing with digital video is responsive to those material facts. And because I am researching a space with large machines and constant movement, a stationary camera on a tripod is not a viable option, so I either hold or wear a small digital video camera as I move around the space and interact with participants.

I do draw on moving-camera techniques from sensory anthropology and mobile ethnography, like walking with video (Pink, 2015) and mobile headcam video (Brown & Spinney, 2010; Laurier, 2014; Simpson, 2014), and from mobile video in literacy sponsorship research (Halbritter & Lindquist, 2012). Specifically, I use a GoPro video camera that shoots at 1080 pixels and 30 frames per second, set on the "SuperView" field of view (FOV) setting. According to the manufacturer, the wide FOV has a focal length equivalent of 14mm, and the SuperView mode dynamically stretches the 4:3 aspect ratio to 16:9. The wide angle allows me to stand close enough to participants and machines to see and hear (and let the camera see and hear) what they are doing and saying while still capturing large machines and a sense of the action in relation to the larger space in the video frame, as in the case I discussed above of my 3D interview with Richard operating a laser cutter (see Figure 6).

In Figure 7, for example, the wide angle allows me to capture not only the entire 3D printing station, but also the gestures of the participants as one of them (Alex) trained the other (Tony) in 3D printing techniques. Those gestures were important in my analysis, as they exemplified a case of a human (re-)translating machine gestures, which are themselves a translation of human instructions to the machine. Similarly, in Figure 8, the wide angle allows me to capture Tony's posture in relation to and his interactions with the 3D printer as he observed it working, and it also captured my field notebook, serving to situate my position in the interaction, both physically in proximity to Tony and the 3D printer and relationally in my role

as a researcher. Furthermore, the wide angle also works well for relatively low-light filming, allowing maximum available light into the camera (in my case, there is little natural light and only overhead fluorescent lights).

Figure 7. A still from a video recorded 3D interview of Alex teaching Tony about 3D printer settings. Video URL: http://praxis.technorhetoric.net/tiki-index.php?page=PraxisWiki:_:3D%20Interviewing. See Appendix One for a transcript.

Figure 8. A still from a video recorded 3D interview of Tony engaged in 3D printing. Video URL: http://praxis.technorhetoric.net/tiki-index.php?page=PraxisWiki:_:3D%20Interviewing. See Appendix One for a transcript.

I shot the videos in Figures 4 and 6 with the camera mounted on my head (via adjustable elastic straps), which left my hands free to take notes. As Brown and Spinney (2010) note, the head-mounted camera does not exactly approximate my eye movements, and because the camera is often positioned just over my eyes, the participants are looking just below the camera to make eye contact with me. The camera does, however, move with my head when I nod (at the end of the clip in Figure 4), lean in to look closely at a machine (at the beginning of the clip in Figure 6), or look down at my field notebook to take notes (at the end of the clip in Figure 6). I do not always wear the camera on my head, though; I shot the video in Figure 5 with the camera in my hands, at chest-level. While the camera's records of my own body movements can be somewhat visually jarring, I value them as a reminder of my relationship to the phenomena I'm recording.

I have found that the logistics of researcher-held (or worn) video change how I see and what I focus on in ways that enact and enrich my orientation to bodies and the making of knowledge. For example, because my participants and I are often in motion, I cannot put

microphones on people (as I would in a seated or stationary interview), and as a result, people's voices compete with machine noise and other voices and sounds on camera, as in my own embodied experience of sometime straining to hear or being unable to hear every word spoken. In this way, the camera-researcher apparatus dislodges the primacy of spoken words in my 3D interviewing in a way that draws attention to other ways of making meaning and other ways of bodily production. After all as Tony (Figures 5 and 6) once said to me, "sometimes you don't have to *say* so much as *show*." Furthermore, the point of view of the camera-researcher is a constant reminder of the researcher's and the camera's participation in the making of knowledge. Rather than making the researcher or the camera seem less entangled, it emphasizes just how entangled the apparatus is in the phenomena I study. Sometimes the footage can be downright dizzying to watch—when I'm wearing the camera on my head and nodding, or when I turn quickly—but the point is not necessarily ethnographic or documentary filmmaking, but rather, a way of attending to embodiment, including the researcher's embodiment, that can be coded or otherwise accounted for in the data analysis.

It is important to note, as Laurier (2014) reminds us, that even the best and most immersive-seeming video set-ups cannot capture everything and are not a substitute for imagination and verbal description. Instead, I see the video recordings as part of the research(er) apparatus, a way of attending to movements and gestures and space along with voices and sounds, and a complement to other recording techniques. Just as the camera-researcher apparatus encourages me to diffract words, sounds, gestures, and spatial relations, the multiple methods of recording 3D interviews encourage me to diffract different ways of knowledge making. I also use hand-drawn sketches and handwritten notes, photos and video recorded with my iPhone, photos recorded with a DSLR camera, and my own embodied memories, particularly since video

recording is not always appropriate (when, for example, participants are discussing or modeling proprietary designs). Indeed, on my site visits, I carried equipment for these multiple methods of recording data:

- GoPro camera (with fully charged battery, a back-up SD card, and a cable to connect to my laptop)
- Head mount strap for GoPro
- Small tabletop tripod
- iPhone (fully charged and with plenty of space for videos and photos, and a lightning cable to connect to my laptop)
- Laptop and power cord
- Field notebook and extra pencils
- DSLR camera (with 35 mm lens, fully charged battery, extra SD card, and a cable to connect to my laptop)

Just as the camera-researcher apparatus encourages me to diffract words, sounds, gestures, and spatial relations, the multiple methods of recording 3D interviews encouraged me to account for different ways of knowledge making. To conduct my analysis, I often began by editing video (in Adobe Premiere Pro), as the act of transcribing the interactions and adjusting sound levels attunes me to nuances and patterns in the interactions, as well as their connections with other events and themes. As I worked, I also consulted my handwritten and typed notes, as well as other photos and videos, looking for relationships and patterns. These relationships and patterns helped me construct both the video stories (the clips I produce) and the ethnographic stories into which those videos are woven.

Data Analysis and Write-Up: Making Genealogies

One of the challenges of this project was developing a method for analyzing, presenting, and discussing my research in a way that allowed me to do what Barad (2007) describes as "genealogical analyses not only of the multiple apparatuses of bodily production that come to matter but also of the changing nature of the dynamics itself" (p. 242). In other words, I needed a way to account for not only the existence and work of apparatuses but also their ever-changing dynamics—particularly in a study that spans more than year's time. After I defended my prospectus, I set out to prototype a genealogy of mattering. Before I spent time in a makerspace, I had never thought of writing as prototyping, but I was struck by how Alex Cheker, one of the regulars in SMS, described his making process in a conversation with his colleagues: "The most important thing [my mentor] taught me was that you build the first prototype fast and with whatever you have. You see if you can get it to work, and you learn from it. It's almost never going to work exactly the way you want anyway. Then, if it works, you spend time on version two." The first genealogy prototype began with the video in Figure 4, which featured in my prospectus (and in the conversation at my prospectus defense) and is now part of Chapter Two.

Why this particular moment? Why start with the moment of Richard's fingers' close encounter with a laser? Quite simply, this moment had been on my mind: initially because it was a surprising moment, but also because I had spent many hours with the video footage as I learned a new video editing program (Adobe Premiere Pro). I had first edited the clip as part of a methods-focused video designed to illustrate what a 3D interview looks like. Furthermore, talking about the video—and specifically the "mattering moments" in it—with my dissertation committee (Anis Bawarshi, Juan Guerra, Candice Rai, and Mark Zachry) got me thinking even more about the ways in which a laser passing near Richard's fingers mattered—for me, for him,

for the laser cutter, for an understanding of making. The significance of this particular cut is not that it reflects the most meaningful moment in SMS in some absolute sense, but rather, the significance is the genealogy that it brings forth. These stories could have been told in many different ways, and different things could have been included and excluded, and different things could come to matter. The point is that this moment was a way in, and I am accountable to it.

The process of moving forward, after receiving feedback from Anis, was less like revising (in the sense I am accustomed to) and more like disassembling a first-version prototype and sifting through the parts for what worked, what cut could be fixed, what was missing, and what could be set aside. From those components, I assembled two new prototypes (which eventually became Chapters Three and Four) and began to articulate a method for my genealogies. Rather than starting with a concept or theoretical frame and then selecting examples from my data to illustrate and support that concept or frame, I chose to start with a "mattering moment," a moment that mattered in both a physical sense (involving the making/remaking of objects, affect, bodies) and a discursive sense (involving the making/remaking of knowledge, recognition, theory). From there, I traced what Barad (2007) calls the "dynamics of mattering," which are nonlinear. As Barad explains (echoing theorists like Rosi Braidotti, Gilles Deleuze, and Felix Guattari), "the past matters and so does the future, but the past is never left behind, never finished once and for all, and the future is not what will come to be in an unfolding of the present moment; rather the past and future are enfolded participants in matter's iterative becoming" (p. 181).

Thus, the genealogies I construct are not meant to recount a sequence of linearly causal events that led to a moment in time; rather I mean, following Barad, that the "mattering moments" rework causality—making not only a present moment, but also a past and a future.

Anne Freadman (2002) similarly reworks causality in defining uptake as the "bidirectional relation that holds between genres." By "holding" genres together, uptakes enable meanings that are made possible from that set of relations. The seams between genres that uptakes weave make movements and translations between and across genres possible. Thus, mattering moments, like uptakes, weave seams between phenomena (or genres) and create possibilities for movements, translations, and connections across phenomena (or genres). As I illustrated in my discussion of interacting with Richard while he operated the laser cutter, when I inhabit and revisit a mattering moment, things I have heard and seen and learned that might have seemed unconnected or even inconsequential at the time come into sharp focus, and a future—possibilities for action, telling stories and asking more questions, and an emergent sense of the material-discursive practices and concepts—emerges.

In these genealogies, I trace shifting frames of mattering (a phrase for which I am indebted to Mark Zachry) as I explore pasts, presents, and futures that emerge and the changing apparatuses of bodily production. In other words, the frames of mattering (the stories, video, and images that comprise this genealogy) shift with changes in apparatus (what I, as a researcher, recognize and experience and learn) and changes in bodies (human and nonhuman). As Barad argues, the apparatuses—the theoretical-methodological framework, my embodiment as researcher, the genealogies—"produce differences that matter—they are boundary-marking practices that are formative of matter and meaning, productive of, and part of, the phenomena produced" (p. 146). Instead of attempting to reflect or reconstruct a pre-existing reality, I am actively engaging in what comes to matter and in what is excluded from mattering as I construct these genealogies. The stories and sections of the genealogies are the diffraction patterns, the differences that matter, that emerge from my entangled intra-actions with people, machines,

things, ideas, economies, and networks in SMS and my entangled intra-actions with theorizing, studying, practicing, and teaching writing, rhetoric, and other forms of making.

My aim is to account for these entanglements and boundary markings through which makers, meanings, things, relations, and knowledges are continually made and remade in acts of making (including the making of this study), because this multidimensional accountability is needed in order to more fully understand acts of making and to account for what is implied in Eric's question: "What do you want to make?" As I emphasize in my articulation of 3D interviewing, to answer that question, we also have to answer other questions to account for boundary marks: Who and what are makers (and who and what aren't)? How, what, and why do makers make (and not make)? What gets made (and what doesn't)? What counts as making (and what doesn't)? How do researchers' and participants' interactions and experiences shape what gets made (and what doesn't get made), including the making of research knowledge? How do these things change over time and in different interactions? It is impossible to fully account for these ongoing, dynamic complexities, but the genealogies in Chapters Three through Six take up this challenge of multidimensional accountability to illustrate the possibilities for this methodological approach, not only in and beyond SMS but also in a pedagogical space that takes up (and also interrogates) the practices of the maker movement.

Chapter 3. SPATIAL MANIPULATIONS

Figure 1. Still image from a video of a 3D printed spatial manipulation toy. Video URL: https://www.youtube.com/watch?v=7tzV5zMIO8w

I never know exactly what I will find when I open the gray metal door to the main space of SMS. On this particular Friday in February 2016, things seemed fairly routine: Alex Cheker—known in the space as the 3D printer genius—sat where he often sits, at a conference table in the middle of the space, working on his laptop, and Tony Loiseleur and his friend (also named Alex) talked at Tony's desk (which was—just for this week—located in front of the 3D printer rack). Richard Albritton worked at his desk toward the back, and Jon Lenoff and another man I did not recognize were at the CNC mill. I greeted Alex C. as I headed toward Tony, whom I'd been hoping to talk to about his work in the space. Tony greeted me and introduced me to his friend, and then to my surprise, he said, "OK, put down your notebook."

I blinked. "What?"

"No, really, you can do it!" Tony teased, "Set it down right here." He pointed to a spot on his desk.

"Okay," I said, still unsure what was going on.

"Here, hold this." Tony put a small white plastic object that appeared to be comprised of small, interconnected discs in my hands.

"What is it?" I asked.

"Just try turning it inside out," he said. And I did, and suddenly I was hooked—because the toy turns inside out infinitely (as demonstrated in the video above). I was delighted at first by the surprise of it and then by the act of turning it inside out over and over. That surprise and delight registered on my face, to which Tony responded, "Pretty great, huh?"

This wasn't the first time I'd encountered a surprising 3D-printed object in the SMS: I've held a prosthetic hand, a collapsible bird house, and a plastic vase that looked like glass—just to name a few. But the endless inside-out motion of manipulating this object was weirdly addicting, more so than anything else I'd encountered. I reluctantly set it down, eventually, to put on my head-mounted camera and pick up my notebook. I asked Tony again what the thing was called, and he demurred again. "I don't know; I'm not sure if it has a name. I just found it on Thingiverse." (Thingiverse is a website run by MakerBot, a mass-market manufacturer of 3D printers, where people upload and download open-source stereo lithographic [.stl] files for 3D printing.) Concerned about how I would describe this object in writing, I pressed, "What was the file named on Thingiverse?" He didn't remember—and he didn't think it mattered for introducing the object to people. After all, as he said when he described sharing the object with his wife, "you don't have to *say* [what it is] so much as just *show*." Later that day, when Tony started making another of these objects, he found the Thingiverse file again and told me it was called a "spatial manipulation toy." This time, I observed his printing process from start to finish,

and I left that evening with my very own spatial manipulation toy, which I played with nonstop on my walk and bus ride home.

This genealogy will account for the past-present-future made to matter in this experience as a way of accounting for the making of my research(er) apparatus in my study of SoDo Makerspace. In other words, my understanding of and participation in these intra-actions brings forth a past, a present, and future of entangled relations. Indeed, the spatial manipulation in this genealogy is not limited to the toy: this is an account of many spatial manipulations, from the making and remaking of bodies and machines in intra-action, to the making and remaking of the makerspace itself. Karen Barad has argued that mattering (as in these makings and remakings) is a dynamic cutting-together-apart of space, time, and matter, or "spacetimematter." As she explains in a 2012 interview with Adam Kleinman:

> A specific intra-action enacts an "agential cut" (in contrast to the Cartesian cut—an inherent distinction—between subject and object), enacting a separation between "subject" and "object" within the phenomenon. In particular, agential cuts enact a resolution *within* the phenomenon of some inherent ontological indeterminacies to the exclusion of others. That is, intra-actions enact "agential separability"—the condition of exteriority-within-phenomena. So it is not that there are no separations or differentiations, but that they only exist within relations. Putting the point another way, phenomena are differential patterns of "mattering"—diffraction patterns dispersed across differently entangled spaces and times, or rather *spacetimematterings*. (Kleinman & Barad, 2012, p. 77)

Thus, I have come to understand the spatial manipulations in this genealogy as reworkings of spacetimematter, as agential cuts by which things recognized as "makers," "ideas," "objects," and "space" are made, unmade, and remade in ongoing intra-action—including, importantly, the making of my research(er) apparatus. In other words, agential cuts are boundary markings that make certain bodies, meanings, and possibilities matter at the exclusion of others. The sections of this genealogy will trace what comes to matter and what is excluded from mattering in relatively micro spatial manipulations, like the weird appeal of this simple toy and the process of

going from idea to object, and in more "macro" spatial manipulations, like the making of makers and the ways in which makers (human and nonhuman) make space for themselves and their makings in SMS.

Tickling Our Animal Brains

The day after I observed Tony printing the spatial manipulation toy, I searched for and found the spatial manipulation toy file on Thingiverse myself. When I read through the comments on the posting (not unlike comments on recipes or other DIY instructions, comments on Thingiverse serve as a place for people to ask questions, discuss issues with the file, and make suggestions), I discovered that the file, which was posted in 2013, was inspired by the OSM Spatial Manipulation Toy on ThinkGeek (OSM stands for Object for Spatial Manipulation and is pronounced "awesome"). The tongue-in-cheek posting on ThinkGeek offers a gif of the toy in motion (without hands), proclaims the toy is "the new way of twiddling one's thumbs," and describes the toy as a "3D kaleidoscope."

The comments on the posting suggest the same sort of fascination I experienced: one commenter confessed to staring at the gif for five minutes, and another wrote "*Quirrel voice* What is this magic???" (The latter commenter is likely referring to Professor Quirinus Quirrell, a wizard in the *Harry Potter* series.) And indeed, the fascination seemed not to be limited to humans: in a section where people who bought the toy could post "action" photos of the product, a customer posted this image:

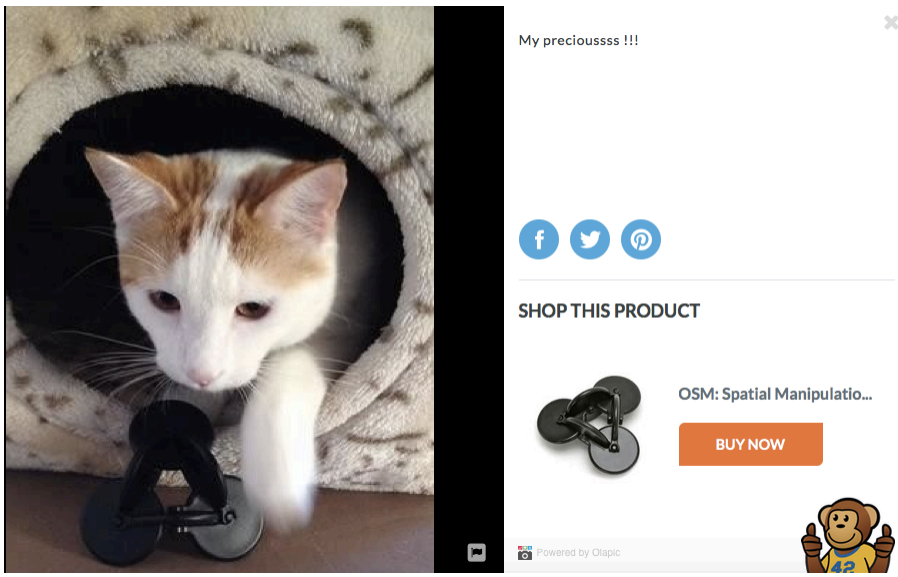


Figure 2. A customer photo of a cat playing with the OSM toy, with a caption "My preciousssss !!!" that references a line in The Lord of the Rings *film trilogy when the character Gollum refers to a ring he has become obsessed with.*

(The OSM toy is no longer available for sale on ThinkGeek or any other retail site I could find, leading me to wonder if the availability of a free file for 3D printing the toy had made the original toy no longer profitable.)

The following week, I confessed to Tony that when I was trying to write about the spatial manipulation toy, I wanted to play with it instead. “I don’t know what it is about [the toy], but it tickles some part of our animal brain,” Tony replied, noting that it had been a big hit all week with people in SMS “except maybe one dude.” I told him I’d also found myself playing with it while I paced around my apartment trying to sort out this genealogy in my mind. “Yeah, well, you know they say for writing: when you’re stuck, take a walk. This is just taking it to the next level,” he said. Perhaps this is why the toy continues to draw me in, even after the initial surprise of the kaleidoscope movement wore off: more so than any 3D printed object I’d encountered in SMS thus far (including my own attempt to print something on one of the MakerBot 3D printers), this one insinuated itself into my daily movements and altered my daily movements. I

even found myself thinking about taking the file to the makerspace on campus to print another spatial manipulation toy.

Consider the ever-evolving collection of 3D printed objects on display in SMS. When I first started visiting the space, these objects, along with the MakerBot printers, were on a table near the entrance. I found it was almost impossible to resist stopping to stare or pick something up as I passed by. Near the end of 2015, in an effort to keep the space more open, the 3D printers and the collection of 3D printed objects were moved to the wall beside the laser cutter. Now that they are less "in the way," though, I also find I notice them less. Still, a 3D printed prosthetic hand is fascinating to me, as are many of the objects on display (see Figure 3). But none of these objects had captivated me in the way this spatial manipulation toy did.

Figure 3. The collection of 3D printed objects includes vases, light bulb bases, a prosthetic hand, a Mad Max*-inspired bird skull, a collapsible bird house, a variety of chains and interlocking pieces, figurines, and machine parts (February 2016).*

As Richard explained to me once, the collection of objects (many of which he printed) is there to help people see what is possible to print. And knowing what is possible to print is certainly an important (and perhaps the first) step in learning how and what to print. But seeing

what other people have printed does not necessarily provide an answer to the question, "What do you want to make?" There seems to be more involved in the process of "going from idea to object" (as Eric puts it), as I will describe below.

For Tony, the spatial manipulation toy was just one step—however enthralling—in a process of learning Alex's 3D printers well enough to operate them independently and teach certification classes when Alex, who also works from home and from his own workshop, is not in SMS. And while this was Tony's first time to go from idea to object on Alex's 3D printers, he had printed objects on the MakerBot printers (which, until early 2016, were the only working 3D printers in SMS) and had also worked on the laser cutter and CNC. Alex's instructions to Tony were not to print a specific file, but rather to keep finding and printing things until he used up at least a spool of 3D printer filament. ("When you're done going through a spool or two, I'll show you the advanced stuff," Alex told him, as they prepared the second spatial manipulation toy file for printing.) While this idea-to-object was a step in a process, it had its own significance for Tony. As he explained to me, he wanted to make something people who walk into the makerspace and are perhaps nervous about a certification class or aren't sure what's going something to play with. And because his wife liked the spatial manipulation toy when it showed it to her, his next 3D printing project was a gift for her: a set of interlocking, seahorse-shaped gears that, like the spatial manipulation toy, can be turned endlessly.

Figure 4. The spatial manipulation toy, photographed by Daniel McNair. While I was captivated by the movement of the toy, Daniel was captivated by the layers of shapes and the light passing through the material as he photographed it.

Going from Idea to Object

My understanding of both the complexity and the significance of going from idea to object for the first time on a machine is in no small way informed by my own experiences, in addition to my observations and conversations with others. When I first visited SMS in February 2015, Eric asked me what I wanted to make and I had no idea what to say. I felt embarrassed that I wasn't even able to make up something plausible and interesting-sounding on the fly, but I couldn't because I didn't know what *could* reasonably be made. I was not yet connected to the shared/distributed knowledge of how machines and materials work and, frankly, because when I saw a space full of men and strange-looking tools, I wasn't sure how I (a woman with no experience with 3D fabrication tools, woodworking, metalworking, or electronics) would fit in.

In June, four months after that first visit to SMS and after many observations of machines and materials and humans working together, I finally asked Eric to teach me how to use the machines in the space. He said we'd start on the laser cutter, and he asked me to think of something I wanted to make. This time, I'd seen enough of the laser cutter in action to know what I wanted to make (and that what was possible to make): a plywood *Star Trek: Voyager*-era combadge. (In the *Star Trek* universe, beginning in the 2360s with *The Next Generation*, Starfleet officers wear a badge that functions as a communication device and a signal for a transporter to lock onto.) While I am always excited to talk about *Star Trek,* I finally experienced the very real excitement of "going from idea to object"—and this, I'm convinced, is an important part of how makers are made, but it is just one part of a very complex intra-action of interest, ideas, machine and material properties, experiences, identities and identifications, and shared/distributed knowledge. In other words, my felt experience of going from idea to object was a spatial manipulation—a reworking of spacetimematter by which "idea," "object," and "maker" were cut together-apart—that was itself entangled in many other spatial manipulations, many other reworkings of spacetimematter threaded through the phenomenon of making a maker.

Another of these spatial manipulations is identification—not only beginning to identify myself as a maker, but also beginning to identify with other makers in SMS. Eric is not a *Star Trek* fan, so before we made my combadge, I explained what the combadge is and why I wanted to make the particular version of it worn by my favorite *Star Trek* character, Captain Kathryn Janeway (the only woman to star as a captain in a *Star Trek* TV series thus far). But there were two other *Star Trek* fans in the space who immediately appreciated my idea: Richard, whose small electronics expertise led him to wonder aloud how we might turn my combadge into an

actual communicator, and Tony, who has since suggested that we collaborate on another *Star Trek*-inspired design. Eric demonstrated the steps of making the combadge: using the laser cutter computer, he searched the internet for a suitable high-contrast image online then showed me how to convert it to a vector graphic in Inkscape and how to enter the appropriate speed and power and thickness for the plywood material (it was a leftover piece from a previous cut, so he knew what the settings should be). He turned on the machine air and fan and started the laser, and we watched as it cleanly and quickly cut out the pieces (no fires).

When he opened the glass door and picked up the pieces, I was as delighted with the negative (see Figure 5) as I was with the combadge, and I held the negative as Eric finished the combadge. As Eric glued the rectangular pieces to the sides of the triangular shape, he asked how I wanted to make it wearable, and I explained that I wanted it to have a magnetic back, like the resin ones worn by the actors on set. So he found and hammered tiny magnetic studs into the back of the triangle, then he found and cut a piece of soft metal and glued it onto another piece of plywood (a test cut he'd done of just the triangle shape to make sure the settings would work) to serve as the back. Even though I hadn't pushed any buttons or hammered or glued myself, I was delighted when I put on the combadge and so proud of it that I posted the photo of it on my shirt (see Figure 5) to Instagram and Facebook on my bus ride home.

Figure 5. Left: Captain Kathryn Janeway, played by Kate Mulgrew (image source: memoryalpha.wikia.com). Right: My plywood combadge and its negative.

My experience of going from idea to object on a 3D printer, the following week, was similar in that Eric's hands were on the computer keyboard and printer controls, while I watched. But while I had been able to come up with an idea to make on the laser cutter, I still couldn't, at that point, think of something I wanted to make on the 3D printer, and browsing Thingiverse felt overwhelming without something specific to search for. So Eric suggested we try looking for a 3D printer file of the same Starfleet combadge, and we eventually found one, or at least the triangular part of one. By contrast, several months later, I observed Richard teaching a 3D printer certification for a twenty-something guy who had been affiliated with another makerspace before moving to Seattle. When Richard asked him what he wanted to print, he said, without hesitation, that he wanted to print a bottle opener. I asked how he knew that's what he wanted to print, and he explained that a bottle opener is often the first thing people print on a 3D printer in a makerspace. "Yeah, the makerspace and beer association is high," Richard added, laughing. The bottle opener printed flawlessly and, to my amazement, really did seem strong enough to open bottles. My combadge print, however, was less successful (see Figure 6). I didn't, at the time,

understand the settings well enough to understand what was going on, but Eric said that the MakerBot was printing at a far lower resolution than what he had input, for reasons that were not clear to him. Since I had envisioned no actual function for this object, I was pleased enough with the strangeness of its appearance and the fact that the extremely low resolution functioned like a microscope to show the layers of filament (however messy).

Figure 6. The "failed" 3D printed combadge.

In fact, that was the closest I've ever gotten, thus far, to operating the laser cutter or 3D printers in SMS myself. It wasn't until I experienced the spatial manipulation toy and observed Alex's training Tony (which, as Tony pointed out to me, differed from usual machine trainings in the space because "Alex is an expert; the rest of us are just amateurs"—more on this below) that I finally felt I understood what was going on in 3D printing and started envisioning making my own spatial manipulation toy. But the experience with the laser cutter was somehow

different. As the laser cut through the plywood in the shape of the Starfleet logo, another agential cut, or boundary mark, was made: the excitement of seeing something I wanted to make go from idea to object marked a change in how I thought about making. For one thing, I finally understood why making things with a laser cutter is exciting and fun. (This was not immediately apparent to me when I first started visiting SMS, even though other people were excited about it.) And something about seeing my idea come to fruition—and also those months spent watching other people make things and troubleshoot—shifted my attitude toward things around me, particularly things involving tools that I had traditionally associated with men. I noticed myself wanting to learn things I hadn't bothered to learn or had felt intimidated by before—like operating a drill, or fixing small things around the house.

Many months later, Eric made a similar observation about his own experience with SMS. "It [the process of making SMS and learning the machines] has changed how I think. Nothing is unknown to me anymore, now that I know how to see in 3D and take stuff apart to figure it out," he explained over lunch at a nearby bakery one day. "That was my impetus for doing this; I wanted to be able to fix stuff around the house. Now, I have a pen, a piece of paper, measuring tape—and I can see everything in 3D, I see shapes and geometry." For me, it seems that in the process of getting to know the people and machines of SMS, and in the process of connecting one of my interests (*Star Trek*) to operating a laser cutter *and* to other makers who are fellow *Star Trek* fans, I had found a new confidence to tinker with tools and machines I had previously not felt interested in or confident around. I can't help but wonder, though, how differently (however subtly) that experience might have gone if I hadn't made something from a TV show that I suspected, even before Richard and Tony responded, others in the makerspace would identify with, given the overlap I've observed in maker culture and sci-fi culture.

Indeed, as we have seen, there are many spatial manipulations threaded through the phenomenon of making a maker. In addition to seeing and thinking in 3D, as Eric described, there is a change in socio-spatial relations with others in SMS (particularly those who are recognized as "makers") and in the neural circuits making and connecting interests, affinities, knowledge, experiences, and identifications. I have come to realize that recognizing oneself and being recognized by others as a "maker"—particularly by going from idea to object—is important both in the educational mission and in the moneymaking mission of SMS. Eric also identified the delight of seeing an idea turn into an object as an important way of engaging the young people he worked with in the Seattle Youth Employment Program (SYEP) over the summer. In July 2015, I observed Eric engaging a group of young men from SYEP (most of whom, he told me, were African immigrants) in a conversation about making in the makerspace. They were all standing around the table with the 3D printers and a collection of 3D printed objects—many of which, including the prosthetic hand, are pictured above in Figure 3—as Eric told them stories of what people make using machines like 3D printers, laser cutters, sewing machines, and CNC (computer-numerical control) machines. They picked up and played with the objects as Eric talked, and they often seemed more interested in the objects than in what he was saying. He even got them to brainstorm a list of things they could imagine making or might want to make and wrote their list on the whiteboard by the table: the list included clothing items, jewelry, phone cases, a bow and arrow, and a display case for boxing gloves. But Eric soon moved the group over to the laser cutter to watch an idea turn into an object: specifically, he asked them all to type their first name or nickname and choose a font for it in Inkscape on the laser cutter computer, and then they watched as the laser etched their names into blocks of plywood, which it then cut out into separate pieces.

Eric later explained to me that he chose the laser cutter because "it goes so quickly from idea to object" (compared to, say, a 3D printer, which can take hours to print even a small object). He chose to have them cut out their names because he believes that the ability to personalize things is an important part of being a maker (in fact, this was one of the first things he told me on my first visit to SMS and it's a common practice in his own use of the laser cutter: for example, I watched him engrave his name on a leather passport cover his wife gave him in anticipation of their family trip to Germany in December 2015). And, indeed, the young men were visibly more engaged by the personalized name etchings than they were with the table of already-made objects and the list of possibilities on the board. As I watched one young man press the etched plywood against his skin, I thought of how I had held the negative of my combadge after the laser cutter finished, running my fingers over the burned paths of the laser cuts.

Still, though, as I myself have experienced, watching someone else cut out something you personalized on the laser cutter does not a laser cutter operator make. In fact, after the initial surprise or curiosity of watching a machine operate for the first time wears off (and this happens rather quickly), the machines are boring to watch. The laser cutter is perhaps the least boring machine to watch because it works so quickly compared to the 3D printers and CNC mill (not to mention the fact that there are occasional fires, as we see in Chapter Four). But, like the young men I observed interacting with the laser cutter (and later the CNC mill), I found myself reaching for my phone—to check my text messages, email, social media, anything—after about a minute of watching the machine.

For many of the SYEP group, this was to be their only interaction with the laser cutter. One young man stayed behind after their volunteer shift was over because he had an idea for the

laser cutter. He asked Tony, who was helping Eric supervise the group, about cutting out a plywood pendant in the shape of Africa with a heart over his home country, so he could hang it on a necklace, and Tony helped him make the idea into an object. (Others in the group got interested in this idea, too, and Tony showed me one of the pendants the following week.) As I was observing the group at the laser cutter, Mike, a "regular" in the space who has 40 years of experience with making and inventing, interrupted me to ask what I was writing down. When I told him I was interested in how Eric was attempting to spark the young men's interest in making, he offered his thoughts on the nature of interest. "You know, Jon [Madamba, a co-founder and co-investor in SMS who is in charge of the educational mission, and who coordinated the SYEP partnership] says that maybe one in ten of these guys will click, and he's right." But while Mike went on to posit that "clicking," or a having an interest in making, cannot be taught and is something "you have to be born with," Jon's view of the extent to which an interest in making can be fostered is perhaps more optimistic—as evidenced in his work to connect students in underserved areas of Seattle with science, technology, engineering, and mathematics (STEM) opportunities. "Clicking" seems to be a very complicated business, indeed.

I did not interview the young men (because they were minors, and because the nature of their relationship to SMS would have made it difficult to obtain guardian consent for interviews), so I do not know how those experiences with the laser cutter changed or did not change their relationship with 3D fabrication technologies. I can imagine, though, that without regular access to these sorts of (very expensive) technologies—to my knowledge, none of the SYEP volunteers have since returned to SMS)—thinking of oneself as a maker of laser-cut or 3D-printed or CNC-milled things might not be a priority or even a possibility. (I am reminded, too, of similar

concerns about technology access in writing studies; see, for example, Grabill, 2003; Banks, 2006). And, as SMS co-founder Clarissa San Diego explained to me, it's not just about access.

I talked to Clarissa via Skype for the first time in January 2016. Clarissa was then living in San Francisco and, like Lauren, is one of two women I met in the course of a year who were or are involved in the operations of SMS. (This is not to say that they are the only two women ever involved in operations; there were other women involved at the beginning, and others have since become involved.) "[Diversity in tech] is important to me," Clarissa explained. "I grew up in poverty in East Oakland with no access to technologies, and I'm Filipino, and there are not many Filipinos in tech." She also noted that "while women are just dipping our toes in software, hardware [working with machines like those in SMS] is still daunting." This is not because the technologies themselves are too difficult to learn or operate, or even that material access (to borrow from Adam Banks' [2006] strata of access) is a problem (as makerspaces and similar workshops continue to proliferate), but rather, it's an issue of environment. She explained that she herself was drawn to SMS by Jon Madamba, who is also Filipino and who shares Clarissa's passion for diversity in tech. But Jon works primarily outside SMS in educational settings, and "since I haven't been around [SMS], there's not as much representation of women and people of color," Clarissa explained. "It really helps [if you are not a white man in a makerspace] to have someone similar to you."

In other words, identification matters not just in going from idea to object, but in making (hardware) makers, or in what Banks calls transformative access to technology that involves inclusion in the ongoing development and administration of a technology (p. 45). After all, "maker," "idea," and "object" are not the only agential cuts made in the making of maker identification; so, too, are cuts like "gender" and "race," especially when those are experienced

as differences. Currently, Tony, who identifies himself as "a product of the French occupation of Vietnam" is the only self-identified person of color who is a regular in the daily operations of SMS. There are no women (of color or white) who are currently regulars in the day-to-day operations of SMS. Connecting with the other makers in SMS and being recognized as a "maker" (in the ways that word means in this particular space and in the maker movement) is an important part of the process of going from idea to object. Seeing or not seeing "someone similar to you," as Clarissa puts it, can make a difference in whether or not someone connects—or how long or difficult that process of connecting might be.

Eric is aware of this issue, too: he told me early on that he didn't want SMS to be a "total dudefest," and in January 2016, he lamented the fact that there were no women "regulars" in the space and speculated that making it more family-friendly would help. Still, one of the criticisms of the maker movement is that it fetishizes expensive, high-tech tools of fabrication at the expense of less high-tech tools and practices of making—especially those traditionally associated with women and indigenous peoples. Maker Media's (2015) own research on maker faire attendance shows that the movement skews overwhelming male, and my own observations have confirmed a similar demographic in SMS.

Finally, and relatedly, familiarity not only with the machines and things but also with the people in SMS was crucial to my participation in Tony's idea-to-object moment with the spatial manipulation toy. I'd been visiting the space for a year, by this point, and had known Tony for about seven months and Alex for four months, and I'd observed many iterations (Clarissa's term for going from idea to object) on many machines. I'd overcome my own feelings of being intimidated by the people and machines in the space. In this way, knowing what you can make and how to make it, as well as desires, identifications, access, economics (particularly

employment status, as I will discuss further below) and gendered/raced/classed bodies-in-the-making, are all entangled in "going from idea to object"—in what comes to matter and what is excluded from mattering, in the ways in which makers are made or not made.

Making Space

For Tony, as I suggested earlier, going from idea to object with the spatial manipulation toy was, in many ways, a microcosm of a larger spatial manipulation: making space for himself in SMS (in both a physical and metaphorical sense). Indeed, despite the name "makerspace," I have learned that neither "maker" nor "space" is a given. Marking oneself as a *maker* involves not only skills and knowledge, or even simply an affinity for maker culture, but also physical space, relationships with people and machines, time, and socio-economic realities. SMS has not functioned, thus far, as a traditional business with paid employees. Instead, the "regulars" in the space—people like Richard, Alex, Jon L., Bob, Mike, and Jeremy—are part of the daily operations of SMS because of the way their own expertises and business ventures intersect with SMS and with each other's. For Tony, whose prior training and experience is in professional writing, being a "regular" in SMS means being, in his words, "basically a shop intern" who is not paid as he learns the machines and helps with daily operations. Particularly as SMS has worked to establish itself (and to break even), the only way people like Tony could be involved in the space has been as a volunteer. In late 2014, after SMS first opened its doors, Clarissa recruited volunteers—like Lauren, the industrial engineering student—with the promise of exchanging volunteer hours for free time on the machines. (Following Clarissa's recommendation, SMS implemented an à la carte style pricing structure in which, instead of paying for monthly memberships—which both Clarissa and research on makerspaces say is often an unsustainable business model—people pay for time on the machines or for someone else to operate the machine for them. [See Wang et al., 2015;

Lindtner & Li, 2012.]) But, as Lauren pointed out, some confusion over the documentation of hours and the exchange of volunteer and machine time "made it easy to quit," and Lauren and all the volunteers who started at SMS with her eventually did stop volunteering.

When Tony connected with SMS in June, none of the original volunteers were still there (to my knowledge), and his vision was to stick out that initial "internship" period to position himself to become a paid employee when SMS did start making money. For the first several months, he worked more with Jon Madamba on educational outreach: for example, he helped lead the SYEP groups over the summer of 2015, and during the fall, he was often at the various locations where Jon teaches and organizes his SPIN (STEM Paths Innovation Network) program. For reasons he declined to discuss, Tony decided to move back to the production work of SMS in early 2016. As SMS moves closer to what Eric calls a "critical mass," with steadier income streams from clients and certifications, Tony's vision of getting paid seems to be getting closer to a reality. Alex brought his professional-grade 3D printers and his expertise as the resident "3D printing genius" (as Eric referred to him from the first week they met), which means SMS can start taking on more 3D printing work, which means Tony could become a 3D printer operator and share in any profits from that work. And as Richard prepares to launch a product—a programmable LED circuit board—he is training Tony to solder the boards, because he plans to hand-make the first batch (before eventually outsourcing the entire production process to a factory in China via DA International, a product development company several doors down in the warehouse building with whom Eric partners for large scale production and distribution of products incubated in SMS).

Tony's tenacity in making space for himself in SMS is evident not only in his willingness to stick out the "internship" but also in his work to secure a physical workspace for himself in a

room where furniture is constantly on the move and work space is premium real estate. One constant in SMS is that regardless of whether or not the regulars have a dedicated desk/work space, they move around the space—to machines and to other people's work spaces—often. And even when they are at their own spaces, they're often still talking to each other, or at least jumping in and out of conversations. Eric moves around the most, perhaps not surprisingly, given his role. (Most of the furniture and machines have moved around many times since then; in fact, the laser cutter is the only thing that has not moved.) In the spring and summer of 2015, the back half of SMS was cluttered with tools, donated equipment, and extra furniture, and so Richard set up his equipment and projects on one of the work tables (see Figure 7). As more people have become regulars in SMS, and particularly when much of the items in the back half of the space moved to a smaller warehouse space SMS is leasing across the street, the regulars have claimed the back half of the space for their work areas, since Eric wants to keep at least the front half open for meetings and trainings (see Figure 7). In fact, at the time, Alex (who, as I noted above, also works from home and from his own workshop) and Eric were the only regulars who did not have permanent desks in SMS: they both worked at the conference table in the front half of the space (see Figure 7). Eric has told me many times over the last year that he wishes that there were no permanent desks in SMS. "That's not the ethos I want," he explained once. "I want it to be where at the end of the day, everyone packs up their stuff and stores it or takes it home." This is, in fact, what Eric does every day, but Eric's self-described role as "the facilitator" is different from the roles of the other regulars, who are designing their own products and carrying out jobs for SMS clients.

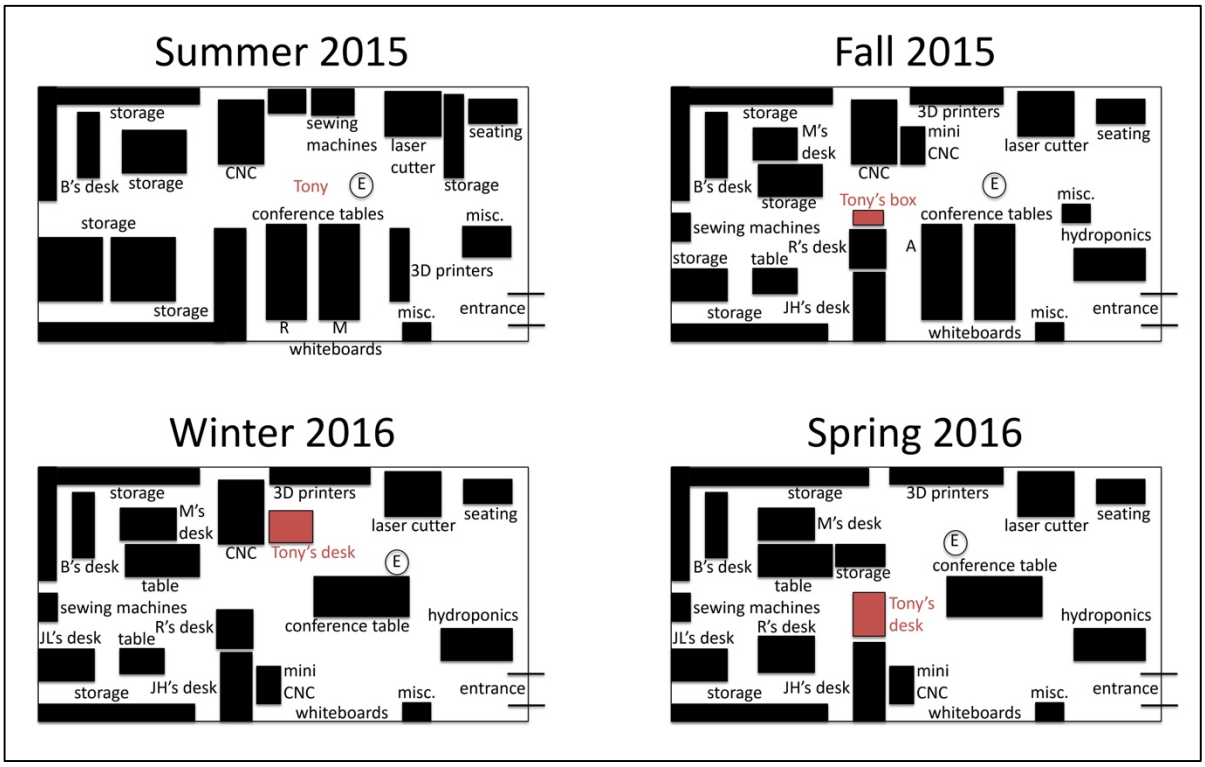


Figure 7. A model illustrating the movement of machines, furniture, and work spaces—particularly Tony's—in SMS over the course of a year. Regulars referred to by name in the genealogy are marked by their first initial here, with the exception of Tony.

Still, for the other regulars, having a work space matters, and it certainly matters for Tony. When he first returned to SMS to focus on becoming a shop assistant, Tony had to negotiate space for himself (see Figure 7). First, he had a box with his name written on it and a chair next to Richard's desk (but he didn't have a dedicated place to set up his laptop), then he used Mike's desk while Mike was away (but soon had to move in anticipation of Mike's return), then he set up a desk in front of the newly-installed rack for Alex's 3D printers (this is where his desk was when I observed his idea-to-object process with the spatial manipulation toy, but Eric and Alex told him they wanted the space in front of the printers to be open). Being near Richard was his goal since his return to the main SMS space in late 2015, Tony told me. "I wanted to be near him so I could just be like"—he mimed leaning across a desk—"'Hey, Rich! What about this?'" I realized, in the process of constructing this genealogy, that while Tony's original goal,

as he had explained it to me and as he had explained in his first blog post, was to get "maker skills" (which he imagined as primarily learning technologies and techniques), that goal had morphed into integrating himself (physically and relationally) into the distributed knowledge network of the space. I realized that Tony's work making himself into a maker and a regular in SMS, like my work making myself into a researcher of SMS, is as much about integration into a dynamic, distributed network (of humans, machines, objects, and cyborg combinations of these) as it is about individually integrating skills or transferring individual knowledge across contexts or machines.

In winter 2016, one of Tony's colleagues finally helped him build a small desk from scrap materials, which he placed in front of the new 3D printing station, where he was apprenticing with Alex, who designs, makes, and operates a 3D printing farm (with an outpost in SMS). But this location was short-lived, because both Eric (the CEO) and Alex objected to Tony's desk being in the way of the 3D printing machines. Finally, in early spring 2016, a shuffling of desks among the other regulars (who had for several months taken up residence in one of the back quadrants of the space) opened up a spot for Tony, who promptly took it. At the same time, Tony did in fact begin sharing in profits from the machine certification trainings he conducted and from the client jobs to which he contributed, while continuing to produce social media content and to produce or edit internal and external communications in SMS, from technical instructions to client emails.

Saying and Showing

I have come to understand that the experiences of printing and playing with the spatial manipulation toy were entangled in many spatial manipulations—from the immensely complex entanglement of bodies, ideas, identities and identifications, knowledges, and machine

movements involved in going from idea to object, to the equally complex nature of making space. I want to return to the conversation that Tony and I had about the name of the spatial manipulation toy to explore another dimension of spatial manipulations: the relationship between saying and showing, to use Tony's words. When I thought more about Tony's comment—"you don't have to *say* [what it is] so much as just *show*"—I was reminded of a comment Mike Momany (an inventor with more than 40 years' experience and a regular at SMS) had made to me seven months earlier (the same day he shared his thoughts on how people "click" with making). Like most people I encounter in the makerspace, he was curious why someone who studies writing would be interested in 3D making, and as we talked, he mused, "I can see how 3D making is like writing. If a picture is worth a thousand words, then making something in 3D is worth even more."

I can think of many ways in which this is true: for example, I chose to make a video of my hands moving the spatial manipulation toy to begin this genealogy, because that video explains the movement more succinctly than I could in words—but this assumes, of course, that my reader is sighted, which may not always be the case (and this is why I still used words to describe the toy as I was describing my interaction with Tony). And whether or not you are sighted, that video is still less persuasive than playing with the spatial manipulation toy yourself, feeling the plastic and the soft grating of the surfaces against each other as you turn it endlessly inside out. As Brian Rotman (2008) observes, in order to overcome the challenges of communicating across distance and time, alphabetic writing erases three-dimensional, embodied, phenomenological gesture. Rotman notes that motion capture technology is increasingly allowing us to communicate gesture over space and time in what he calls a "transposed corporeality" (p. 46), and, indeed, as I also discuss in Chapter Four, G code (the language that

the laser cutter, 3D printers, and CNC machines use to carry out jobs) functions as a translation matrix for a transposed corporeality between humans and machines by translating shapes into machine movements on a XYZ axis. Alex (who, like me, does not always like being on camera and is thus just off the left side of the frame) explained this the day I observed his mentoring Tony on the second printing of the spatial manipulation toy in the video referenced in Figure 8. Tony had just initiated the slicing process in Slic3r, and I asked what that meant.

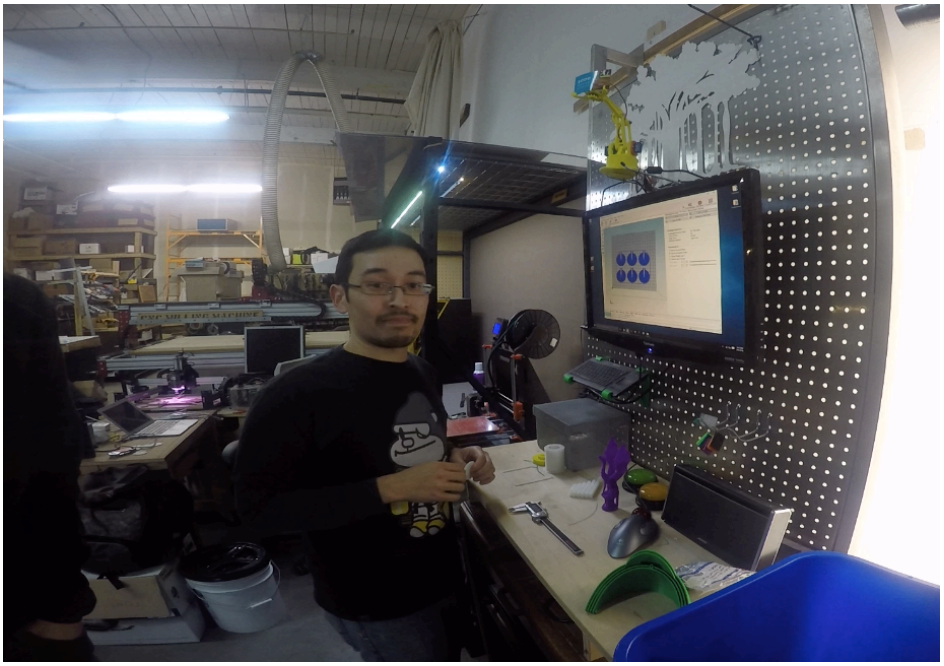


Figure 8. A still from a video clip of Alex (whose arm appears on the left side of the image) explaining slicing to me while Tony sets up the print. To the left of Tony, in the background, is his desk, before he moved to a spot further back by Richard. Video URL: https://drive.google.com/file/d/0B4KMqpglDoh8dGtfTTliSzloV3M/view?usp=sharing.

"Slicing is the process of taking a three dimensional shape and turning it into G code, which is the instructions—line per line instructions—that tell the printer how to move, and what to push plastic out, what temperature to set itself at, and all that," Alex explained. "It's basically taking a shape"—he mimed holding a three dimensional shape in his left hand—"and turning it into instructions"—he mimed holding the same shape in his right hand—"on how to reproduce that shape."

What struck me about this intra-action—and so many others I've participated in before and since—was not the primacy of either gesture or verbal language but, in fact, the entanglement of several languages (spoken and written English, shapes on screens, G code, and the many languages of programmed machine and body circuits) and several gestures (human and nonhuman), resulting in many transposed corporealities and spatial manipulations—including the spatial manipulation toy, and eventually this genealogy itself. Alex verbally instructed Tony to re-slice the file, since they had made adjustments to the print settings. Tony instructed Slic3r, via clicks of a computer mouse, to transform the shapes of the spatial manipulation toy file (as well as the settings he specified for infill (the density of the object), perimeter layers (which create a solid surface over the honeycomb pattern of the infill/interior), and the temperature for the 3D printer's extruder (which melts the plastic filament much like a hot glue gun melts a stick of glue). Having seen and heard this, I verbally asked about slicing, to which Alex responded using both words and gestures, and I in turn connected his explanation to my prior knowledge of how G code works (both in words and in my mind). The camera I was holding with both hands (in such a way that I could ensure that Alex was at least mostly out of the frame, per his wishes) recorded our voices and movements (in 2D), which are now accessible—along with this alphabetic account—to readers of this project. Once Slic3r finished, it sent the G code to Alex's Prusa I3+ printer, which then translated the G code into movements to make the discs of the spatial manipulation toy (see Figure 9).

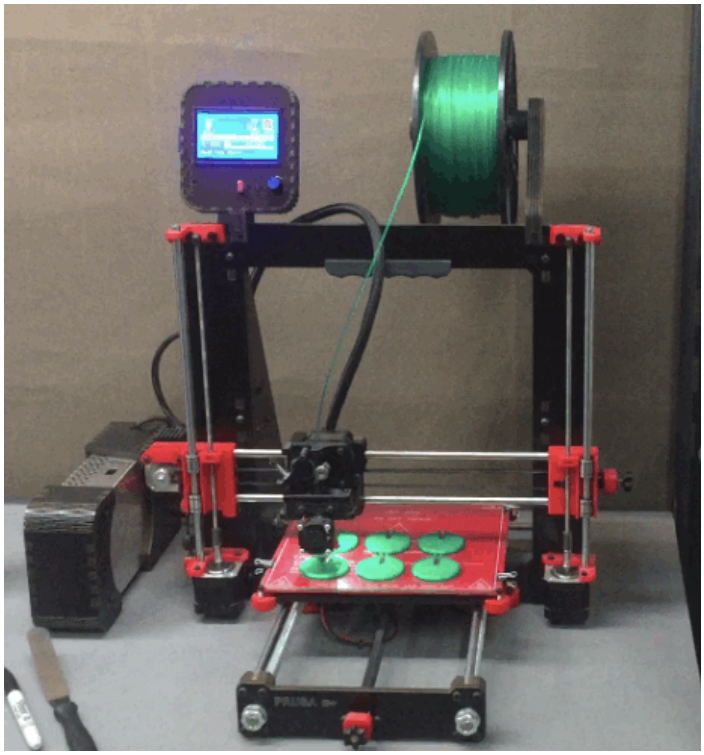


Figure 9. A still image from a gif of Alex's Prusa I3+ (which he designed and made in a "chocolate and red" color scheme, because he likes the look) printing a spatial manipulation toy in green. He laser cut matching chocolate wood pieces with living hinges to put on the ends of the printer's computer (on the left) to improve what he describes as the "boxy" aesthetic of DIY.

Once the printer finished, Tony followed Alex's instructions for removing the (clear) glass printing surface from the red bed (using a fingernail and the spatula in the bottom left of Figure 8), and then he set the glass on the gray shelf surface to cool. (The red printer bed is heated to keep the filament from cooling too quickly and solidifying on contact.) As the cool surface of the shelf cooled the glass, the glass began to shrink and pull away from the 3D printed pieces, making what Alex described as "tiny snap-crackle-pop sounds" (referring to Rice Krispies) that can only be heard in very close proximity (see Figure 10), which Tony and Alex invited me to experience for myself, and I did. The sounds were indeed very faint, but audible with my ear nearly touching the glass.

Figure 10. Tony listens to the snap-crackle-pop of the glass pulling away from the 3D printed discs.

Once the tiny snap-crackle-pop sounds had ceased, Tony picked up the glass and tilted it to let the pieces slide off, which most did immediately. He nudged a still-stuck piece off gently. While we waited for these green discs to print, Tony had disassembled the spatial manipulation toy made from white discs (see the video linked at the beginning of this genealogy). Tony handed me three white discs and three green discs, keeping the remaining six green and white discs, and he instructed me (verbally) to snap the pieces together, alternating colors (see Figure 11), then snap the two ends of the chain together. The result was two green and white spatial manipulation toys (one to stay in the space, and one that Tony gave to me, pictured in both Figure 1 and Figure 11).

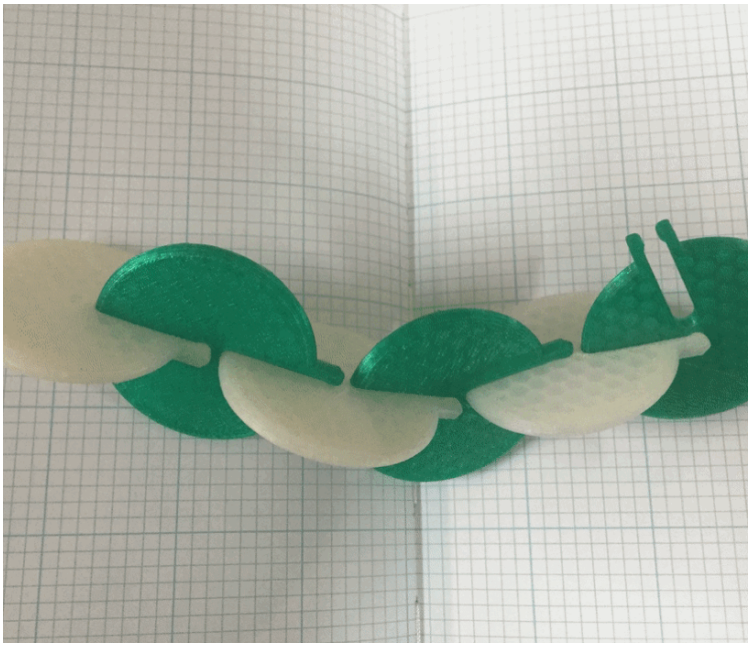


Figure 11. I used my open field notebook in my lap as a makeshift table for assembling six interlocking discs in alternating white and green. Then I snapped the two ends together.

So while Tony is absolutely right that sometimes it is more effective to show than to say, and while Mike is right that 3D objects are often worth thousands of words (or at least many words), sometimes saying and naming are more expedient than showing or doing. For example, Tony could presumably have eventually figured out all what he needed to know about printing on the Prusa I3+ by tinkering and troubleshooting—and indeed, Alex prescribed at least a spool's worth of printing and tinkering to give Tony the opportunity to figure out things for himself. But Alex also saved Tony quite a lot of tinkering time by giving him verbal explanations and advice. And Tony—a writer by training—told me about a month before this intra-action that he thinks stories could play a powerful role in helping people go from idea to object. "I see people come in the space because they saw it online and are curious, but they just kind of stand there or wander around confused until Richard or Eric goes up to them like, 'hey, can I help you?' and they still don't really know [what they want to make]," he said. Tony is convinced that the solution to this problem is storytelling: not only stories of going from idea to

object on various machines, but also stories of how makers are made. “Eric wants me to blog [on the SMS blog] about stuff happening in the makerspace, and that’s fine, I can do that, but I think people need to see those narratives [of how makers themselves are made] to really get it,” he explained. (As a fellow storyteller, I am of course inclined to agree—though I also wonder, even if I had seen such a narrative before my first visit to SMS, if I really would have been able to improvise much better in answering the question “what do you want to make?”)

And often going from idea to object (or helping others go from idea to object) involves a combination of saying and showing, as in the case of the 3D printer certification materials developed by Alex. In February 2016, Alex wrote a manual for the certification training that includes common terminology and definitions, pictures, safety protocols, step-by-step instructions, and troubleshooting tips. Tony, who copyedited the manual, offered me a copy, noting that it was the first written certification manual and that he hoped it would be a model for certification manuals for the other machines. As I read the manual, I drew on my experiences observing people working with 3D printers—and especially Alex’s training Tony the day he made the spatial manipulation toys—to understand the instructions, and I realized that the instructions didn’t make reference to the settings for infill, perimeters, and top and bottom layers I’d heard Alex and Tony discussing. The next time I saw Alex, I asked him if those particular settings were perhaps too project-specific to include in the manual, and he replied, “Well, they’re not in this version but they should probably be in the next version. But actually, I also made these—” he reached for a set of three 3D printed tabs on a key chain and offered them to me “—for the three standard settings.” On one side, each tab (one labeled “lite,” one “medium,” one “strong) included infill, perimeter, and top and bottom layer settings printed on a sticker label (see Figure 12). And each tab was printed with the settings described on the label, allowing a

user to compare setting configurations by seeing and touching. I remarked to Alex that, to me, the tabs were a far more effective way to teach and model the settings than a written description or even a picture. In this way, saying and showing entangled with each other, just as they are also always entangled in the rhetorical and more-than-rhetorical work of spatial manipulations—be they transposing corporealities, "tickl[ing] our animal brains" (to return to Tony's phrase), going from idea to object (and/or object to idea), or making space for ourselves or others. In other words, both saying and showing are necessary meaning-making practices for integrating (into) systems.

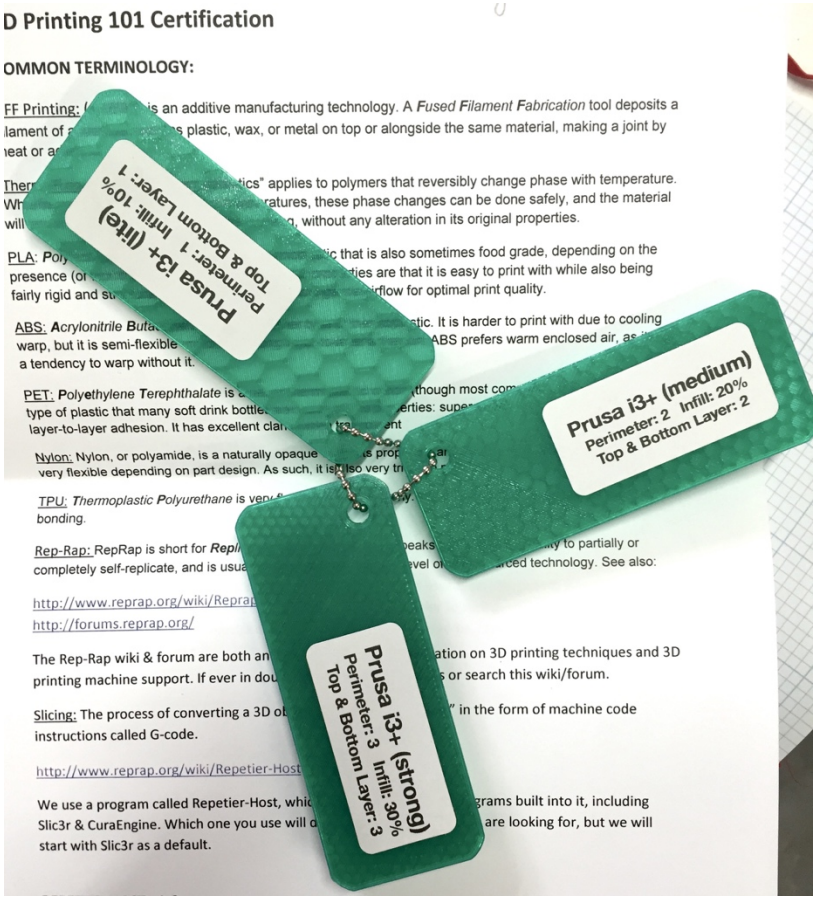


Figure 12. The 3D printed tabs with standard setting configurations, photographed atop the training manual. The differences in infill setting are most readily visible in this image, in the varying sizes/density of the honeycomb pattern in each tab.

But making space is an ongoing negotiation—both for me as a researcher and for the people and things in SMS. For example, neither Tony nor I would claim that, by summer 2016, the boundary marking by which his skills as a writer were seen as separate from (and less valuable than) his making skills had been overcome. I watched Tony operating the sewing machine with ease while he commented that others in the space were "more useful" in terms of fabrication skills, but that he did feel he contributed to the space in more ways than just social media content, now that he could operate the machines himself. Just as by learning several martial arts traditions he became a "full spectrum warrior," Tony explained, by adding fabrication skills to his writing skills he became a "full spectrum creator." He went on to point out that beyond the content production and editing he does and even his work with the fabrication technologies, he sees his ability to explain those technologies and their possibilities to newcomers in SMS as an important contribution.

Figure 13. A still from a video-recorded 3D interview with Tony while he is sewing LED lights into the hood of his jacket. Video URL: annsm.us/making. See Appendix One for a transcript.

"For places like this to grow and expand, there has to be someone there not just to advertise it but to *explain* it to people," he said. "When we have people walk in because they've heard of makerspaces or 3D printing, it's important to help them wrap their minds around what it means for them and their communities that they have access to these technologies." Of course, as technical communicators well know, effectively explaining technologies to newcomers requires an extensive knowledge of those technologies—it requires, in Tony's words, a full spectrum creator. (I have found this to be true in my own writing about SMS and making.) In the spirit of being useful (Grabill, 2012), I am committed to using my position and findings to support Tony's continuing work to trouble the boundary between writer and maker, which can open up new possibilities for mattering and making for him and for others in SMS. And I can't help but wonder how my first experience at SMS would have been different—and thus how my research apparatus itself might have been different—had Tony been there then as a full spectrum creator to help me answer Eric's question, "what do you want to make?" by showing me what I could make.

Implications

As both a researcher and a teacher, I am less interested in calling everything "writing" or "rhetoric" than I am in exploring writing and rhetoric as forms of and in relationship to other forms of making. This means, as I hope is evident in this genealogy, recognizing the entanglement of saying and showing, of languages and gestures—as well as the differential processes by which "saying" and "showing" are recognized as such—as part of the processes of spatial manipulations. In other words, making and manipulating space involves meaning-making with words, bodies, objects, and interactions, and these different ways of making meaning are marked in relation to each other, and in interactions, just as more-or-less human/makers and

machines and things and connections are made, unmade, and remade. This has implications not only for how we theorize and study rhetoric and writing (and other forms of making), but also for how we teach writing and rhetoric.

The entanglement of human bodies and nonhuman things in this genealogy reminds me of the work Jacqueline Rhodes and Jonathan Alexander (2015) do in their multimodal webtext *Techne* to emphasize the phenomenological, queer/ing interactions of bodies and things.

> As we touch our technology, we are increasingly reminded of how it touches us back, sometimes through the agency of others reaching out to us. …What happens to us as we feel ourselves touched by our technologies? [Sara] Ahmed [in *Queer Phenomenology*, 2008] argues that bodies are "shaped by contact with objects and with others, with 'what' is near enough to be reached. Bodies may even take shape through such contact, or take the shape of that contact. What gets near is both shaped by what bodies do, which in turn affects what bodies can do." (54) (Orientations)

I see this happening on many levels of spatial manipulation (or orientation, to use Ahmed's word, or spacetimemattering, to use Barad's word)—and not only in touch and gesture but also in language, and I find that a diffractive approach to making genealogies of mattering can help us further study and theorize this entanglement.

This approach to accounting for spatial manipulations (including what comes to matter and what is excluded from mattering) also has implications for teaching and doing writing, rhetoric, and design. Composition studies, in particular, has a long history of wrestling with the complex intra-action of factors (human and nonhuman, discursive and nondiscursive) in the making of writers—from process pedagogies, to discourse and cultural studies approaches, to public rhetoric and genre approaches, to new media and post-pedagogy. Here I follow Paul

Lynch's (2011) articulation of post-pedagogy as an acknowledgement that there is not a single true pedagogical approach and that pedagogy is what happens after class (rather than before). (p. 95). In this sense, post-pedagogy is perhaps the most similar approach to what I have observed in SMS, in that its advocates emphasize creativity and personalized instruction and intervention over standardized curriculum (see, for example, Marc Santos and Megan McIntyre, 2016). But there is also a tendency in post-pedagogy (and in SMS, for that matter) to treat creativity and desire as neutral forces (particularly when desire is figured in a Deleuzian sense as a vector that flows through the material; see also Brian Massumi, 2015) or as habits to be cultivated. Barad (in Dolphijn and van der Tuin, 2012) argues, however, that the material is not a medium for desire but is in fact itself a "desiring dynamism" bound up in what comes to matter (and what does not). In other words, the making of makers by going from idea to object—in writing classrooms and in makerspaces—is a complicated business, and creativity is not merely a choice or habit of a cognizing individual; as we see in the case of my own integration in SMS and Tony's integration into SMS, the making of makers is an intra-action that makes some things matter and excludes other things from mattering.

Similarly, rhetoric and professional and technical communication (PTC) have most recently taken up the challenge of entangled matterings by turning to interdisciplinary work in (new) materialism. This has resulted in ecological approaches to understanding the circulation of rhetoric (Edbauer, 2005), in posthumanist approaches to rhetoric (Mara and Hawk, 2008), in "giving objects their due" (Marback, 2008), and in seeing Latourian symmetry (parity of humans and nonhumans) as a methodological move for understanding spatial/rhetorical manipulations (Spinuzzi, 2015). But as I hope this genealogy—and the project as a whole—shows, we also need to attend to the entangled and differential processes by which objects become objects,

rhetoric becomes rhetoric, actions become actions, and humans become more or less human, or more or less maker. In other words, to study the entanglement of saying and showing, of humans and nonhumans, we need more than maps or descriptions of geometric relations between rhetoric and objects, people and machines. We need, as Barad (2007) argues, topological, genealogical accounts of how boundaries are made between language and gesture, maker and made, finished and unfinished. After all, as Sharon Crowley (1999) reminds us, "Distinctions and boundaries are never disinterested," and studying the partisan nature of boundaries has long been the project of rhetorical studies (p. 363).

This genealogical work—to intervene in a material-rhetorical situation ourselves, or to teach our students to intervene in material-rhetorical situations—involves all of our bodies-in-the-making, not just our cognizing minds and linguistic communications. Alex's approach to training Tony on his 3D printers involved a combination of several ways of making meaning: direct instruction (like "go ahead and re-slice that file since you've made changes to the settings, because any time you make changes, you should re-slice"); answering Tony's questions directly (or turning them back on Tony for him to figure out himself: "you tell me what the perimeter values correspond to"); engaging with Tony in recounting and considering mistakes, problems, and successes; watching Tony go through steps, doing some of the steps with or for him, leaving him alone to work on his own; and prescribing a lot of time (measured in spools of filament used, not in objects completed) to "make mistakes," "break things (and don't worry about it, because you know I can fix it)," and "learn to eyeball" things that initially require measuring. But Tony's training also involved drawing on their relationship as colleagues, in the form of friendly chatting during down time (of which there is plenty in a print that takes about an hour and twenty minutes) about shared interests (music and gaming) and about colleagues and

happenings in SMS. And the training involved Tony's determination to make space for himself in SMS.

These layers of entanglements remind me of Shaun Slattery's concept of mediation—"the use of existing documents, notes, and software necessary to 'do' technical communication" (p. 354)—which he offers as a way of bridging the divide (in the literature on teaching technical communication, if not in practice) between "tool-based skills" and "higher order competencies" (or rhetorical skills). In other words, Slattery's concept of mediation undercuts the assumption that rhetorical skills are separate from technological skills, and, indeed, as Laura Gonzales (forthcoming) argues, rhetorical skills like translation *are* technological skills. In the spirit of this entanglement of the rhetorical and the technological, I extend Slattery's (2005) definition of mediation to include the many rhetorical and technological (and material) entanglements involved in Tony's training on the 3D printer. I also expand the agency implied in Slattery's notion of mediation from a single human mediator to the entanglements themselves, meaning that mediation is a wicked problem in a more-than-human sense—which I discuss in further detail in Chapter Four. And, of course, the entangled mediation in this genealogy is not limited to Tony's entangled mediations: my own participation in, observation of, and accounting for this training is entangled with the things I know and do not know about SMS, about teaching, about 3D fabrication. This has implications for how we frame and approach assessment, which I discuss further in Chapter Six.

Chapter 4. DISEQUILIBRIUM

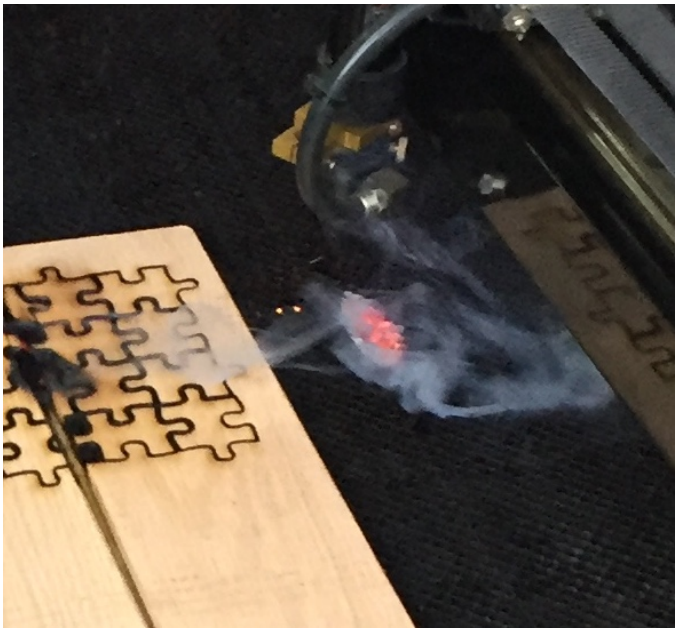


Figure 1. A (little) fire on the bed of the laser cutter.

"Just a little fire in the laser cutter." These are not words I would have anticipated saying before my involvement in a makerspace. But that morning in February 2016, when one of the regulars walked in and looked mildly surprised to see Eric, the CEO, on his knees sweeping debris out of the base of the laser cutter, I said to him, by way of explanation, "Just a little fire in the laser cutter," while snapping pictures with my phone and jotting down notes. And just like that, we all went about our business. This is not to suggest that laser cutter fires are not dangerous—they are—but, rather, that we had all by this point seen fires in the laser cutter and were not particularly surprised. In fact, a portion of this chapter/genealogy is a genealogy of fires in the laser cutter. This little laser cutter fire came to matter to me as a way of understanding the complex function of disequilibrium—by which I mean system imbalances and breaking systems—in making processes in SMS. Disequilibrium, or system imbalances, include human errors like the causes of laser cutter fires (when the laser beam power is too high relative to its

speed, the material, and air flow), as well as machine malfunctions. But disequilibrium also includes system imbalances in SMS-as-system, particularly tensions between the amateur ethos of the space (and the maker movement) and systems of production that privilege traditional expertise.

Disequilibrium, or system imbalance, sometimes happens in ways that humans and machines do not intend, but sometimes human makers bring about disequilibrium on purpose (or at least don't try terribly hard to avoid it) as a way of learning or innovating. Therefore, disequilibrium also includes intentionally or knowingly disrupting or destabilizing systems (knowledge, processes, etc.) as a teaching and learning strategy, as Santos and McIntyre (2016) describe in their approach to a disequilibrating technical communication pedagogy. I noticed that many of the makers in SMS allow for and even cultivate a relatively high tolerance for disequilibrium as an inventional practice, in the forms of hacking and troubleshooting, failing often and fast, and a "ready, fire, aim" philosophy (as Eric describes it). Thus, this genealogy traces disequilibrium as both a marking of boundaries *and* a site for intervening in boundary marking. The two main threads of this genealogy focus on two of the most prominent fabrication technologies in SMS, the laser cutter and the 3D printers, as a way to examine and account for disequilibrium-as-boundary-marking in machine operation and maintenance, in prototyping and design, in the ethos of the space, and in production systems. Thus, while Chapter Three approaches boundary marking phenomena from the frame of integrating into systems (making and manipulating space), this chapter approaches boundary marking phenomena from the frame of breaking systems. This is not to suggest that one must first integrate into systems in order to break them; rather, integration and imbalance may very well be two ways (boundary marking

practices) of looking at the same phenomenon, but the different frames make different meanings and possibilities matter.

Ready, Fire, Aim

When Eric was bringing me up to speed on the history of SMS in March 2015, he told me that SMS had acquired the laser cutter—six months earlier, in September 2014. He told me that he had committed to a paid job on the machine before he and his colleagues were even sure they could operate it. "Right after we got [the laser cutter], we got our first customer call," he recalled as he looked at a photo of the laser cutter in Google Photos on his smartphone (the application organizes photos by date and location, and he was using it to prompt his memory as he recounted the history of SMS). The order was for an etched wooden poster for Seattle's Decibel Festival (an electronic music festival), and it was designed by a local graphic design firm, Soup Standard. Eric realized that "graphic designers needed to know about this place [SMS], because we can take their designs and turn them into objects," and so "we hadn't hooked up the machine, but we'd already committed to the job. Like 'ready, fire, aim.' I knew that if we couldn't get it done here, we could pay to get it done elsewhere; we just needed to start our network," he explained, then swiped to the next picture of the smiling graphic designers holding the finished poster. "Here's the happy recipients," he said. "That was a proud moment."

One of the challenges for me, as someone with no prior engineering or hardware training, was learning how software and hardware in SMS communicate and how humans and machines communicate, and I learned that these sites of communication were also frequent sites of disequilibrium—sometimes intentionally, as in the "ready, fire, aim" inaugural job on the laser cutter, and sometimes not, as in the many little laser cutter fires. Some of these sites of disequilibrium are located in the two main communication interfaces associated with the laser

cutter: a driver that connects the machine to a desktop computer and software on the desktop computer that connects human users to the machine. The laser cutter, like 3D printers and CNC machines, uses CAD (computer-aided design) programs and G code (a programming language). Next to the laser cutter is a dedicated computer connected to the machine; this computer has the laser cutter driver—not unlike a desktop inkjet printer driver—that interfaces with the laser cutter, as well as a copy of Inkscape, an open source vector graphics program for designing files (ultimately rendered as tool paths) for the laser cutter. These programs function as a translation matrix for human-laser cutter communication.

In Inkscape, an image can be rendered into a vector graphic, or a vector graphic can be created from scratch or modified from a template. Different lines can be assigned different colors: for example, blue lines for a border to be cut out, red lines for a design in the middle to be etched. That graphic file can then be exported to the laser cutter driver (see Figure 2). In the driver, a person specifies the speed and power for the cut (both expressed as percentages), which are dependent on the material being used and whether the person wants the machine to etch or cut through the material. (Speed and power charts for various materials are made to streamline the trial-and-error process of getting these variables right; in SMS, there are speed and power charts for plywood, leather, and acrylic.) The driver asks for a material thickness measurement, and people usually use a caliper to get a precise measurement, rather than assuming, for example, that plywood sold as 0.25-inch is in fact exactly 0.25 inches thick. The human user also specifies instructions for the various line colors in the file. The vectors, speed and power variables, and material thickness are translated into Gcode (a series of XYZ coordinates) for the machine's movements. The driver also prompts the person to send the machine through a homing sequence to locate the starting point for the cutting head (which is not itself the laser beam source, but

rather a mirror and focusing device for the laser beam, which is located off the back corner of the cutting bed). A small red laser point indicates where the cutting laser beam will be. Experienced users sometimes skip this step and manually step the head on an XY axis (left and right, forward and back) to the starting point, and when this step is skipped, the driver window on the computer flashes in red, NOT HOMED.

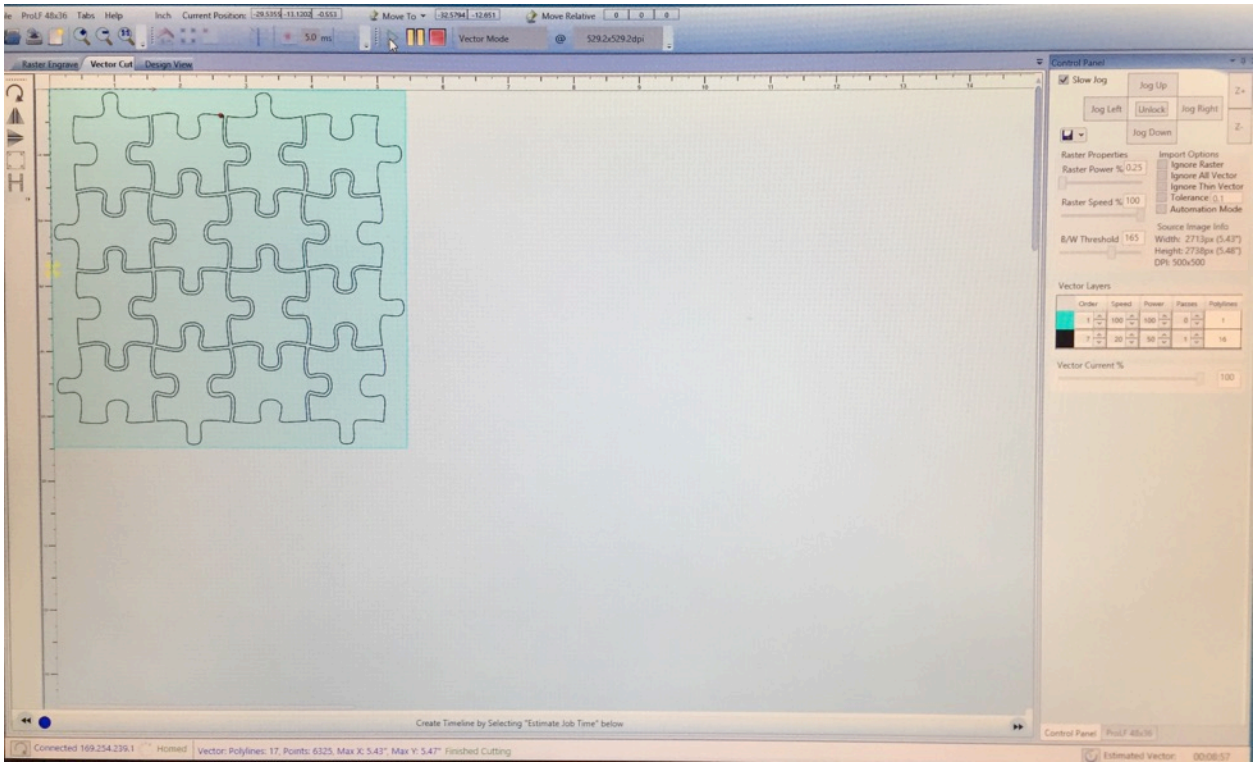


Figure 2. The laser cutter driver interface, photographed in February 2016. On this job, Eric homed the laser before beginning, as indicated in the lower left corner.

This file translation matrix is a key part of the process not only of going from idea to object but also of problem solving and maintenance, and not unlike translation of human languages, this is not a one-way form of communication. In addition to the necessity of troubleshooting the speed and power specifications, human users also face the necessity of negotiating with the machine's priorities and memory if they try to make changes mid-job. For example, the first time I watched a start-to-finish project on the laser cutter (in April 2015), I

observed Eric engage in a series of negotiations with laser cutter, mediated by the driver program. He had a ready-to-go file—a scaled down finger-joint planter box to be cut on plywood—on a USB flash drive that he loaded onto the laser cutter computer, but he couldn't get the program to resize the scale of the object the way he wanted, so he pulled out his smartphone, where he had recorded the original down-scaling calculations, and manually input the measurements in the driver. After turning on the machine's chiller air and exhaust fan system, he instructed the machine to cut on the blue lines in the file at 85% strength (he explained that 70% hadn't been enough to cut through the material last time he'd tried). He turned up the exhaust fan, explaining that it needed to be on a higher setting because cutting through a material generates more smoke and dust, and then he asked the driver for an estimate of how much time it would take the machine to complete the job. When the laser cutter started cutting, Eric watched the machine cut out the first piece, hoping to see visual evidence that the piece was completely severed from the material (indicated by a slight drop of the cut piece). No such drop occurred, and Eric decided he wanted to slow down the machine (decreasing the speed percentage) to see if that would help the machine cut completely through the material. But when he changed the speed variable in the driver, nothing happened: the machine kept cutting at its original speed. When he realized this, Eric explained to me that the machine was not responsive because it already had memory (for the original job instructions) built up. He shrugged and left the machine to finish its work.

When the machine finished and the laser shut off, Eric opened the glass door and examined the results. The machine had not cut completely through the material, and Eric speculated that perhaps the machine hadn't cut through because the plywood was warped. He had used 3D-printed clamps (designed and printed by co-founder Richard Albritton to fit snugly

into the honeycomb-style cutting bed to hold down the edges of warped plywood; see Figure 3) to flatten the material, but perhaps it hadn't been enough. Or perhaps the lens that focuses the laser was dirty. He decided to send the machine through another cutting sequence to see if the pieces would drop free this time. As the laser cutter worked, he mused, "I'll take a look at the mirrors," and prepared a cotton swab dipped in rubbing alcohol as the machine finished. When the laser cutter completed this job, he inspected the pieces again. The pieces still hadn't been cleanly cut out, but Eric was satisfied: "I'm calling this a success. Most of the pieces can be pushed out [by hand] now."

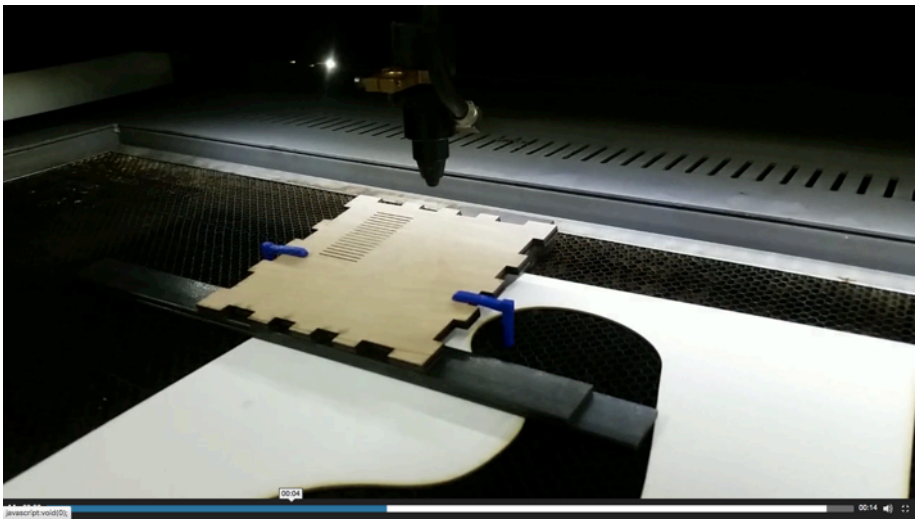


Figure 3. 3D printed clamps (blue) are pictured in this still from a time-lapse video created by Tony Loiseleur and posted on the SMS blog in February 2016.

I didn't understand this at the time, but Lauren, an industrial engineering student and former SMS volunteer, later explained to me that a dirty mirror can indeed unfocus the laser beam—not unlike the way a piece of dust on a person's glasses can change that person's vision, she noted. I'd first met Lauren in SMS in March 2015, when I happened to visit on a day she was volunteering. I only saw Lauren in SMS that one time, but I used her member contact information on the SMS Trello board (a web-based project management application; see Figure 4) to get in touch with her and arrange a meeting on campus (where we both were students) in

January 2016. Even though Eric had walked me through the process of making my own "idea to object" on the laser cutter, I still didn't entirely understand the machine, especially when it came to human safety and machine maintenance. As Lauren described her experiences in SMS to me, she noted that she was concerned about machine safety, citing the laser cutter as an example.

But human safety is not the only concern in SMS: protecting the laser cutter—whose parts are expensive to replace—is also an ongoing concern. Indeed, a switch on the side of the laser cutter that controls the machine's exhaust fan proved to be another site of disequilibrium in the early months of operating the machine in SMS. That fan pulls air through the open space just below the glass door (the space through which Richard reached to hold down the plywood in the video in Chapter Two) and vents fumes out into an exhaust pipe. Lauren explained that people were turning down the fan—which is quite loud—in an attempt to avoid drowning out conversations in SMS, which also functions as a meeting space and houses other (loud) machines. But the lower fan speed meant that dust and smoke were not being properly vented from the system, leading to the accumulation of dirt on the laser lens and the de-focusing of the laser beam. And especially when a user compensated by increasing the laser power instead of cleaning the lens, the laser beam could ignite the dust, and the resulting fire could then overheat and crack the lens—something that happened at least once during Lauren's time at SMS. (Until Eric was introduced to a lower-cost provider by his mentor at MakerLabs in Vancouver, B.C., in early 2016, a replacement laser lens cost him more than $200.) "One day things were catching on fire [on the cutting bed], and [the people operating the machine] were like, 'oh, the person who taught the [laser cutter certification] class said that was normal,'" she recalled, "but I said, 'no, that is not normal.'"

By the time I observed Eric's job and problem solving on the laser cutter in April, at least a temporary working solution to the fan and lens cleaning issues was in place. In fact, in March 2015, when Eric sat down with me and recounted the history of SMS (from idea to object/makerspace), he told me that in February, "we had a problem with the laser cutter, and I wanted to figure out how to never have it again. It got clogged up and had to be completely deconstructed to find the piece with the clog. So I created a solution with a small fan connected to an LED. If that part ever gets clogged again, the lack of air flow through the fan will cause the light to flash red, and this helps us avoid the expenses of replacing parts." He showed me a video on his smartphone of the process of testing this fan/light solution that allows the laser cutter to indicate to its human users if there is an exhaust/venting problem.

I came to understand that the "ready, fire, aim" interactions Eric and his colleagues had with the laser cutter, particularly in those early months, were entangled with the amateur ethos of SMS, particularly, and of the maker movement. Because I was so utterly unfamiliar with any of the technologies in the space when I began my fieldwork, I tended to view Eric and his colleagues as experts on the laser cutter and other machines (and they certainly were, relative to me). But as I got to know the people and machines, I realized that, particularly, in the early months, everyone was an amateur. By contrast, this was very clear to Lauren from the beginning of her involvement with SMS. As an industrial engineering student, she was being trained in the disciplinary-centric model of expertise that the maker movement resists. After all, the philosophy of a makerspace is to create more access to machines—like laser cutters—that might otherwise only be available to engineers and fabrication specialists. Related to this democratizing impulse is an Aristotelian "learn-by-doing" ethos that encourages hands-on (literally) experimentation, troubleshooting, and even risk taking (within limits). Expertise is not located in a manual (or in a

degree) but in experience, which includes (and vaunts) failures. Being self-taught—like nearly all the regulars in SMS—is a badge of honor in a movement that privileges DIY and encourages people who might not otherwise feel authorized to learn and intervene in processes of design and production that are typically in inaccessible labs and factories.

But in SMS, at least, the "ready, fire, aim" ethos also affected safety and maintenance documentation practices in ways that created (further) disequilibrium, even as they were also inventive and inventional. As I talked to Lauren, I realized that in almost a year of observing people working on the laser cutter, including being walked through the process of operating it myself, I'd never seen a set of written instructions (other than a list of prohibited materials, printed from another makerspace's website, laminated, and hung from a lanyard attached to the laser cutter). It seemed that in laser cutter certifications, the training was conducted through verbal explanation of steps and safety protocols and close observation or hands-on experience. When Lauren was describing her concerns about machine safety in SMS—and particularly about information provided to volunteers—she directed me to wiki.sodo.ms, a site created by another volunteer who started when she did and who was also concerned about documenting machine safety information, as well as organizing volunteers and co-founders (much in the same way that Eric and Richard, particularly, have more recently worked to get other "regulars" to use Trello consistently). The brief entry on the laser cutter is a checklist that includes making sure the "lens [is] clean" and the "air [is] running." To my knowledge, the wiki site is no longer used or updated, since Lauren and the group of volunteers who started around the same time she did have mostly stopped going to SMS. The laser cutter entry, for example, was last updated in December 2014 and as of January 2016 had been accessed 4 times, one of which was by me. This led me to realize that the way safety and operation information is communicated (verbally,

in written form, or in haptic experience) and the accessibility of that information (the cost of certification training, the location on the internet and in SMS of written instructions) is a marking of boundaries that has much to do with who and what can come to matter—and who and what is excluded from mattering.

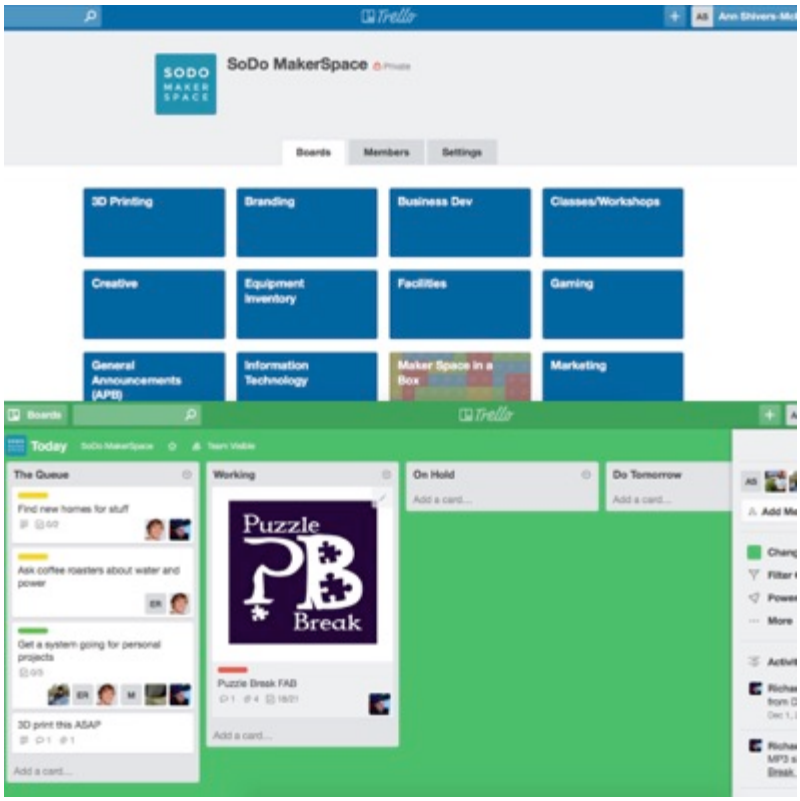


Figure 4. Top: the SMS "team page" on Trello. Bottom: the "Today" board, with cards for tasks and projects. Puzzle Break, a local business, is a regular SMS client.

I heard Eric address the issue of documentation when he was experimenting with etching fabric dye into pieces of acrylic on the laser cutter in July 2015. During that summer, SMS participated in the Seattle Youth Employment Program (SYEP), in which at-risk youth were paid by the city and placed in participating local businesses as volunteers/apprentices. A group from SYEP was in SMS helping with an art project for the community wall, and Seattle police officer Jojo Cambronero, of the department's community outreach section (according to the business card he gave me as we talked), was there visiting with the SYEP participants and chatting with

Eric as he experimented. (Officer Jojo—as Eric referred to him—told me his outreach to the youth included inviting them on all-day ride-alongs.) As they chatted, the fabric dye ignited, starting a small fire on the cutting bed, and Eric quickly switched off the machine. No harm was done, but once Eric had recovered the piece of acrylic, Officer Jojo asked, "So are you writing down what you're trying [on the machine]?" to which Eric replied, "In an ideal situation, we'd be writing down everything we try, but I'm just doing it on the fly." And when he realized that the machine hadn't burned the color from the fabric dye into the etched marks (an outline of the Seattle skyline) on the clear acrylic, he dabbed his fingers in the dyes (blue and green, for the Seattle Seahawks) and rubbed the colors into the etching until they showed up. "I'm calling this a success," he said.

But not all disequilibrium is tolerated (or framed as an opportunity for success). Seven months later, in January 2016 (not long after my conversation with Lauren), an incident with the laser cutter resulted in written documentation regarding laser cutter maintenance in the form of a blog post on the SMS site, as well as changes to the laser cutter's exhaust system. Tony Loiseleur, a freelance writer and self-described "shop assistant" at SMS, described this incident in a blog post on the SMS website titled "Making and the Art of Laser Maintenance." After several hours of cutting stencils for RainWorks, a startup incubated at SMS, the fairly new lens cracked, but "as best as we can figure, the reason [it] broke wasn't because we had been using [it] for hours on end—apparently, the manufacturer claims that it's able to run for eight hours straight, no problem—but rather a number of minor maintenance problems coming together to make for a perfect storm of lens destruction," Tony explained in the post. Eric and Jon, who has a BS in mechanical engineering and joined SMS in late 2015, went through the now-familiar steps of cleaning with rubbing alcohol and cotton swabs and checking the exhaust system.

Despite Eric's efforts in creating the LED light solution to alert human users to a fan problem, the exhaust system had "unfortunately gone without much maintenance" over the last several months, according to Tony, so Eric and Jon took apart and cleaned the fan. Jon also adjusted the bearings on the fan, which showed signs of heat damage, and he added a second fan and installed additional ducting for both fans (see Figure 5).

Figure 5. Added ducting for the laser cutter. Photo by Tony Loiseleur.

The implementation of the exhaust system upgrades was not only an effort to prevent future lens cracks but also an anticipation of an upgrade in the laser bulb. The laser had operated with a 90 watt bulb until January, and Eric had arranged to purchase a 130 watt bulb as part of a bulk order placed by his mentor at MakerLabs in Vancouver (in fact, he called this "a first step" in the regional makerspace network he hopes to establish). The new bulb was installed in late January, and because it is more powerful than its predecessor, the laser cutter users had to recalibrate strength and power settings for various materials. In February, I observed Eric troubleshooting with these settings on a ¾-inch piece of wood flooring (which the previous bulb would not have cut through). The previous week, while we were eating lunch at a nearby bakery,

Eric told me that as a result of his experiences in SMS, he had figured out how to solve a problem in his house that he wouldn't have known how to solve before: an uneven spot in his wood flooring that needed a custom-sized replacement piece. "I realized that I could take a pencil and a piece of paper and push the paper down into the spot and trace it in 3D, and then just cut a matching piece [of flooring] to fit," he explained. "And then I started thinking it would be cool to cut out designs in a piece of flooring for my kids' rooms—like their names, or shapes."

Indeed, disequilibrium is a reality in SMS, whether it is being cultivated in rapid prototyping practices or it is an unintended byproduct of operations in what Eric calls a "bootstrapped" makerspace. But I can attest, even from my more limited engagement as a researcher, that continual exposure to disequilibrium (and the resulting problem solving processes) affected how I thought about problems and invention—from fixing things around the house to prototyping this dissertation. So the following week, as I watched, Eric experimented with cutting out puzzle piece shapes in a piece of wood flooring. This time, he was noting the strength and power settings directly on the piece of wood, next to various cuts (see Figure 6).

Figure 6. Left: a close up of the flooring piece Eric was experimenting on, with notes on the strength and power settings and number of passes for a series of cuts. Right: Eric consults another section of the practice piece with a small strength/power test grid.

While Eric was not recording these settings in the way that I suspect Officer Jojo meant (months earlier) when he asked him if he was writing down what he was trying, these notes were certainly guiding Eric's efforts in this particular project. As is visible in the right image in Figure 6, Eric had, the day before, found a strength and power combination that successfully cut through the practice piece, and he was now attempting to recreate that cut on a new piece. But the settings that had worked before were not working today: the puzzle pieces were not dropping free. Eric offered several reasons for this: the flooring piece could have a slight difference in thickness from the practice piece, or this piece (or the practice piece) could be slighted warped, or there might be a different amount of moisture in the air or in the material, or there could have

been a temperature difference. “Too many variables to track and write down,” he added. “It’s easier to just get through it.” (Indeed, this was not an unusual philosophy of documentation in SMS.)

And this brings us to the little laser cutter fire that begins this genealogy. Eric instructed the laser cutter (via the driver) to make another pass, this time at a slower speed and after it began cutting, he turned away to set his practice piece (with the notes) on a nearby table. Out of the corner of my eye, I saw a flame on the laser cutter bed through the glass door, and I called Eric back. He grabbed his water bottle and opened the machine door, which automatically shut off the laser. The fire went out with the rush of air (just as I took the photo in Figure 7), and Eric removed the burned pieces. (Now that I’ve seen fires on the laser cutter, Eric’s “ready, fire, aim” metaphor at the beginning of this genealogy has taken on a whole new meaning.) He speculated that the fire might have been caused by having the laser make another pass when the material was still hot from the previous pass, or perhaps the speed setting was too slow. He made a note on the burned pieces of the speed and power settings on the pass when the fire occurred.

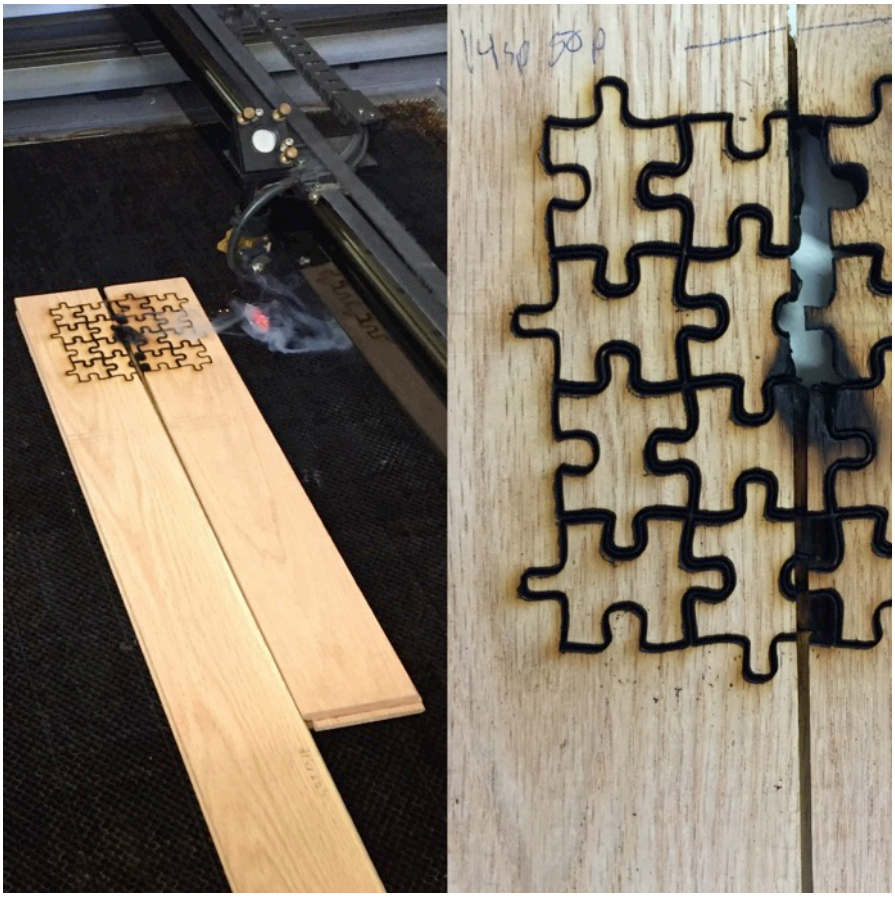


Figure 7. Left: the last flicker of the laser fire. Right: the burned pieces, with Eric's note on the speed and power settings.

Eric then removed the cutting bed and opened a panel on the front of the machine, pulling out a tray full of bits of materials from previous cuts. He dumped the tray in the trash and grabbed a broom to reach further back into the machine to try to sweep out still more pieces. “It’s only gonna be as nice to me as I am to it,” he pointed out as he cleaned (see Figure 8). Jon walked in and saw Eric crouched in front of the laser cutter with a broom. “Just a little fire in the laser cutter,” I said, and he nodded.

Figure 8. Eric cleans debris from previous cuts on the laser cutter.

Two weeks later, in mid-February, I saw a printed set of daily, weekly, and monthly maintenance steps for the laser cutter sitting on the laser computer station (see Figure 9), and I learned that Jon had produced them. When I saw the instructions, I was reminded of the defunct wiki instructions Lauren had shown me. There are similarities: both sets of instructions offer a checklist and attend to the fan/exhaust system, but while the wiki instructions seem to focus on daily use, Jon's instructions include many more steps and include longer-term maintenance. While, as both Lauren and Eric had told me, the regular users of SMS in its early months were mostly "amateurs" (their word), the addition of two "experts" (a word used by Eric and Tony to describe both Jon and Alex, the resident 3D printing guru) in late 2015 seemed to have tempered the "ready, fire, aim" ethos and brought about changes in the troubleshooting and documentation practices with the laser cutter and 3D printers (I will discuss the latter below).

I asked Tony if he'd worked on this set of laser cutter instructions, since I knew he was invested in making more written documentation for training and machine maintenance and had

helped Alex with written instructions for the 3D printer certification. “Yeah, no. I wish I could have edited them, though,” Tony replied. “Did you see how it says ‘monthy,’ like without the ‘L’?” (In fact, someone had handwritten an “L” in the misspelled word.) “Stuff like that could make us look bad, like we’re not accurate,” he continued. Just as Jon had provided a correction to problems in the exhaust system and problems with human maintenance of the laser cutter, Tony saw his expertise in writing and copyediting as providing a correction to the professional image of the space, particularly in its written artifacts.

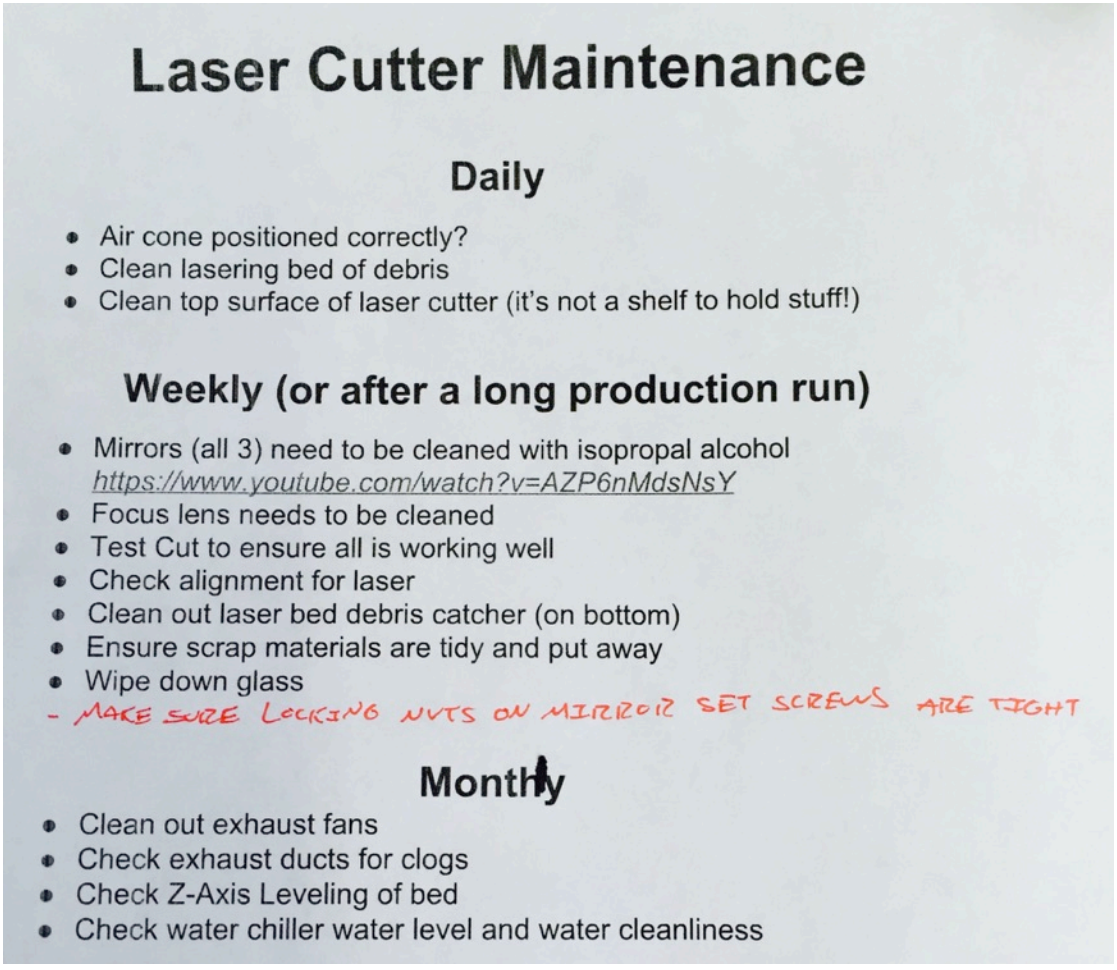


Figure 9. Laser cutter maintenance instructions, photographed in February 2016.

Failed But Still Cool

As I considered the contrast in these laser cutter instructions (which, I should note, were not readily taken up in SMS) and the "ready, fire, aim" approach, I pondered Eric's remark that it was easier to "just get through it," which reminded me of what he'd said to Officer Jojo seven months earlier—that "in an ideal situation" notes would be recorded on strength and power combinations. I was struck by the realization that, in this situation, learning by doing was perhaps a more effective, or at least realistic, way of documenting than attempting to record everything in writing. "Learning by doing" is an embodied practice involving written notes to himself, numerical instructions to the laser cutter via the driver, remembered experiences, machine knowledge, environmental and material variables, and experimentation with settings. (After all, as Aristotle said in *Nichomachean Ethics*, "for the things we have to learn before we can do them, we learn by doing them.")

Indeed, an important factor in this kind of embodied knowing, I've learned, is time. As we see in Spatial Manipulations, Alex measured Tony's training on Alex's reprap 3D printers in spools of filament. Over time (or, specifically, "after you've used up a spool or two"), Alex told Tony, "you'll get a feel for things," including learning how to "eyeball" things that initially require machine- or tool-aided measurement. In fact, "getting a feel for things" often results in a kind of cyborg embodiment wherein a human's sensibilities—including proprioception, like eyeballing 3D printer measurements or knowing a (relatively) safe distance between fingers and laser beam—extend to include the appendages and movements of a machine. (Or, in a less-human-centric sense, a human body is recalibrated to a machine.) When this is going well—at least from the human's perspective—the result is a making of an object from an idea, or the making of a maker. But sometimes this embodied cyborg knowing goes awry, resulting in

disequilibrium—a different kind of making, including the making of literal marks on bodies. I have witnessed a few small nicks and cuts on human bodies (usually hands) in SMS, and Clarissa told me that there was a somewhat more serious finger injury on the CNC mill in the early months of SMS. I also observed that the laser cutter fire I described above (Figure 8) left a permanent light-gray burn mark on the laser cutter's grated cutting bed, and in the aforementioned blog post, "Making and the Art of Laser Maintenance," Tony documented burn marks on the bearings of the laser cutter's fan engine as a result of a lack of regular maintenance and readjustments.

In fact, embodied knowing or learning often happens *through* disequilibrium, including the making of mistakes, which are often themselves embodied things that take on a life of their own or change future makings. For example, "failed" 3D prints often take on a life of their own that exceeds or diverges from the original purpose. As I describe in Spatial Manipulations, my failed 3D printed *Star Trek* combadge may not have been what I'd envisioned, but it was still strangely beautiful to me, and it helped me understand the movements of the 3D printer as it creates layers in an object. Similarly, Richard noticed when he was 3D printing a skull (for Halloween) on one of the MakerBots that the filament was unusually stringy because it had absorbed moisture from the air (and in the fall in the Pacific Northwest, there is considerable moisture in the air), creating a webbed effect (see Figure 10) where there should have been open spaces. Months later, I learned in a conversation with Alex that this is called filament "snot" and that snotty prints can be avoided by storing filament in airtight containers—a practice Alex has implemented with the filament for his 3D printers, though the filament spools for the MakerBots, which are still what Richard primarily uses, are still stored in the open air above the machines. Still, while snot is generally undesirable in 3D prints, the effect was fitting for a Halloween skull,

which was on display for months on a shelf of 3D printed curiosities that I discuss in Spatial Manipulations (Figure 10).

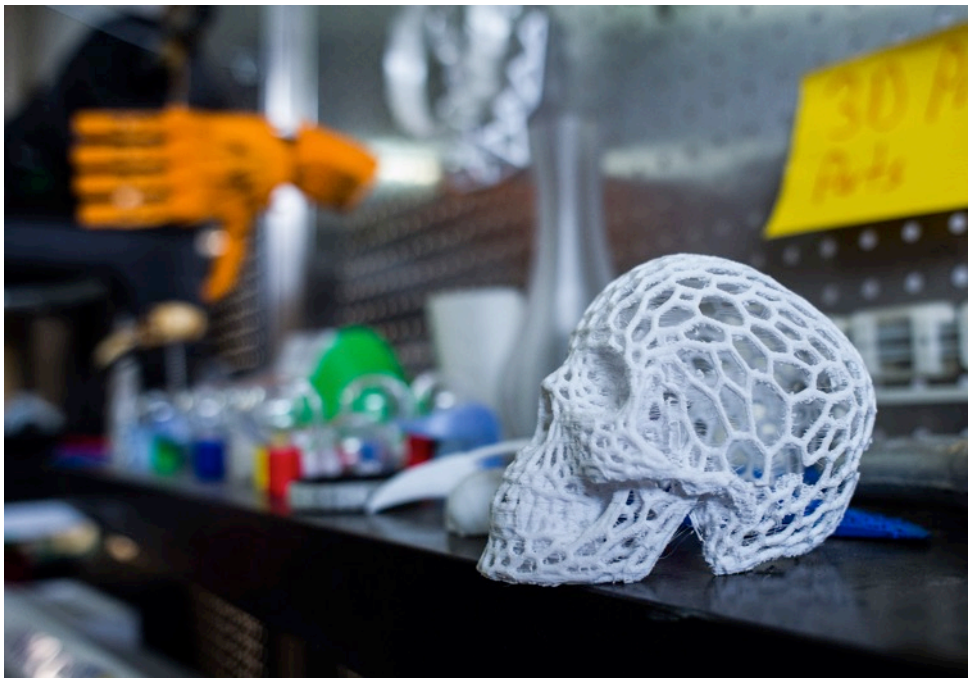


Figure 10. The snotty--and appropriately creepy--3D printed Halloween skull, photographed in February 2016 by Daniel McNair.

And I'd only known Alex for a few weeks when he offered me a "failed print" of a small vase printed from PET filament (the same material soda bottles are made from) that looked surprisingly like etched glass. I took the vase with me to a meeting with my dissertation committee a few weeks later to use as a "show and tell" object as I explained my 3D interviewing methodology to them. Alex keeps all his "failed" prints in a clear plastic box (just below his 3D printers) labeled "FAILED (But Still Cool) PRINTS" (see Figure 11). Much like the assortment of 3D printed objects displayed on a nearby shelf (see Figure 10), these objects not only helped the maker adjust settings for future prints but also serve to illustrate techniques and possibilities to other makers, like people taking the 3D printer certification class.

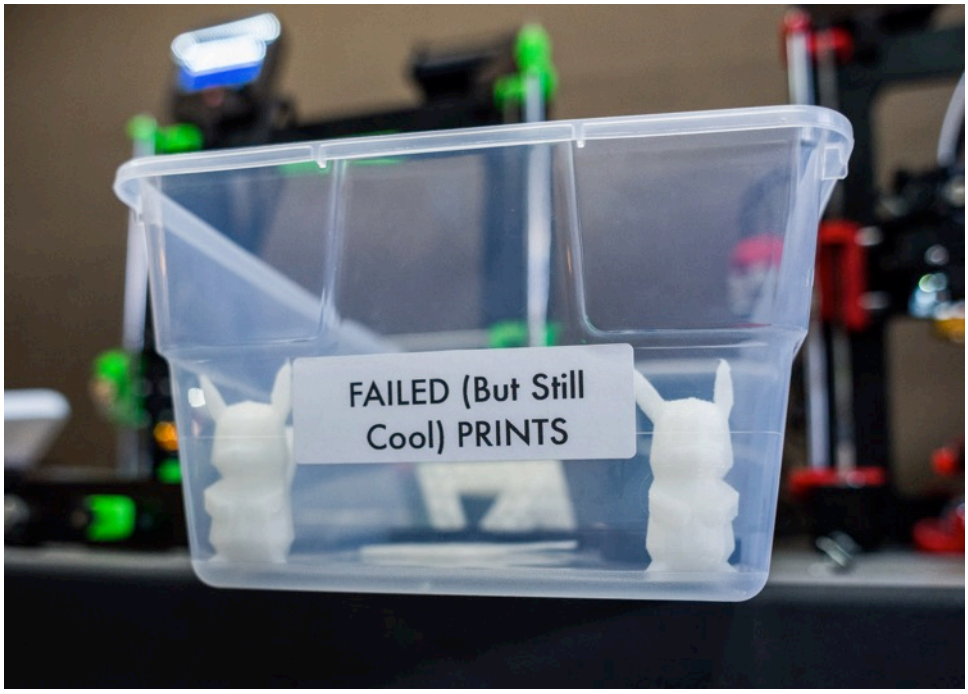


Figure 11. There is an ever-changing assortment of objects in the "FAILED (But Still Cool) PRINTS" box. On this particular day in February 2016, there were two Pikachu figures, in honor of the 20th anniversary of Pokémon. Photo by Daniel McNair.

Mistakes or other problems—like warped materials, design flaws, or malfunctioning machine parts—can also result in unexpected entanglements of human and machine labor, as was the case when (as I describe in Chapter Two) Richard used his fingers to flatten warped plywood on the laser cutter. And that day in April 2015 when I observed Eric going from idea to object (and problem solving) on the laser cutter, he was simultaneously engaged in trying to fix a filament jam in the extruder piece of one of the MakerBots (which, at the time, were the primary 3D printers in SMS). He ended up having to stand next to the machine with his arm in the top of the machine, applying pressure to the extruder with his hand, or as he put it, literally "giving the machine a hand."

Similarly, when Clarissa San Diego described to me (via Skype) her experience of learning to use the CNC machine (see Figure 12), which she says is her favorite machine in SMS, along with the laser cutter, she mentioned not only time and her own mistakes, but also

problems with the machine itself, as integral to her learning process. (Like Eric's first job on the laser cutter, making a poster for a graphic design firm, Clarissa's first job on the CNC was a "ready, fire, aim" job for a client who had commissioned six-feet-tall marquis-light letters made from lavender foam.) "I loved it because it was a huge learning process for me," she recalled. "I made tons of mistakes; I failed; I wasted material, money, and time. But after it was done, you really felt that satisfaction of, 'wow, I made this,' and the next time going around was way easier." And it wasn't just that Clarissa experienced a learning curve on that particular process of going from idea to object: "at the time, our CNC machine was acting up every other hour, and that's when I got really intimate with the CNC. I was like, 'all right, [laughs] I'm gonna get to know you in and out because you keep breaking on me and I need to know how to fix you.'" She paused, and continued, "And that's kind of been the case: it's just always not being afraid to fail, understanding that when things go wrong, there's a process to figure out how to make it right. And it's so great—once we turned on all the marquis lights, you just kind of forgot all that, it was just, 'wow, it was worth it.'"

Figure 12. The CNC milling machine, one of Clarissa's favorites, photographed in February 2016 by Daniel McNair.

Who Makes?

In fact, I've observed a tendency among many of the makers in SMS to anthropomorphize machines: Clarissa's referring to the CNC in second person as someone she got to know well, Eric's "giving the [MakerBot] a hand" and his observation that the laser cutter would only "be as nice to me as I am to it," as well as Alex's practice of giving the reprap machines he builds names (like Little Millie and Big Buddha) that are different from the official product names he eventually gives them. This anthropomorphization is breaking a system (in this case, who counts as a maker) by re-marking boundaries: in addition to the expansion (re-marking) of proprioception to include both machine and human appendages, there is also an expansion (re-marking) of who and what count as a maker. Learning to see the machines as makers is part of the embodied process of becoming a maker. We might even call it "significant prosthesis": as Donna Haraway (1988) explains, "Embodiment is significant prosthesis: objectivity cannot be about fixed vision when what counts as an object is precisely what world

history turns out to be about" (p. 588). Or as Karen Barad (2007) puts it, "bodies in the making are never separate from their apparatuses of bodily production" (p. 159).

Mattering as a maker—becoming a body recognized as a maker—is not solely the purview of humans, but neither are all humans made to matter as makers. In some ways, the laser cutter, the 3D printers, and the CNC machines are addressed as "makers" more than some people (particularly those who do not engage in the kinds of making practiced in SMS and the maker movement—a reminder that the maker movement and the technologies associated with it are not neutral). While other forms of disequilibrium in SMS can be sites of invention and possibility, this disequilibrium, or boundary markings that create imbalances in who and what count as makers, is a site of exclusion and foreclosure. While the SMS regulars are committed to increasing diversity in SMS and access to fabrication technologies, others in the maker movement and tech industry, such as Debbie Chachra (2015) and Amy Nguyen (2015), have pointed out that the privileging of the kinds of making associated with the maker movement and the tech industry is a privileging of traditionally male practices. Indeed, the definition of "maker" in SMS and the maker movement does seem to be tied to certain kinds of making (often involving heavy, expensive machinery) and not other kinds of making, like the kinds of making that often get labeled "crafting" and that are traditionally associated with women and indigenous peoples.

But just as the fabrication technologies can themselves be barriers to a human's being recognized as a maker (because they may be intimidating, or because they might not correspond with what that human wants to make), not all non-human makers are granted equal status by their human users. Consider, for example, the MakerBot 3D printers and Alex's 3D printers. Even before Alex and his 3D printers joined SMS, Eric and Richard (in particular) frequently

expressed their annoyance with the MakerBots—and usually in the same breath—the company that makes them. For example, when Eric was giving the MakerBot's jammed extruder a hand, he remarked that the extruder was a "piece of shit" and "I can't believe [MakerBot] puts their name on it." He added that the replacement part was sold out—probably because they all break so quickly, he speculated—and that he would have to pay $100 to talk to customer service or buy another entire MakerBot printer, neither of which he was willing to do. Instead, he said, he had taken apart this extruder's predecessor and was determined to learn how to fix it himself. Though MakerBot is closely aligned with the maker movement, Eric is not alone in his irritation with their 3D printers (and the extruders, specifically), as evidenced in a Reddit thread entitled "Is MakerBot really that bad?"—to which the answer is mostly a litany of complaints against MakerBot. As Richard explained to me in fall 2015 (and as some of the Reddit posters in that thread also describe), MakerBot has fallen out of favor with some makers not only because of alleged issues with quality and customer service but also because the company's response to increased competition in the 3D printer market was to make what had once been open source hardware and software closed source, a decision Richard called "short sighted."

By contrast, both Alex and his 3D printers were referred to with respect and admiration. Eric called Alex the "3D printer genius" from the beginning, and he was clearly positioned as the 3D printing expert in SMS. I accompanied Eric and Jeremy Hanson, founder of Seattle startup ReWork Nation and a regular in SMS since fall 2015, to visit Alex's workshop in January 2016, just before Alex brought two of his machines into SMS. Both Eric and Jeremy were visibly delighted by Alex's machines, which he built in eye-catching color combinations like green and black, or red and chocolate brown. They were equally delighted by the neatness and efficiency of Alex's workspace, including desktop lazy susans he designed for in-progress machines (see

Figure 13). Alex's machines are entirely open source. For example, Alex built the red and chocolate brown Prusa I3+ using 3D printed, laser cut, and off-the-shelf materials, and he modified the design from the reprap Prusa I3. (Reprap refers to open source 3D printers that are capable of self-**rep**lication, meaning they can print the parts from which they are made, and **rap**id 3D prototyping. I3 = iteration 3. Alex told me he added the "+" to the name of his printer because "I wanted to show that lineage.") The only problems that have occurred thus far with Alex's printers have either been user errors (by people learning the machines) or problems with the computer connected to the 3D printers, which lacked a sufficient graphics card to execute the G code slicing (described in Spatial Manipulations [link]). (Tony documents the work to upgrade the 3D printer computer in a February 23 blog post entitled "Misadventures in Preparing Our New Slicing Station.")

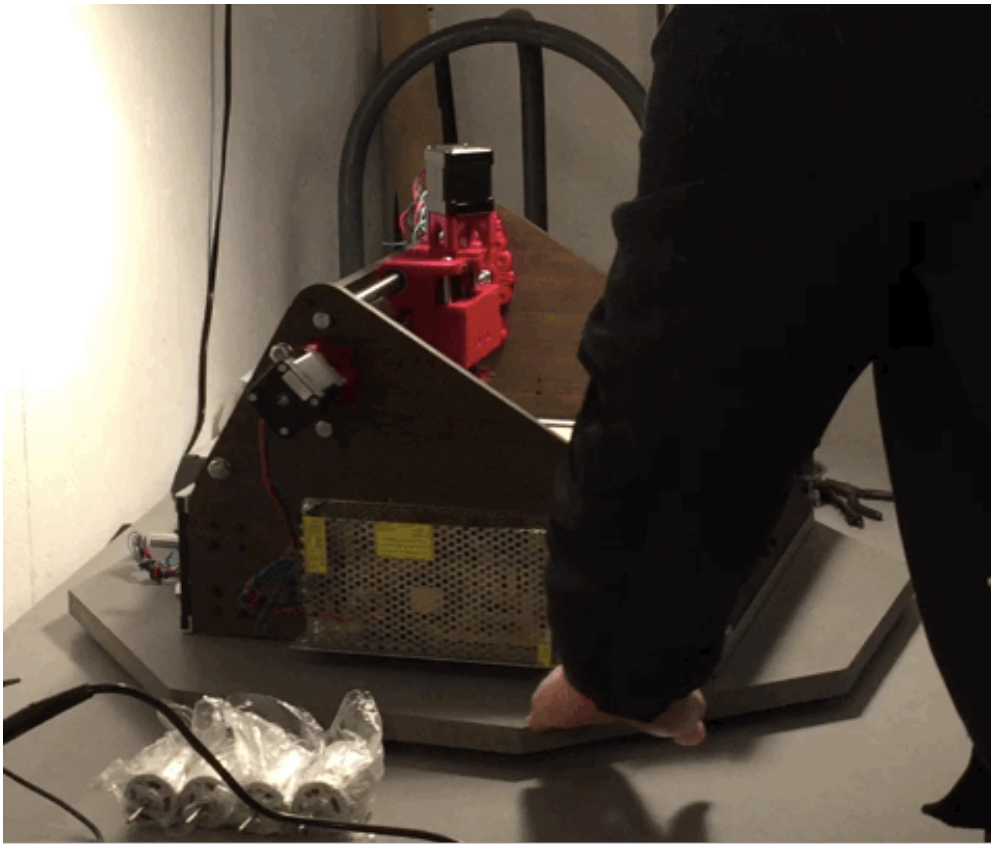


Figure 13. Jeremy captures phone video of a lazy susan in Alex's workshop. On the lazy susan is an in-progress mini CNC mill Alex calls "Little Millie."

In February 2016, Alex, Tony, and Richard were discussing a set of panic buttons (each played a different sound when pressed) that Eric had bought to put at each machine, and Richard joked that the one that played a trumpet fanfare sound should be assigned to the MakerBots to be pushed "if they ever execute a flawless print—so basically never." Still, Richard continues to use the MakerBots to print seasonal items and, as he turned his attention to preparations for launching his LEDiva microcontroller, he used a MakerBot to 3D print small boxes to organize the parts and tools for assembling a test batch of LEDiva. In fact, I've noticed that while, at the beginning, Richard was the only co-founder who already knew how to operate all the machines in SMS (because of his prior experience at MakerHaus) and thus was often responsible for helping with problem solving and training people on all the machines, the arrival of other

experts—like Jon, "the laser guy" (Tony's words), and Alex, "the 3D printer genius" (Eric's words)—allowed Richard to focus more on his own interest and expertise in small electronics. Indeed, Tony referred to Richard as "our electronics maven" in a February 18 post entitled "LEDiva Revision B Testing." While this disequilibrium at the level of the SMS system—the shift away from the amateur ethos that characterized the early months of SMS—opened up new possibilities for making for Richard, the increased emphasis on fabrication expertise also made it more difficult for Tony to make space for himself, as I describe in Chapter Three.

The disequilibrium between the maker-movement-inspired amateur/DIY ethos and the increased privileging of fabrication expertise parallels an economic disequilibrium in the production and revenue systems of SMS. While SMS, like the maker movement, frames itself as a rapid prototyping space—for inventors, entrepreneurs, artists, hobbyist, small business owners, kids, and others who might not otherwise have access to such technologies—the reality is that rapid prototyping services—sometimes a one-off weekend project for a hobbyist, or an occasional prototype for an inventor—is not a steady or significant revenue generator. Clarissa designed the *à la carte* pricing model that SMS relied on for most of my fieldwork to be responsive to the fact that many clients of makerspaces are hobbyists who would rather pay as they go for certifications and machine time than buy a monthly membership to the space. The problem with the *à la carte* model was that there were not enough repeat or steady customers, leading SMS to shift to a membership model in early 2017. But the membership model faces similar challenges; indeed, SMS rose out of the ashes of another makerspace that operated on a membership model. Emerging research on makerspaces suggests that the business model may not be sustainable, not only in the U.S., but also in China and Europe (Lindtner & David, 2012; Wang, Dunn, & Coulton, 2015).

SMS has thus increasingly focused on steadier sources of income, including incubating products—like the aforementioned RainWorks—for mass distribution and taking a percentage of the profits. Like the maker movement, SMS positions itself as disruptive, in the sense of democratizing access to prototyping technologies. But it is also reliant on traditional, globalized, capitalist systems of production. While RainWorks was prototyped in SMS, it is mass produced with materials sourced from other countries and assembled and distributed in an international production and distribution facility near SMS. SMS is indeed democratizing access to prototyping technologies and thus creating opportunities (at least for some bodies), but it does so within, not outside of, the global forces of disequilibrium in neoliberal fast capitalism.

Implications

Disequilibrium—both as an inevitability and as an inventional practice—operates at the intersection of the local and the global, and the re-marking of boundaries opens up possibilities for some bodies and forecloses possibilities for others. In this way, disequilibrium can serve as a site not only for invention but also for intervention. The laser cutter fires resulting from the "ready, fire, aim" approach drew attention to sites of communication (or miscommunication) that might otherwise have been taken for granted or not well understood. And the disequilibrium I experienced in the marking of my gendered difference drew my attention to the politics of technologies and making practices in a way that reminds me of the Selfes' (1994) call for attention to the politics of interfaces in computer tools for composing.

I would argue that it is important to keep that sense of disequilibrium—as an occasion for paying attention to boundary marking practices—in mind when we employ disequilibrium as an inventional practice in the ways described, for example, by Marc Santos and Megan McIntyre (2016), who draw on Jody Shipka's work in advocating for asking students to work "outside the

expectations and forms of established genres" in order to expand their "creative capacity, autonomy, and their ability to negotiate ambiguity" (para. 3). Like technologies and interfaces, disequilibrium itself—even as a pedagogical or inventional strategy—is not neutral; it is inherently political, differential, a boundary marking practice. Just as Kate Losse (2016) emphasizes that "failing fast" in Silicon Valley is not a universal experience but a privilege afforded primarily to white men with access to venture capital, "failing fast" in writing classrooms is entangled with difference and privilege.

Furthermore, the problems in what Eric describes as a "bootstrapped" makerspace—run by a collective of people ranging from amateurs to experts, some self-taught and some formally trained—are often and perhaps not surprisingly what Horst Rittel and Melvin Webber (1973) describe as wicked problems, in the sense that there are, as Eric says, "too many variables" (human and nonhuman), in the sense that the expertise required to (permanently) solve a problem sometimes exceeds the knowledge of the user, and in the sense that fixes sometimes lead to more problems. In a new materialist sense, the problems are wicked (perhaps regardless of whether humans experience them as such) in that they involve an entanglement of interfaces among humans, nonhumans, time, materials, alphabetic and spoken languages, written and embodied knowledges, gestural and haptic interactions, and cultural and economic forces. It seems that the regulars in SMS tend to work with, rather than against, these wicked entanglements by treating both problems and solutions (however temporary) as "open source." I mean that not only in the sense of open source hardware and software (so prized in the maker movement and in DIY culture) but also in a metaphorical sense. As Clarissa explained, it's "understanding that when things go wrong, there's a process to figure out how to make it right." And that process almost always involves distributed knowledge that spans written, verbal, gestural, embodied, digital,

analog, human and nonhuman forms. In other words, to become a "maker" or even an "expert" seems to be as much about learning through failure as it is about learning from codified knowledge, and as much about seeking out "open source," distributed knowledge as it is about possessing individual knowledge.

Richard Marback (2009) argues that composition studies has failed to account for the wickedness of design (which he equates with rhetoric) by "isolating the 'individual action' of the designer from the agency of artifacts" (p. 408). Marback is referring specifically to Gunther Kress's focus on a composer who agentively navigates the affordances of various media, but I would extend Marback's argument to the use of individual reflections for teaching and assessing the wicked problem of design. As I point out at the end of Spatial Manipulations, what Slattery (2005) calls mediation, or what Marback calls design, is a wicked problem in a more-than-human sense, in that "agency" is a complicated matter that extends beyond a single human writer/rhetor/designer/maker. Agency also extends beyond what Brendan Faber (2002) calls the "neoliberal hangover" of the structure vs. (individual) agency model articulated by Anthony Giddens (1987), which suggests that an individual can combat the forces of "structure" if they work hard enough or possesses the right skills (or "literacies," as Johnson-Eilola and Wysocki [1999] point out in their critique of the neoliberal promise of literacy-as-mobility). But as Karen Barad (2012) points out, to take an entangled, multi-interfaced view of agency is not to "democratically distribut[e] agency across an assemblage of humans and non-humans"; rather, "[t]he specificity of intra-actions speaks to the particularities of the power imbalances of the complexity of a field of forces" (p. 55).

As we prepare students to intervene in rhetorical situations and wicked problems, to write in vastly complex fields of forces in academic and professional situations, perhaps instead of

presenting “skills” as individual to a singular writer/rhetor and “affordances” as compartmentalized to media and genres, we could present these things as an entangled, multi-interfaced field of forces. Furthermore, we can create safe spaces for productive disequilibrium and encourage students to engage entangled failures productively, to recognize the importance of time, to see problems and their solutions as entangled (or wicked) and “open source,” and to be mindful of the processes of embodiment—including who and what comes to matter and who and what is excluded from mattering—involved in solving problems. And we can apply the same approach to assessment—which is just as wicked a problem as design—as I discuss further in Chapter Six.

Chapter 5. COMMUNITY STRATEGY

With Clarissa San Diego

The genealogies in Chapters Three and Four focus on relatively local phenomena: acts of making (integrating into systems and breaking systems) in SMS. As I turn, in this portion of the dissertation, to implications for collaborative knowledge making, professional practice, and pedagogy, the scope of these chapters expands beyond the physical space of SMS. Furthermore, in Chapters Three and Four, my attention to boundary marks was primarily descriptive, as I accounted for my understanding of the ongoing marking and re-marking of boundaries in SMS and in my own research(er) apparatus. My experiences describing and accounting for boundary marks in SMS opened up new possibilities for implementing my theoretical-methodological apparatus not only as a tool for theorizing but also as a tool for practice. Therefore, in this chapter, as in Chapter Six, I turn to strategies for ethical boundary marking in practice.

In this chapter, Clarissa and I offer an account both of our collaborative knowledge making process and of our analysis of her work as a community strategist in the maker movement and related industries. The scope of this chapter tacks between the local (relative to SMS)—the specifics of our collaboration, her work in SMS—and the global—her international consulting work, as well as the intersections we trace among international community strategy, intercultural technical communication, and global UX. Community strategy emerges as a practice of ethical boundary marking (both in collaborative research and in professional practice). In particular, localization is a key community strategy practice through which boundaries (such as local/global, user/provider, useful/not useful) are continually marked and re-marked. In what follows (adapted from our contribution to the May 2017 issue of *Technical Communication*), we account for the making and marking of our main argument, which is

twofold: first, that the multifaceted localization practices of community strategists intersect with and are integral to user experience and user localization processes, and second, that collaboration—between researchers and practitioners, and among community strategists, technical communicators, and user experience researchers—is itself a localization practice that can support design, engagement, knowledge-making, and social justice work.

Globalization and Localization

Technical communication researchers and practitioners are recognizing the importance of cross-cultural, cross-contextual engagement in our increasingly globalized work (see, for example, Getto 2014, 2015; Jones, 2014; Herrington, 2010; Starke-Meyerring, Duin, & Palvetzian, 2007). Communicating competently and effectively across geographic and cultural differences demands a skillful and dynamic coordination of audiences, meanings, and technologies: St. Amant and Rich (2015) emphasize the importance of creating and sustaining interactive communities as a means of effectively engaging and communicating across physical and cultural boundaries. Indeed, while our commitment to knowing and engaging our audiences remains foundational to our work, a focus on globalization brings to our attention both the possibility for wider engagement and the need to communicate effectively across differences.

Key to this globalized, cross-cultural work is localization, the practice of contextualizing technologies (Sun, 2006, 2012; Suchman, 2002) and meanings (Gonzales & Zantjler, 2015) in specific communities. As Breuch (2015) explains, drawing on Sun (2012), localization involves "paying attention to the characteristics and needs of a particular culture, population, or even individual" as a way to "resist stereotypical characterizations of culture that may manifest when we think of 'globalization'" (p. 114). Breuch offers "glocalization" as "an approach that strives to balance both universal (broad range of cultures) and particular (specific cultures) needs and

concerns" (p. 114). Indeed, we would add that not only is localization (or glocalization) about *balancing* the universal and the particular, but it is also a practice of *marking* and negotiating the boundaries between the universal and the particular in ways that are responsive and accountable to users.

Both glocalization and localization bring together the shared concerns of technical communicators and user experience researchers: As Breuch notes, to put localization into practice, communication and UX researchers must engage more closely with the people for whom they are designing. A shared concern for engaging audiences and communities is at the heart of the field's exploration of the expanding definitions of technical communication (Henning & Bemer, 2016), particularly in relationship to user experience (see, for example, Getto, 2014; Lauer & Brumberger, 2016; Redish & Barnum, 2011; Redish, 2010). It is precisely the need for sustained engagement upon which the present study seeks to build and expand. We describe a collaboration between a researcher (me) and a practitioner (Clarissa) that led to an analysis and articulation of the importance of international community strategy work both to the practice and to the research of localized global user experience and cross-cultural communication, and also to social justice research and practice.

Social justice work in technical communication is another practice of attending to and intervening in boundary marks. A growing body of scholarship emphasizes the importance of empathetic, social justice-oriented approaches to cross-cultural, cross-contextual engagement (see, for example, Agboka, 2013; Crabtree & Sapp, 2005; Jones, Savage, & Yu, 2014; Scott, Longo, & Wills, 2006; Walton, Mays, & Haselkorn, 2016). Indeed, social justice research and practice shares with cross-cultural communication approaches a commitment to localizing information and design for specific communities and audiences, with attention to working across

differences (see Kerschbaum, 2014), and to building and supporting interactive, dynamic communities. Crucially, social justice work aims not only for cross-cultural communicative competence but also for advocacy and change. Agboka (2013) offers a synthesis of perspectives on social justice that includes "'advocacy for those in our society who are economically, socially, politically, and/or culturally underresourced' (Frey, Pearce, Pollock, Artz, & Murphy, 1996, p. 110)"; "communion, cooperation, and liberation (Crabtree, 1998)"; and "inclusiveness, dialogue, and passion (Artz, 1998)" (p. 28). Or, as Jones and Walton (forthcoming) put it, social justice work should be "a collaborative, respectful approach that moves past description and exploration of social justice issues to taking action to redress inequities" (n.p.). Furthermore, social justice concerns encompass not only our methods and practices but also our theories, definitions, and sites of focus. For example, Jones, Savage, & Yu (2014) argue that increasing diversity in the field should change not only the demographics of the field but also the practices and concerns of the field. Grabill & Simmons (1998) and, more recently, Walton, Mays, & Haselkorn (2016) have argued that technical communicators committed to understanding and practicing culturally sensitive social justice work should expand their research purview beyond traditional business organizations to include non-profit and humanitarian organizations. Indeed, social justice work in technical communication involves re-marking and renegotiating the boundaries of who and what count within our own field, as well as in the phenomena we study and to which we contribute.

We build on this work by highlighting the intersections of technical communication, user experience, and community strategy work through the lens of localized social justice and inclusion advocacy. Indeed, our commitment to social justice in both research and practice shaped the nature of our collaboration and, in turn, our methodology and methods, as we

describe below. In other words, our commitment to re-marking boundaries between technical communication, user experience, and community strategy (as well as between researcher and practitioner) is itself a boundary marking practice that shapes our work and our findings, just as my research(er) apparatus in SMS was as much part of the phenomena as it was a way of accounting for phenomena. Following Walton, Zraly, and Mugengana (2015), who present both their research process and their research findings as their argument, we offer both our dialogical collaboration between a theorist and a practitioner and our exploration of the connections between community strategy work, user experience, and localization as our argument for decentralized and localized approaches to the generation of theory and practice. Specifically, we argue that the characteristics of community strategy we highlight here—localizing communities, goals, communication, and inclusion—are at the heart of the overlap of cross-cultural technical communication, global user experience, and social justice work. We begin by defining community strategy, then we illustrate its multi-faceted localization practices in theory-building and in practice. We conclude with a discussion of the limitations of our study and possibilities for ethical boundary marking in further collaboration and practice.

Community Strategy

We chose to use the term *community strategy* because it is how Clarissa, a practitioner, describes her work and because we want to emphasize how essential both community and strategy are to the work. Following researchers like Spinuzzi (2015) who note the rise of all-edge adhocracies (dynamic, rhizomatic, nonhierarchical organizations), we illustrate community strategy as an adhocratic boundary marking practice that exceeds the scope of a traditional bureaucratic organization. We describe community strategy in terms of the practices it shares with technical communication and user experience, particularly listening (Breuch, 2001),

responsivity (Long, 2014), and audience analysis (Ross, 2013), in addition to localization, in the hopes that more collaboration and research will carry forward these fruitful intersections and complementary practices.

At its most abstract, community strategy is bringing people together in ways that center shared goals through localization. Specifically, community strategy bridges (or re-marks the boundaries between) developer localization, which Sun (2012) defines as "the localization work occurring at the developer's site that we commonly refer to when thinking of localization," and user localization, which is "energetic user efforts of using a technology within meaningful social practices and incorporating the technology into one's life" (p. 40). To connect developers and user communities, Clarissa draws on her knowledge and experience in hardware and software—one example is in her producing a tutorial that implemented a past employer's microcontroller along with coding instructions for a simple solution for finding a phone set on silent for hackster.io, an online community focused on hardware. She also organized the DevRel Summit, a one-day conference featuring talks and workshops focused on professionalizing and supporting people who work in developer relations (which involves connecting platform and API providers with developer communities). As a cofounder of a makerspace in Seattle, for example, Clarissa focused on assembling a team with different and complementary skillsets (in hardware, software, and management), experiences, perspectives, and identities, and she focused on leveraging those team members' networks and skills to connect with local communities. And as an advocate for inclusivity in technology industries, Clarissa works to create online and in-person communities of support—be it a Slack channel for people of color in hardware and software industries around the world or a Women Who Code meet-up in Seattle.

The focus on communities and their goals is also why we prefer *community strategy* to a term like *growth hacking*, though, again, community strategy can certainly include growth hacking. In addition to the resistance to the term growth hacking Clarissa has encountered from colleagues in software and hardware development (who are concerned about who and what is being hacked), we also note that growth is not always the desired or best outcome for the developer, provider, or the community. Community strategy emphasizes the localized nature of outcomes and the importance of tailoring both the nature of the engagement and the measure of that engagement's success to the community, rather than imposing a set of goals or assumptions. Localization of engagement is another point of connection between community strategy and global UX, which, as Quesenbery and Szuc (2012) emphasize, demands that assumptions (boundary marks) be laid bare and open to change based on deep, immersive knowledge of a user community.

The emphasis on strategy in the name *community strategist* highlights the skills involved in building relationships, connecting complementary differences, and localizing developer and community goals. Indeed, a community strategist cultivates a global network of people with diverse skills, identities, and experiences, covering a range of organizations, cultures, languages, and geographical locations, in order to be able to wield that network effectively for specific purposes—whether it is connecting a Polish data science company with niche U.S. markets, or connecting a person of color who may feel alone in his workplace with a community of other people of color in working in technology. In other words, a community strategist works at and intervenes in boundaries by configuring and reconfiguring communities, which also involves configuring and reconfiguring rhetorical practices and goals, as we demonstrate in our analysis.

Furthermore, the tactics a community strategist employs are rhetorical and user-centric, and the community strategist, like technical communicators and user experience researchers, plays an important role in the user localization process. The product may no longer be in its initial development by the time the community strategist is involved, but the community strategist helps an organization anticipate and facilitate user localization processes, which, in turn, can lead to refining not only marketing and technical materials but also the product or service itself as well as organizational practices. Technical communication is important to community strategy, whether it is writing a DIY tutorial for a product to engage online communities or localizing Web content for a niche market.

Likewise, user experience is important to community strategy: the community strategist's goal is to create a positive, useful first experience (rather than merely a first impression), and the strategist carefully creates environments and situations for that initial experience, drawing on rhetorical knowledge of the community. Like UX researchers and technical communicators, community strategists intervene rhetorically in the complex nexus of markets, technologies, developers, and communities. Murray and Ankerson (2016) analyze the challenges faced by the developer of a lesbian dating app in balancing user preferences with funding demands. Specifically, lesbian users desired a distinctly queer and slow mode of temporality (not rushing to a hookup, in contrast to gay apps like Grindr), but the startup world and capital providers demand quick pathways to traditional revenue generators like matching, chatting, and meeting up with other users. While Murray and Ankerson do not mention a community strategist in their analysis, the challenges they describe are precisely those that a community strategist is well positioned to navigate, along with UX researchers and technical communicators. As Lauer and Brumberger (2016) point out, rhetorical skills are as essential to user experience as creativity.

Finally, an ability to work empathetically and effectively across differences—not only race/ethnicity, gender, class, sexuality, language, culture, and ability, but also skill sets, goals, and situations—is at the heart of community strategy, much like technical communication and user experience. Social justice and inclusion advocacy are central to the work of community strategy, and we would argue that they are also central to the work of globalizing UX. As a Filipino-American woman who grew up in poverty in Oakland, California, Clarissa is aware of and strategically wields her embodiment of diversity in technology as a way not only of demonstrating the importance of inclusion but also as a way of supporting others who are marked as different. She draws on her own experiences of working across cultures and differences to help companies, organizations, and developers do the same, and key to this work is treating inclusion itself—like the communities, technologies, and goals—as a localized practice. And even when a client's goal is not explicitly to reach or include "diverse" communities, Clarissa's own commitment to cultivating diversity—in many different forms—in her networks and contacts means that a broader, more inclusive reach is embedded in her work, which can ultimately benefit both her client and the communities she connects. If we are truly committed to globalizing UX and to localizing user communities, then inclusivity and advocacy—as themselves localized practices—should be woven into every part of the process. Furthermore, just as Breuch (2015) argues that glocalization "need not be limited to international contexts, businesses, or designs" and "can inform our understanding of cultural differences within regional and national boundaries" (p. 114), we argue that these characteristics of community strategy are scalable from local to international contexts.

Because our approach to collaboration is as much a part of the exemplification of community strategy as Clarissa's professional and advocacy practices, we present a detailed

description of our collaborative process in the hopes that other theorists and practitioners may find it a useful model. We then present our analysis of Clarissa's professional and advocacy practices. Specifically, the two facets of our analysis cover 1) our own collaborative work in six collaborative sessions over the course of nearly a year, and 2) Clarissa's experiences (with examples drawn from her freelance international community strategy work, her work with the international organization Women Who Code, and her role cofounding SMS, all over the course of two and a half years).

Localizing Researcher and Practitioner Communities and Goals

Our collaboration began when I interviewed Clarissa (via Skype) in January 2016, after Lauren, the industrial engineering student and former SMS volunteer, connected us (in the conversation I described in Chapter Four). Clarissa had moved from Seattle to San Francisco when I began my study of the makerspace. I asked Clarissa about diversity and representation in the makerspace, since there were no women and relatively few people of color who were regulars in the makerspace, despite Clarissa's efforts to advocate for diversity and inclusivity before she moved. Clarissa remarked that simply declaring an intention to be inclusive was not enough, and that it was important for people to see someone like themselves—for example, another woman, another person of color—in a space.

At this point, what had begun as a semi-structured ethnographic interview turned into an energetic discussion of issues of diversity and inclusion in the maker movement and in technology industries, since we had both been thinking about and observing these issues from our different perspectives as a researcher and a practitioner, and as a white woman and a woman of color. We both articulated that these were issues we wanted to write about, both for academic and industry publications, and we agreed to collaborate and keep thinking and talking about

inclusion, access, and social justice. Thus we began to trouble boundaries between researcher and participant and between researcher and practitioner. Over the course of nearly a year, our ongoing, collaborative analysis revealed to us four key dimensions of community strategy practices: localizing communities, localizing goals, localizing communication, and localizing inclusion. While we initially identified these dimensions (each of which is a boundary marking practice) in our interpretation of Clarissa's work as a practitioner, we realized they also applied to our knowledge-making collaboration.

Over the course of the next few months, after our initial conversation, we examined, in periodic, brief conversations held over Facebook Messenger, what diversity means, and we quickly established that diversity is not a global or definite term; it is local and contextual. We also began drafting a research plan to explore these issues for an academic study, with additional deliverables for other professional and community-focused venues, because we wanted our collaboration to support theorists and practitioners both through national and international publication venues and through local interactions. Clarissa returned to Seattle, and we began meeting in person to generate data for our collaborative case study of her work as an international community strategist and inclusion advocate. At the first of our in-person meetings, I took up a more-or-less traditional researcher role, asking open-ended questions about Clarissa's experiences, practices, and goals as a community strategist, and recording her responses (via audio-recording and typed notes). The conversation tacked between specifics of experience and the principles and logics behind those experiences.

The following questions were generated in our conversation about Clarissa's role in the SMS, and they became more and more specific over the course of multiple conversations and collaborative analysis. Some of the broader questions were revisited to fill in more information.

- What is community strategy?
- How do you define diversity and social justice?
- How did you get into community strategy?
- What are your goals as a community strategist?
- How do you connect with potential clients, particularly international ones?
- What is your process for international consulting?
- What information and communication technologies (ICTs) do you use, and how and why?
- How do you frame your services and relationships with clients (in terms of length of time, scope, etc.)?
- How do you connect with meet-ups in your clients' target markets?
- How do you follow up with or stay in touch with people at the meet-ups?
- How do you balance your passion for diversity advocacy with the goals of your clients?

Most broadly, we were working to define international community strategy in relation to global UX, technical communication, and social justice advocacy. While our initial goals were focused on our respective researcher and practitioner communities, our collaborative localization work brought both our goals and communities together. For example, Clarissa connected me with other practitioners in the Seattle area, and Clarissa facilitated a discussion and workshop in my undergraduate digital rhetorics course in November 2016.

Renegotiating boundaries in knowledge making

Just as Clarissa advocates for combining both in-person and online engagement in her practice (as we discuss further below), our collaboration made strategic use of both in-person conversations and technology-mediated co-analysis and co-writing. After our first in-person

meeting, I transcribed the conversation and created a shared document with Clarissa. In that document, I underlined phrases that Clarissa had emphasized as important or that were repeated or appeared to be part of a pattern or theme. We met again to go back through the notes, to fill in more data and information, and to discuss the emerging themes and categories. The bolded phrases below represent attempts at initial categorizations that were as much intended to generate more discussion as they were to analyze. The underlined and bolded phrases are extracted and represented here in list form, but at the time of analysis, they were annotations to the original transcription in our shared document.

Community strategy work/Strategist-as-ambassador

- Strategist – you can't just get a bunch of people together; there needs to be complementing skill sets, understanding the types of people needed to get stuff done
- Marketing
- Outreach to communities with less access to tech
- Find someone else in another city who wants to do the same thing, then build structure to make it easier for others.
- Trip to Europe this year: audiences, you actually need a niche audience; I help them get into the U.S. market, being a representative, helping them understand that because there are so many different types of to start off. People need to be open minded, trust that I knew what to do in order to get them there.
- You have to understand community and who you're serving.
- Being face to face gives them a more substantive relationship that can't be recreated online.

- In-person demo helps you control the temperature of how it's received.
- Strategy is important – you have to understand when to bring people in.
- As a strategist, you have to know what's out there.
- The more you're exposed to communities, the more you realize what you can contribute to communities.
- You want to be able to resonate with their end user, that's not a technical thing, that's a human thing.
- You want to respect the community
- You need to walk through things to see if the next step makes sense, even if you know what's ahead, be patient and understand where people are coming from in terms of execution.
- Making connections: In communities, you're doing this because you want to learn, you don't want to fail your team, but you're also exploring.

Diversity (in tech, in SMS, in networks; defining)

- This highlights an important thing: there are groups out there who aren't trying to limit diversity, they just don't know how to make it happen. Trusting me was the best thing they could do.
- That's why diversity is so important in tech. Not just color of skin, but age, class, upbringing all in play. Everyone wants to see resonance somehow. Seeing someone like you.
- This is something I'm constantly thinking about, especially because it's not always feasible in some places. How do we help allies succeed? How do we open that up? Perceived leaders/influencers should be the ones adding their voices.

- What's even more important is keeping women IN tech; numbers show women in tech are dropping because we're not getting the environment we need to thrive.
- Understanding all these different types of groups in the hopes that one day we will find common ground.

Technologies/online tools for strategists

- Translating websites into demographic-specific U.S. English.
- Hardware/software.
- Any type of community management or strategist – another language they need to be able to speak is online, communicating in blogs, Slack, social media. Still dependent on human moderation. For me it was just using it.
- Make technology use contextual.

In a follow-up meeting, Clarissa then took my initial underlinings and categories and generated a more concise, prioritized list of core practices, which we then began connecting back to the data, and which prompted more data generation. In this way, our dialogic approach allowed us to negotiate and renegotiate boundary marks in the data itself: specifically in what patterns came to matter. The following categories and subsets emerged in a follow-up conversation, during which more examples and analogies were also generated. We began to envision these as potential sections of our discussion.

Diversity (localized)	**Relationships**	**Tools/technologies**
gender	making connections	human/in person (meetups, networks, feedback in person)
race	being an example/visible (also **diversity)**	digital/online (Slack, hackster.io, Google slides, email, twitter)
age	mentoring (also **diversity)**	hardware (microcontroller, laser cutter)
class	listening, asking how can I help	
skills	respecting	
interests		
markets		

Figure 1. Categories and subsets of core practices

After another conversation that included more data generation and simultaneous analysis (particularly in thinking through relationships between practices and experiences and abstracting principles), as well as discussion of a working outline for the manuscript, we saw that localization was common to all the categories and realized that our categories were, in fact, dimensions of a community strategist's localization practices. We also divided the "relationships" category into "localizing communities" and "localizing goals" to better represent the complexities of those processes. We also revised "localizing diversity" to be "localizing inclusion" to emphasize the active nature of inclusion.

Localizing communities	**Localizing goals**	**Localizing communication**	**Localizing inclusion**
making connections	listening to and respecting community	balancing face-to-face and online engagement	including more people, broadening beyond the "usual" (white male/ privileged) channels
bringing people together strategically	bringing community and client goals together	localizing first experiences	diverse networks lead to diverse connections and users for clients
making/materializing networks	research heuristic	localizing technologies for outreach	mentoring and support structures for sustainability
			embodying/seeing resonance

Figure 2. Revised categories and subsets of core practices

Writing with, not about

We see the collaboration of a researcher and a practitioner as central to our method and our methodology (by which we mean the logics and principles behind our approach to the study). A researcher-practitioner collaboration offers three important affordances for knowledge-making. First, by including a practitioner as co-constructor of the data and the analysis and interpretation, we take up Blyler's (2004) call to decentralize researcher authority (or, as we see it, renegotiate the boundaries of the researcher apparatus) in the hopes that our goals and findings will be more useful—both for researchers and for practitioners, as Grabill (2012) advocates. In this way, we are moving beyond the traditional member check or participant check approach, wherein results of analysis are presented to participants for confirmation, and toward the transformative data analysis model described by Alsup (2010), wherein the researcher maintains open communication with participants throughout the process with the goal of reciprocity, as a strategy for social justice research that can support the flexibility and reflexivity described and advocated for by Jones (2014). Like Koelsch (2013), we treated member checks as part of the

data collection process, not simply as a validity measure at the end of the analysis, and this transformed our relationship from researcher and participant to researcher and practitioner as co-authors.

Second, the balance of insider and outsider perspectives enriches the analysis of the data, as Walton, Mays, and Haselkorn (2016) demonstrate. Mays provided an insider perspective and entrée to the humanitarian culture being examined, while Walton and Haselkorn provided an outsider perspective. In our study, Clarissa provided an insider and practitioner perspective, while I provided an outsider perspective. More specifically, Clarissa's experiences are the data for our case study, but equally importantly, her insights into the values and practices of community strategy were key to our collaborative analysis, particularly in generating and prioritizing categories. I drew on researcher practices like open-ended interviewing to structure the data generation and collection and also drew on a grounded theory (Glaser & Strauss, 1967; Corbin & Strauss, 2014) approach to collaboratively analyzing the data.

Third, and finally, we believe that embracing and accounting for the messiness of researcher-practitioner collaboration is essential for research and work toward globalizing UX, particularly since, as Quesenbery and Szuc (2012) point out, global UX increasingly requires teamwork that connects researchers (academic and professional) with local practitioners. Walton, Zraly, and Mugengana (2015) and Fleckenstein, Spinuzzi, Rickly, and Papper (2008) call for transparency about not only research phenomena but also the often-messy processes by which we arrive at phenomena. As I argue in Chapter One, our methods are as much a part of the phenomena we study as they are a way of accounting for phenomena. Thus, we account here for our knowledge-making process, from the formation of our collaboration to the generation of data

to the analysis, interpretation, and presentation of the data. In what follows, we turn to the second facet of our argument: international community strategy in practice.

Localizing communities

In an age of all-edge adhocracies (Spinuzzi, 2015) where professionals rely increasingly on their own dynamic, highly-connected (but also highly permeable) networks instead of the structures of a traditional, hierarchical company, cultivating a global network of individual and community contacts that can be localized for specific clients and purposes is an essential practice. This networking practice, which is central to community strategy, complements and meshes with the aims of technical communicators to construct networks, which Read and Swarts (2015) describe as a "working, coordinated configuration of actors in a setting that affords such a configuration" (p. 15). And as Read and Swarts' definition suggests, networking is a localized boundary marking practice. In this sense, a community strategist is continually seeking out and making connections among individuals and communities. These connections (themselves boundary marks) are grounded in shared interests and experiences, with the understanding that future opportunities may present themselves to re-contextualize those connections for a new purpose, as in Getto's (2017) articulation of "user experience design as a form of networked rhetorics" (p. 15).

Meet-ups are central to Clarissa's community strategy work because they allow her to connect with existing communities and facilitate connections across communities. For example, Clarissa's involvement in the Seattle chapter of the global organization Geek Girls Carrots—which focuses on attracting women to and supporting them in technology industries, and which hosts meet-ups—led to her making connections with the chapter in Warsaw, Poland, which in turn led to Clarissa visiting Warsaw for what she calls a working holiday. There she attended a

local meet-up and met people looking to expand their software solutions company into U.S. markets. After a follow-up meeting to discuss goals, and during which Clarissa advised the potential clients to focus on their data science service for U.S. markets, the company contracted Clarissa for international community strategy services.

Connecting and localizing communities and networks is a material practice, both in the sense that it has material effects and in the sense that the connections involve articulations (and markings) of both humans and nonhumans (like infrastructures, technologies, and documents), as Read and Swarts (2015) have observed. Clarissa observes that her experiences growing up in a low-income neighborhood taught her to be resourceful: Without access to capital, relationship-building was key, because it facilitated bartering with more than money and honed her ability to understand value as localized in particular moments in particular places for particular people. And in connecting provider companies with meet-ups, she uses her physical presence, textual and visual rhetorical elements (usually a presentation), and (depending on the product) physical objects to localize and materialize—both in an economic sense and in a physical sense—network connections between designers/providers and users/communities. But the boundaries between provider and user are porous and contingent: the users of one day's network may become the providers of another day's network, which is why we prefer the term *community* to *user*—to emphasize ongoing connections and relationships even as roles of user, designer, and even strategist change or evolve in different interactions.

The nature of the connections and networks assembled, however, is crucial. A community strategist, much like a technical communicator, expertly and carefully marks and assembles people, texts, knowledge, information, and things in complementary ways to accomplish a goal. Long (2014) points out that, for technical communicators, responsiveness to

those engaged is a rhetorical art that resists routinization. Similarly, a community strategist's work centers responsiveness. By cultivating a careful knowledge of the skills, experiences, and strengths of the people, systems, and technologies she knows, Clarissa is able to materialize networks with complementary strengths and goals. Furthermore, because she is concerned about sustainability beyond her own involvement, her work to materialize networks involves attention to creating network infrastructures—not only assembling complementary strengths and goals but also creating precedents for effective communication, organizational, and interactional practices.

Localizing goals

As an intermediary between designers/providers and user communities, a community strategist—like technical communicators and user experience researchers—practices listening (Breuch, 2011), responsiveness (Long, 2014), and audience analysis (Ross, 2013), both for clients and communities. Clarissa prioritizes listening to and respecting the goals of communities, because meaningful engagement and support of communities is foundational to successful community strategy. Ultimately, her work involves localizing the goals of both communities and providers through careful listening, understanding, and connecting. Clarissa relies on the following heuristic for learning about the goals and interests of the people she meets:

- What brought you [here]?
- How do you know [person]?
- How did you hear about [event]?
- What do you want to get out of [event/talk]?
- How can I help you?

Sometimes Clarissa moves through this heuristic fairly quickly, as in the case of a conversation with a potential user at a meet-up. But when she is working across cultures, she emphasizes time and observation, in addition to listening, as key to generating meaningful cross-cultural, cross-community understanding, just as Quesenbery and Szuc (2014) emphasize immersion (as opposed to research, which suggests a more limited engagement) as key to globalizing user experience. The last question, "how can I help you?" is how the community strategist begins to connect her understanding of a person's or community's needs or interests with her own resources and the resources—human, technological, informational, infrastructural—in her networks of connections. For example, Clarissa's Warsaw client is a software provider with many services and products, which she learned is typical of and successful in the Polish market. But because their goal was to expand into the U.S. market, which is more competitive, Clarissa encouraged them to focus, at least at first, on data science. She then asked them to identify three industries their data science service could support, and, finally, she gathered information about that service that would help her localize the service for each particular industry in her presentations at various industry-specific meet-ups.

However, the answer to "how can I help you?" may not always involve making immediate provider-user connections. For example, Clarissa connected online with a community in the Philippines that is using microcontrollers to improve conditions in their villages, where they face difficulty in obtaining basic electronics, even light bulbs, for their communities. Clarissa's primary goal is to learn more about what these communities are doing, then consider how access to technology (in this case to hardware) could improve quality of life, in the hopes that by connecting these communities with resources and suppliers in her own networks (which are primarily US-based), she could help the communities build better infrastructures and carry

out their projects on a larger scale. But even if the communities' goals are to build something that does not immediately require connecting with investors or suppliers in Clarissa's networks, she commits to respecting and helping with their goals.

Localizing communication

One of the most important services Clarissa offers as part of her community strategy work is giving face-to-face product demos at local meet-ups in the target market. These face-to-face interactions are perhaps one of the most concrete ways in which she localizes communication between companies and communities. Since the Warsaw software company was interested in U.S. markets, Clarissa offered them a choice of the four U.S. cities in which she has extensive networks: Seattle, San Francisco, Boston, and New York. Clarissa emphasizes face-to-face engagement at meet-ups because it allows her to connect the product with communities of potential users in a way that aims to establish a mutually beneficial relationship between the community and the company from the outset. The meet-ups are identified because they represent industries and interests already aligned with those of the company, and Clarissa offers to give a presentation that addresses the meet-up's interests and connects the product demo to those interests, since many meet-ups are looking for speakers for their events.

The face-to-face interaction also helps Clarissa rhetorically shape what she calls the *first experience* (rather than first impression) by connecting the product to the goals of the meet-up by creating a positive environment for users encountering the product, and by being an empathetic advocate on behalf of potential users when they have concerns about the product's usability. Indeed, the first experience is a boundary marking practice wherein Clarissa opens up possibilities for engagement. The first experience is an important part of the mutually beneficial relationship that the community strategist can build: When the interests and experiences of the

community of potential users are centered, the community can benefit from the application of a product—in the case of the Warsaw company, data science—for a specific need or problem, and the provider company can benefit from ongoing user research facilitated by the community strategist acting as a user advocate. As user researchers well know (see especially Sun, 2012), particularly at the international scale, a feature that works in one local user community may not work or resonate in international contexts. A community strategist's ongoing responsiveness to communities of potential new users and the boundaries between local and global can help companies save time and face in addressing issues before a full international launch.

But the community strategist's work of localizing communication also includes media for online engagement. In addition to facilitating face-to-face demonstrations, Clarissa also helps her clients revise their websites to be more rhetorically effective for specific communities. For example, Clarissa helped her Polish client re-translate their English-language product site into more demographic-specific U.S. English. In other words, while the work of translating from Polish to English had already been done, which, as Gonzales and Zantjler (2015) demonstrate, is already a process of user localization, Clarissa helped further localize that translation by attending to the particular lexis of a specific English-speaking U.S. demographic. Still, though, we note the limitations Clarissa, who is not fluent in Polish, experienced in re-localizing the already-translated materials. Clarissa knew enough about her clients' communicative practices to sense how nuanced and context-specific meanings were, and she knew to keep asking questions to make sure she was getting at those nuances as she re-localized the translated text, but she wishes, in retrospect, she had done so even more. We note, furthermore, that our analysis led us to resolve, following Gonzales and Zantjler (2015) and Walton, Zraly, and Mugengana (2015), to seek out opportunities to include and to highlight the work of translators in community strategy.

Rather than imposing a standard set of information and communication technologies (ICTs) for her work, Clarissa adapts to the ICTs preferred or already in use by the clients and communities with whom she works. For a hardware provider, Clarissa wrote a tutorial for using the provider's microcontroller to serve as a solution for finding a misplaced mobile phone by having it play music, so that even if the phone's ringer is off, the phone can still be heard and located. She published the tutorial on hackster.io, a popular international forum for people interested in hardware, which is an established medium for localizing hardware technologies. But she was also attuned to the opportunity to connect the provider's goals of connecting with new users with her own goals of engaging more people in hardware: She designed and wrote the tutorial with first-time or novice users in mind and was pleased when novice users commented that they had successfully implemented the code and appreciated the usability of her instructions.

Localizing inclusion

Clarissa is a passionate advocate for inclusion in technology (both in industry and in community access), and her commitment to social justice permeates her work as a community strategist (and, therefore, the previous three dimensions we have described). Central to her advocacy practice is continually localizing inclusion itself—specifically, the definition of diversity and social justice outcomes. While there are certainly issues of diversity and social justice—for example, representation of women in technology industries, or access to hardware and software technologies in what Agboka (2013) calls unenfranchised communities—that transcend local circumstances, we emphasize that the approach to inclusion is localized. In other words, "diversity" and "inclusion" are not static definitions we can begin with; rather, defining "diversity" and "inclusion" in response to particular contexts and with accountability to the bodies being marked is an ethical boundary marking practice. Furthermore, while organizations

may have representation from people of diverse backgrounds, identities, and abilities, this does not mean that those people are made to feel welcome; inclusion is an active localization practice that includes whether or not diversity and difference is explicitly named and in what ways, as well as whether or not the advocacy comes from a community, the community strategist, a client, or some combination of these. Key to this work is exploring local contexts and balancing one's own commitment to advocacy with the goals and commitments of the communities engaged, which, in turn, can lead to sustainable progress toward not simply describing but redressing inequities, as Jones and Walton (forthcoming) advocate.

Clarissa recognized that one of the problems with diversity and access in technology industries is that the channels companies use to recruit employees, users, and communities are the "same old channels"—including, for example, predominantly white U.S. universities, or predominantly male meet-ups or special interest groups. A community strategist can intervene in this feedback loop by including more channels to more communities, especially those underrepresented in technology industries. Clarissa leverages the diversity in her community relationships to make meaningful connections that include more voices, identities, experiences, and perspectives. Even when a company's explicit goals do not involve increasing diversity in its user communities, Clarissa connects her own, more diverse networks as part of her strategy work. The Polish data science provider, for example, was defining diversity in terms of international markets: specifically, in crossing cultural, geographic, and linguistic boundaries by reaching U.S. markets, both digitally and in person. Clarissa, in turn, further expands (and simultaneously localizes) the work of inclusion through her own networks, which are diverse from both U.S. and Polish technology industry perspectives, and by being, herself, what she calls a "face of diversity." In this way, a community strategist's re-marking of boundaries through a

localized practice of diversity and inclusion advocacy can benefit both companies and communities.

Indeed, we emphasize the importance of a "show, don't tell" approach to localizing and supporting inclusivity. (Or, to put it in the terms I use in Chapter Three, there needs to be more showing, not just saying.) As we discussed and reflected on Clarissa's work cofounding SMS and the fact that after she left, there were fewer women and people of color involved in the space, we realized that while the intention of the makerspace to be inclusive remains unchanged, what has changed is that Clarissa herself was no longer prominently visible in the space to *show* diversity and inclusivity in practice. Clarissa notes, furthermore, that she wishes she had taken pictures of women and people of color involved in the makerspace to include in the organization's web and social media pages as a way of showing inclusivity beyond telling or proclaiming an intent to be inclusive. When Clarissa is in a position to make increased inclusion an explicit goal—for example, in her work organizing conferences like the DevRel Summit in Seattle—she is careful about how (or if) she explicitly names the diversity she is working toward. Since her goal was to recruit balanced representation of men and women at the DevRel Summit, she chose not to explicitly name it a women-focused conference, because she has found that naming the conference that way leads to extremely low attendance by men. Instead, she made sure to advertise the event to channels that reached both women and men, and she recruited women and people of color to be speakers and leaders for the event.

As a result, women and men were nearly equally represented in the 500 conference attendees, and a male developer relations professional who attended the event wrote in his review: "While the tech industry tends to be overwhelmingly white and male, the selection of presenters wasn't. When you factored in the panel compositions, there were more women on

stage during the day than there were men, yet there was never a feeling that this was a conference about women or for women. It was simply a professional conference that just happened to have more women on stage. That was cool" (Bulmash, 2016, par. 3). In her work with Women Who Code, Clarissa has found that the fact that the word "women" is in the name of the group is a boundary mark that has sometimes led to sponsorships and partnerships that have felt more tokenizing than meaningful. The potential for tokenization has prompted Clarissa and her colleagues to begin articulating guidelines for meaningful relationships, which they plan to start by highlighting the inclusive practices of a partner organization they hold in high esteem. At the same time, as we were analyzing this experience, Clarissa realized although she and her colleagues had successfully fostered diversity in gender and ethnicity, they had missed an opportunity to reach out to older audiences. In some ways, the conference was focusing its outreach on people who were already inclined to agree and have similar perspectives, while missing the experiences and different perspectives of diverse age groups. If the goal of a community strategist is to foster a self-sustaining community, then creating an ecosystem with diversity in demographics and experience is essential.

Just as fostering diversity in demographics and experience is important to the sustainability of a just community, mentoring is crucial both to localizing and to sustaining social justice work, specifically, and community strategy work in general. Some of this mentoring work is directly connected to the contracted work of a community strategist. To sustain the relationships and networks she materializes beyond her own direct involvement, Clarissa mentors organization and community members to carry on the work of strategically assembling and connecting human, technological, and material resources across cultures. Mentoring is particularly important in groups who want to be more inclusive and diverse but are not sure how

to go about making meaningful and sustainable changes. If, for example, the goal is to include more women, more people of color, or more people with disabilities, then Clarissa emphasizes the importance of having women, people of color, and people with disabilities at the center of that strategy work—ask them how to reach out meaningfully and trust and support them. But at the same time, she also emphasizes the intersectional nature of diversity: it is never just gender, just race/ethnicity, just class, just ability, just geography but rather the intersections of all of these, which means that including and listening to many voices and perspectives is crucial for finding resonances amid differences.

Other aspects of this mentoring work happen outside of official business. For example, Clarissa is in a Slack group for underrepresented groups in technology industries founded by a friend in the Bay Area. The goal of the group is not only to support each other, through regular posting on channels like #todayimade, but also to mobilize the group to be public examples of diversity by, for example, connecting with others to attend local events together. Informal, ongoing mentoring and outreach, in turn, strengthens the ongoing community building and community connecting work that is at the heart of community strategy.

Implications

Just as Gonzales and Zantjler (2015) observe that localized translation practices are layered, multiple, and built over time, our analysis suggests the same is true of the user (or community) localization practices of a community strategist. As our analysis indicates, these four dimensions—localizing community, localizing goals, localizing communication, and localizing inclusion—are overlapping and intersecting dimensions, not only within the work of an international community strategist but also across the work of community strategy, global UX, and cross-cultural technical communication. In other words, these dimensions are themselves

boundary marking practices, even as they describe and intervene in boundary marking practices. The overlaps and intersections among these dimensions present both opportunities and challenges.

We emphasize that the methodological process by which we arrived at our findings is itself a boundary marking practice and an opportunity for further investigation and collaboration across research and practice, as well as across cultures. The process of transforming the traditional qualitative interview-analysis-member check model into a collaboration that entwines data generation and analysis is a localization: It emphasizes the particularity of our shared understandings and experiences in the same way that localized UX emphasizes the particularity of language and culture in different communities' experiences (Schumacher, 2010). Certainly this particularity is a limitation of our study. Our dataset is limited to the experiences of one practitioner, and the specific experiences of community strategy are not intended to be generalizable to all or even most community strategists (and global UX researchers and technical communicators). However, just as Sun (2012) reminds us that user localization "emphasizes the contributions users have made to a technology's design process in participatory culture" (p. 41), we argue that our collaborative method is a way of accounting for a participatory approach to research. Just as Getto (2014) advocates for localizing methods, we suggest that our method itself, as well as the key dimensions we found, can be taken up and re-localized in other contexts. In this way, we envision the possibility of a dynamic, cumulative, global potential from these ongoing re-localizations of both method and findings. In this way, we can collectively renegotiate the boundaries of the particular and the generalize-able in our knowledge making.

Relatedly, we note that technical communicators, user experience researchers, and community strategists are well positioned to support each other in intervening in effective and

culturally sensitive ways in iterative design and localization processes. To return to Sun's (2012) distinction between user localization and developer localization, we note that the community strategist bridges users, communities, developers, and providers. This bridging work can occur at many points in the iterative design and localization process. Sometimes the community strategist is the bearer of bad news to developers and providers, when a user community does not respond to a feature in the ways developers had hoped, and sometimes the community strategist participates in the making of a community or in a community's work toward a goal. Even the term *user* is highly relative in this work; it is boundary marking practice that matters. Sometimes developers are users, sometimes communities are users, and sometimes communities are comprised of developers and users. We are reminded of Potts' (2014) preference for the term *participant* over *user* to emphasize the importance of participation in systems; for a community strategist, both *community* and *participant* are vitally important and also dynamic.

However, such dynamic approaches can be accompanied by the challenge of justifying often non-quantitative and even non-quantifiable engagements that require different metrics from traditional revenue-based measure. The metric of success in community strategy is not always quantifiable in growth. The primary goal of community strategy is to identify personalities and groups that work well together, both in and across communities, which can lead to growth. But not all communities need to grow, or grow as much as others, to fulfill their purpose. Community strategy goes beyond a more directly revenue-oriented objective to emphasize relationships, which can, in turn, benefit both communities of users and providers, but this is not always recognizable to clients and companies as measurable success. San Diego, Persing, and Fifield (2016) offer recommendations to community strategists for articulating value added to companies that resonate with the recommendations of Redish (2010), Redish and Barnum

(2011), and Lauer and Brumberger (2016) to technical communicators for articulating their value to UX work: notably, both sets of recommendations involve constantly localizing value—in the same way that community strategists, like technical communicators and UX researchers, are constantly localizing goals. This means listening to stakeholders, having a range of strategies and approaches that can be flexibly reshaped or even abandoned, and making rhetorically responsive cases for the importance of community strategy to the iterative design and localization process.

User localization, audience analysis, and cross-cultural communication are important practices in technical communication and user experience. Community strategy work supports and extends these practices by emphasizing relationship building and a deep understanding and support of communities. Collaboration among community strategists, technical communicators, and user experience researchers—or implementing their combined practices—can lead to more effective communication, more responsive technology design, and more meaningful engagement of communities. Researchers and practitioners committed to social justice and inclusion advocacy can benefit from the practices of and collaborations with international community strategists. Crucially, definitions of *diversity* and *community* in our research and practice should be products of meaningful, localized engagement, not assumptions we start with. Inclusivity is more than simply having people of diverse backgrounds, identities, and abilities in an organization or community; it is actively making people welcome. In sum, attending to and intervening in boundary marks both in knowledge making and in professional practice involves accountable, responsive localization at every turn. We call for further research into the dimensions of localization we describe, and particularly localizing inclusion as an essential practice for cross-cultural, global design and engagement.

Chapter 6. ACCOUNTABLE RESEARCH AND TEACHING

Just as Chapter Five offers implications of my theoretical-methodological apparatus for collaborative research and professional practice, this chapter offers implications for teaching. Specifically, I offer strategies for ethical boundary marking in course design (and re-design). In this discussion, user-centered design emerges as an orientation to boundary marking in pedagogy, and (as in Chapter Five) localization emerges as a practice of marking and re-marking boundaries. In Part One of this chapter, I offer pedagogical implications that both draw upon and push back against the influences of the maker movement. I draw on my observations and experiences of teaching an undergraduate course on writing as/and making, and I describe an in-progress study of UCD and usability in the course that is co-authored with students from the two sections I taught in 2016. In Part Two, I discuss the limitations of and future directions for this study.

Part One: Pedagogical Implications

Curricular design is all too often enacted through a systems-design, rather than a user-centered, framework. We know what skills and rhetorical tools we want students to take with them from our classes, but we often ascribe these outcomes from our own understandings of usefulness and appropriate function. - Douglas Eyman, 2009 (p. 222)

In this section, I argue for and articulate a rhetoric and writing pedagogy that both draws upon and pushes back against the influences and practices of the fast-growing international maker movement. This pedagogy threads together emerging conversations in composition studies about making, makerspaces, and the maker movement (for example, Craig, 2014; Prins, 2015; Sheridan, 2010; Sherrill, 2015; Shipka, 2011, 2016; Shivers-McNair, 2016) with my research in SMS and my experiences teaching writing alongside other forms of making. Much of the current conversation on makerspaces and composition focuses on the possibilities for

multimodal and 3D composition (Craig, 2014; Shipka, 2011, 2016) and opportunities to intervene in a culture where access to 3D fabrication (and therefore 3D rhetoric) is increasingly widespread (Sheridan, 2010; Sherrill, 2015). While I certainly acknowledge these possibilities, my approach tempers these possibilities with an emphasis on the ways in which the technologies, making practices, and economies privileged in the maker movement are by no means neutral: they make some bodies, meanings, traditions, and possibilities matter and not others.

Just as the theoretical lineages we trace, the rhetorical traditions we draw on, and the methodologies and methods we implement are entangled with what and who matters in our research findings, the traditions and kinds of rhetorical making we privilege in our classrooms are entangled with what and who matter and what and who are excluded from mattering. In other words, ethical concerns are inherent in our pedagogical choices (regardless of whether or not they are overtly critical), and my goal is to offer ways for both teachers and students to be accountable to the ethics of mattering. Therefore, I take up Eyman's (2009) call to approach curricular design as an opportunity for seeking out student-user feedback and co-creating responsive pedagogies with student-users through processes of user-centered design. The syllabus for a 300-level digital rhetoric course in which I implemented my user-centered approach is included in Appendix Two; in what follows, I discuss user-centered design as an accountability practice, my goals for the course and the context of the course, and some of the key features of the course that I believe could be adapted across course and institutional contexts and offer examples from my course. I draw both on my own experiences and on an ongoing study of the course coauthored with students.

Accountability and User-Centered Design

As I explain in Chapter One, accountability for boundary marks is central to my theoretical-methodological apparatus. This includes the entanglement of the apparatus and the phenomenon, as well as how the boundaries we mark—more or less human, more or less discourse, more or less maker/making—make some bodies, traditions, meanings, actions, and possibilities matter at the exclusion of others. As a teacher, my goal is to be accountable for the possibilities I'm opening up and closing down, and for which bodies and traditions and kinds of making I'm privileging and which I'm excluding or marginalizing. I've known for years that transparency—being explicit about the logics of and connections between activities, assignments, scaffolding, and assessment—is an important accountability practice for supporting learning in the classroom. But my theoretical-methodological approach to accountability reworks the causality of pedagogical logics and connections, as well as the agency of logic-making and connection-making. Transparency is not enough, because the logics and connections—as my students and I experience them in space, time, and matter—are not linear or stable: every reading, activity, and interaction is a boundary marking moment that opens up a past, a present, and future possibilities. Responsibility for (including agency to manipulate) the ongoing making and remaking of knowledge in and beyond the classroom is not a choice, a burden, or something to be taken up by discrete individuals; it is inherent in the ongoing relations and interactions/intra-actions by which logics and connections are made and remade. For me, user experience and user-centered design emerged as an accountability practice that guides not only the readings and assignments but also assessment (both of student work and of pedagogical design).

In Chapter Five, I offer an account of user experience in relation to technical communication practice; here, I focus on user experience in relation to pedagogy in writing studies as a way of accounting for the concepts and practices that guided both my design of the course and my collaborative study of the course with students. In making a case for bringing usability into the broader field of rhetoric and composition studies, Susan Miller-Cochran and Rochelle Rodrigo (2009) note the intersections of rhetoric and usability, which they define as "anticipating users' needs and expectations, as well as designing texts, documents, systems, platforms, spaces, software—and many other things—with a purpose in mind that is appropriate to and tailored for that audience of users" (p. 1). Indeed, scholars in technical communication have long asserted that technical communicators' rhetorical expertise makes them well qualified to design for user experience (Dumas & Redish, 1994; Lauer and Brumberger, 2016; Redish & Barnum, 2011; Redish, 2010; Sullivan, 1989). Scholars in compositions studies are increasingly turning to user-centered design approaches to testing the usability of pedagogy (Brown and Hocutt, 2015; Miller-Cochran and Rodrigo, 2009; Panthee, 2014).

But as Felicia Chong (2016) notes in her analysis of technical communication textbooks and syllabi, there is not a single definition or model of "usability" in pedagogy or practice. Indeed, as Chong observes, Jakob Nielsen's (1993) oft-cited definition of usability positions it as a quality (with five interrelated dimensions: learnability, efficiency, memorability, errors, and satisfaction), while Miller-Cochran and Rodrigo (2009) define usability as a process. Similarly, "user experience" and "user-centered design" are contested both as terms and as practices. For example, Liza Potts (2014) prefers the term "participant" to "user," to emphasize their active participation in the design and localization of systems, and Ann Shivers-McNair and Clarissa San Diego (2017) make a case for "community" as a more useful term than "user." And as

Jennifer Bowie (2009) argues, UCD approaches often and problematically "create a universal user who does not fully represent the universe of users" (p. 135).

But one thing that is widely agreed upon, both in technical communication and in rhetoric and composition, is that rhetoric and user experience share a concern for audiences/users. My experiences inhabiting both rhetoric and composition studies and technical communication have led me to see fruitful connections and overlaps between, for example, user localization and uptake, particularly as Anis Bawarshi (2016) defines it. Bawarshi argues for understanding uptake as "the taking up or contextualized performance of genres in moments of interaction," which draws our attention not only to genres themselves and their relations with other genres, but also to the "history, materiality, embodiment, improvisations, emotion, and other *agentive* factors" that enable genre performances (n.p.). These disciplinary connections, along with my experiences researching SMS and collaborating with Clarissa, informed my rationale for and design of the Rhetoric in the Making course.

In the design of my course and in the collaborative study of the course I undertook with student coauthors, we take up UCD practices with a rhetorical, participatory focus on users. We follow Huatong Sun's (2006; 2012) model that positions cultural usability at the nexus of immediate and sociocultural contexts, between the local and global. As I explain in Chapter Five, this model does not treat culture, user, or technology as static or monolithic, but as dynamic and localized. Sun also emphasizes user localization, which she defines as "energetic user efforts of using a technology within meaningful social practices and incorporating the technology into one's life" (2012, p. 40; see also Breuch, 2015). Therefore, while our class covered common approaches to usability testing such as concurrent and retrospective think-alouds and concurrent and retrospective probing (Bergstrom, 2013), we ultimately approached usability testing as an

empathetic, flexible, ongoing engagement with our audiences and users. As Chisnell (2009) argues, "all you need for a usability test is **someone who is a user of your design** (or who acts like a user), **something to test** (a design in any state of completion), and **someplace where the user and the design can meet and you can observe**" (emphasis in original, par. 22). We worked to solicit feedback early and often, to listen, and to co-design with our users—both in the projects in the class, and in our study of the class.

Indeed, usability testing, UX, and UCD are useful not only as concepts to teach but also as approaches to teaching. As Douglas Eyman (2009) argues, "Curricular design is all too often enacted through a systems-design, rather than a user-centered, framework. We know what skills and rhetorical tools we want students to take with them from our classes, but we often ascribe these outcomes from our own understandings of usefulness and appropriate function" (p. 222). Following Eyman, one of the core assumptions that guides the pedagogical design we examine in this study is that principles of user-centered design can and should be more than course concepts and assignments; they can be core practices of the course that hold both students and teachers accountable for the impacts of their rhetorical choices. In other words, both iterations of the course we examine here were designed not only to *teach* user-centered design and usability testing, but also to *be tested* for usability, both through feedback during and immediately after each iteration and, ultimately, through the collaborative analysis process that we describe here.

What, then, does UCD look like in pedagogical practice? As a teacher, it means being actively accountable for and continually open to revisiting what bodies and traditions are privileged in the readings I assign, in the assumptions I make about language(s) and media and usability and access, in the way I structure and assess students' work, and in the interactions/intra-actions I participate in and foster. It means not only being frank with students

about why I chose a reading or designed an activity, but also being open and responsive to different logics and connections that students will make (or unmake, or not make). For example, while I was teaching the first iteration of the course in spring 2016, I was inspired by my students' rhetorical-cultural usability research and design work on accessibility for people with disabilities, as well as by Anne-Marie Womack's work with the Accessible Syllabus project at Tulane, to make my course materials more accessible and inclusive. I incorporated accessible design features (sans serif fonts, text that can be manipulated by screen readers, shaded text boxes to lower contrast, a variety of visual and design elements instead of just long blocks of text, and alt-text and captions for images) and inclusive language (invitational rather than mandatory) and policy (presenting ways to accommodate needs and offering flexibility). When I shared the syllabus with students in the second iteration of the course, I explained how my rhetorical design choices were inspired by past students' work, as a way of acknowledging a past, inhabiting a shared present, and opening up future possibilities for me to learn from my students (and for my students to feel like they can teach me, even as I teach them).

And perhaps most significantly, my orientation to UCD as an accountability practice led me to approach my study of those two iterations of the course as a collaborative research project with (self-selected) students from both sections in which we examine how usability and UCD operated not only in their course projects, but also in their interactions with each other and with me. This, in turn, has led me to make further changes to the design of the course as I plan for future iterations. For example, weekly studio sessions (in which students shared their in-progress work with each other) were a staple of both iterations of the course, and while in both sections I invited students to envision different formats for our weekly studio (workshop) sessions, which

led to changes in the format that occurred toward the end of both iterations of the course, I learned from our collaborative study that these changes were still too little and too late.

In the first iteration of the class (spring 2016), I scheduled the studio sessions for the second hour of each class period, meaning that (since our class met for two hours, two days a week) half the students presented one class period, and the other half presented the next class period, in any given week. The first class period hour each day was spent discussing and synthesizing readings and concepts. My rationale for this was, in retrospect, more systems-design than user-centered. I thought having the discussions and studio sessions back-to-back might create more cross-pollination between the two. And to further mix things up, I had a rotating studio schedule, so that students weren't stuck always presenting on the first day or second. However well intentioned, in practice, this system was often confusing. Furthermore, I adhered closely to a gallery format for the studio sessions (three simultaneous presentations given three times, with the presenters stationed in three corners of the room and the audiences rotating among the presenters), because this was a format I had used in teaching public speaking that worked well as a low-stakes practice-and-feedback format. But this, too, had its weaknesses, because (as my student coauthors helped me realize) the goals of practicing delivering a speech are not the same as the goals we had for our studio sessions, which was to help each other think through the usability of widely varying projects. And though I solicited feedback on the format, it was mainly in terms of time parameters. It wasn't until the last studio session of the spring 2016 course that we changed the format entirely.

In the second iteration of the class, in response to feedback from students in the first iteration, I changed the schedule: the first day of class each week was discussion day, and the second day of class each week was the studio day. This eliminated many headaches. I started

again with the gallery format, and I held on to it for several weeks—still several weeks too long. We changed the format for the last few studio session to a small group discussion, and this, I learned from my students, was by far the most productive session. This, in turn, led me to design studio sessions as self-selected small group discussions in the course I am currently teaching.

For my students, I frame UCD as a localized practice of accountability for our making practices at every step: from the theoretical, practical, and methodological traditions we draw upon to the technological and infrastructural resources required to make, distribute, and access the composition. I certainly do model how writing can help us be accountable and intervene ethically and effectively. One such way is reflective or metacognitive writing/thinking/speaking intended for the writer's own use as a means of rhetorical knowledge-making, as Kathleen Yancey (2016) argues is characteristic of a third generation of reflection in writing studies, or, as Anis Bawarshi (2010) advocates, as a means to "delay and, as much as possible, interrupt the habitual uptakes [a term he pairs with Min-Zhan Lu's notion of "learned inclinations" about language use] long enough for students to examine critically their sources and motivations" and "consider what is permitted and what excluded by these uptakes" (201). Another way writing helped with accountability and intervention (in the Rhetoric in the Making course) was in the form of informal reports (written or delivered in audio and/or visual format) in which students shared ongoing choices, questions, and concerns about their work-in-progress with me and solicited feedback. Similarly, students often prepared multimodal presentations that included writing to share their work-in-progress and solicit feedback from their classmates in weekly studio sessions. Some students incorporated narrative accounts into the making of their project-specific effectiveness measures (which I discuss further below). The point is that regardless of

the form it takes, we treat UCD as a localized and shared practice, and that includes the role it plays in how students' work is assessed, as I explain further below.

Course Context and Goals

My goal in taking up the pedagogical implications of my research on SMS has not been to turn my classroom into a makerspace *per se*, though certainly I incorporate what I have found to be the most useful practices and dispositions I've learned from the regulars of SMS. I considered forming a partnership with my university's makerspace that would allow my class to meet occasionally or regularly in the makerspace, or assigning fabrication work that would require students to use the makerspace, but I decided against it in favor of asking students to choose the forms of making they would take up in the course. Ultimately, I wanted to guide my students through an experiential examination of discursive and nondiscursive forms of making as rhetorical interventions involving bodies (human and beyond) and material-cultural environments in intra-action. While I certainly see the value in assigning a particular medium/mode (such as 3D printing) to all students, I was more interested in what would happen when students chose the media and modes they worked in, and I was reluctant to privilege the technologies of maker culture, specifically, when my goal was to engage students in practicing and accounting for writing as a form of making, alongside other forms of making.

My decision to leave the choice of media and modes (and projects) up to students was also grounded in my local context: I was teaching a 300-level course in a new multimodal composition sequence in the undergraduate English major, though the course is also open to non-majors and satisfies a university-required writing credit. Thus, the class positions English majors alongside engineering, business, science, communication, and fine arts majors. I saw this as an opportunity to recreate (and expand upon) one of the practices I admire most about makerspaces:

the ways in which they work across traditional disciplinary boundaries by physically positioning makers with expertise ranging from electronics to industrial design to sculpture and music in proximity to each other and encouraging collaboration among them. Thus, from the outset I encouraged students to draw on and expand their disciplinary, experiential, cultural, linguistic, and technical resources; to explore and design projects that resonated with their interests and concerns in and outside the academy; and to see each other as potential collaborators and resources.

As is evident in the weekly studio prompts and final project prompt (see Appendix Two), I did not specify quantities of written (alphabetic) content or equivalent production of other media content. Rather, I framed benchmarks in terms of engaging rhetorical and design concepts and meeting rhetorical goals, and I worked with students to localize the scope, deliverables, and measurements of effectiveness of their particular projects. In the end, students produced more writing than the minimum amount specified by departmental requirements for a course fulfilling a writing credit, even as they also were engaged in other kinds of composing, including web design, sewing, crafting, cooking, videography, choreography, and data visualizations. I acknowledge that while this worked well in this particular course context (students' projects were highly successful in meeting the expectations I set for the course, and students responded positively in course evaluations), in other contexts, more structure might be helpful. Still, my experiences as a teacher have led me to tend to err on the side of giving students more rather than less room to localize projects for specific goals and contexts within the parameters of course expectations. This was my attempt to renegotiate the boundaries of what and who can come to matter in my pedagogical design by creating as many opportunities as possible to attend to

boundary marking, as a group, and for students to mark and re-mark boundaries in their work, rather than responding to decontextualized parameters.

Core Pedagogical Features

While my course goals and design are certainly localized for a particular institution, department, course sequence, and student group, there are, I believe, core features of the pedagogy that could be adapted across course and institutional contexts. These include 1) space for non-linear composing, wherein students can cultivate openness to *kairos* by generating multiple prototypes without the expectation that they should all be successful or even revised; and 2) 3D assessment, which is so named not only because it triangulates students' self-assessments, my assessment of their rhetorical skills, and audience-specific user experience measures, but also (and most importantly) because it contextualizes rhetorical work in terms of three-dimensional bodies in three-dimensional, dynamic environments.

Non-linear composing

A non-linear approach to composing processes complements the non-linear, dynamic causality emphasized by a genealogical approach to accountability. To foster this approach, I draw on practices I observed in SMS of prototyping and "failing fast" (even as we interrogate the privilege inherent in "failing fast," particularly in the technology industry). I designed low stakes requirements for the weekly studio assignments in order to encourage students to explore and take risks as they worked toward the final project, which itself can be a series of "failed" prototypes, or a refined low- or mid-fidelity prototype, or a high-fidelity prototype or even a finalized product (though none of my students thus far have submitted a finalized product). In this way, I tried to recreate another condition of makerspaces that I admire, which is a spirit of openness to failure or to disequilibrium, as I describe it in Chapter Four. This openness includes

embracing the discomfort and disappointment of failure (or even a string of failures) without being overwhelmed by it (in ways that resonate with Kelly Myers' [2016] discussion of *metanoia*, which we read together and discuss), being willing to let go or move on (and, conversely, knowing when to commit resources to revision and development), and seeing failure as an opportunity to learn from mistakes or re-envision goals, purposes, or expectations. And just as disequilibrium—as finding oneself in a system imbalance, or actively breaking a system—can be an invention and innovation strategy in SMS (even as it is also a boundary marking practice that can exclude), ethically-managed disequilibrium in a learning environment can also be generative, as Santos and McIntyre (2016) argue.

Instead of a more-or-less linear or recursive process of composing in which an initial draft must be carried out to a final version, even if heavily revised, I observed in SMS nonlinear processes of rapid prototyping in which many bare-bones prototypes were generated without the expectation that all (or even most) of them should be developed or revised. I tried to recreate this—to the extent it's possible, given the vastly different institutional contexts—in my class by designing a course structure that moves through a more-or-less linear model of composing concepts and strategies in rhetoric, design, and professional communication, while at the same time encouraging students to explore a non-linear process, including coming to terms with failed prototypes, in weekly studio sessions. For example, even as we move from discussing and modeling research as an empathetic practice one week to discussing and modeling empathetic and accessible design the next week, students can (and do) continue exploring empathetic research in their studio activity for that next week. I found that in many cases, it took weeks of building trust with students for them to take me at my word when I say that failing can be as valid and useful as not failing, and that they do not have to move through the linear-recursive

composing process. I made a point of modeling and fostering a spirit of generosity toward all work, especially as some students seemed to be moving forward with compositions and others found themselves back at the drawing board, and I found that students not only adapted to wide range of composing stages each week (not to mention the wide range of media, goals, and expertise), but also became genuinely invested in their classmates' work and processes, which they demonstrated in collegial in-person interactions and wrote about in their reports and course evaluations.

But even as I work to create safe spaces for risk-taking and failure in the scope of my course, I talk frankly with students about the ways in which "failing fast" is not a neutral or universal concept; it is bound up with privilege and context (as a 2016 *New York Times* editorial by Kate Losse that we read together argues so well). While some students are initially uncomfortable with and even resistant to the non-linear composing process in the course, all students (thus far) have, in the end, taken me up on my provision that the final project need not be "finalized" in the sense they might have initially envisioned. But, as we are all aware, the realities of other composing situations—in other classes, in various community and work settings—do not always allow for such flexibility with timelines and expectations. Therefore, we also talk about how students can carve out spaces for themselves to take risks, let go of and learn from failures, and seek out feedback, even when the formal structure of a class or work setting does not provide such spaces.

3D assessment

I call my approach to evaluating student work "3D assessment," not only because it triangulates students' self-assessments, my assessment of their rhetorical skills, and audience-specific usability measures, but also (and most importantly) because it contextualizes rhetorical

work in terms of three-dimensional bodies in three-dimensional, dynamic environments. That includes not only the way the final projects were assessed, but also the weekly studio sessions where students were constantly sharing, modeling, testing, exploring, explaining, and getting feedback on their work-in-progress. My approach is, at least in part, a response to conversations in multimodal composition about the complexity of composing and transferring knowledge across media and modes. As exciting as multimodal and new media composing can be for expanding how we and our students write and engage in rhetoric, we need to be careful about how we approach that work. As I noted in Chapter Three, Richard Marback (2009) argues that multiliteracy/design/multimodal approaches have thus far failed to account for the wickedness of composing and design by treating media as "affordances" to be manipulated by an agentive designer-writer-rhetor (rather than themselves forces exerted on the composing process) and by subordinating the logics of non-alphabetic compositions to the print-based logics of "argument." Caution is needed in making claims about "knowledge transfer" between alphabetic media and non-alphabetic media, particularly when teachers and researchers rely on verbal and textual reflections to assess that transfer (see DePalma, 2015; Shipka, 2011). And similar caution is needed in our approach to assessing multimodal/multimedia compositions. As I point out in Chapters One and Three, I have concerns about reflections (in the form of writer's memos or statements of goals and choices) as an assessment tool, because assessing reflections might tempt us to treat those reflections as representations of a process rather than as themselves a meaning-making process constrained by the teacher-student relationship. Indeed, just as reflexivity cannot substitute for socially just interventions and accountability to our participants in our research, we ought not to position students' reflections as substitutes for accountability to the (embodied, material-discursive) rhetorical effects of their work.

Therefore, just as my goal in developing the 3D interview method was to diffract words, gestures, spatial relations, bodies, time, and environments, rather than privilege verbal or written reflections, my goal in 3D assessment is to honor the dynamic, entangled, and distributed ways we make rhetorical compositions that matter. When I set out to adapt my 3D interviewing strategy developed for this study to a classroom practice, I considered the following questions:

- How can we teach writing alongside—and entangled with—other ways of composing without subordinating those other ways to the logics of traditional "writing"?
- Can we assess students' rhetorical dexterity across media without relying solely or primarily on written, individual reflections?

This last question has been taken up most recently in the edited collection *A Rhetoric of Reflection* (2016), in which J. Elizabeth Clark provocatively compares e-portfolios to selfies, noting that they are in many ways detached from contexts and that they are "an opportunity for the audience to make meaning of the image," which makes them an "anti-self-reflection" (p. 164). And while Clark ultimately sees reflection as an antidote to that disconnect and as a dispositional practice that can transcend specific media, I am less convinced that the fracturing of contained, individual, medium-specific knowledge that Clark sees as a disconnect is necessarily a problem.

As I noted in Chapter Three, I have been struck by the distributed nature of knowledge, knowledge-makers, and knowers in SMS. What would it mean to focus on immersing students in entanglements and distributions of knowledge, instead of holding them individually accountable for skills? What if—to push Rebecca Nowacek's (2011) work further—what we call "transfer" is as much about integration of a writer/maker/rhetoric into a network as it is about individuals integrating skills or knowledge across contexts (or technologies or media)? Furthermore, that

process of integration almost always involves distributed knowledge that spans written, verbal, gestural, embodied, digital, analog, human and nonhuman forms. As I argued in Chapter Three, to become a "maker" or even an "expert" seems to be as much (if not more so) about seeking out this "open source" distribution as it is about possessing individual knowledge.

To evaluate distributed, entangled, dynamic making as such, we need distributed, entangled, dynamic means of assessment. In my approach, this means distributing assessment (in the form of responses and reactions to work) across bodies, space, and time. The physical, digital, and temporal spaces of the classroom are saturated in low-stakes, ongoing, multi-perspective feedback: from me, from classmates, from intended audiences/users of the work, from self-assessment (that can and often does include reflection). It also means that feedback and assessment are necessarily dynamic and therefore negotiable: I teach students to actively and rhetorically solicit useful feedback on their particular projects/process stages from me and from their peers and intended audiences/users. And my approach to assessment also involves entangling assessment as much as possible by sharing the work of developing localized effectiveness measures with students and their intended audiences/users. Students draw on their rhetorical understanding of UCD, usability testing, and feedback to develop effectiveness measures for their final projects by which their projects can be assessed on their own terms and students can demonstrate rhetorical skills within the contexts, timeframes, media/modes/languages, intended audiences/users, and goals of their specific projects. The balance of written, verbal, visual, aural, gestural, and 3D forms of meaning-making involved in students' deliverables and effectiveness measures is therefore localized, rather than stipulated upfront by me. In terms of assigning grades, I was guided by Jane Danielewicz and Peter Elbow's (2009) approach to contract grading, in which students who met the basic requirements

of each assignment (which involved localized measures effectiveness) automatically qualified for a B grade and could score higher by exceeding the requirements.

My coauthors and I discuss this dimensional, multi-layered approach to assessment in great detail in our in-progress manuscript. Here, I will briefly describe two examples offered by two of my coauthors, Hanh Mai and Joy Phillips. For Hanh, localizing effectiveness meant combining a pole-dancing routine she choreographed with a guide she developed for her classmates (and me, since I have very little training in dance) on how to encounter and respond to art using rhetorical concepts. She used digital video and slides, as well as a printed handout, to present this work to her classmates, and she created a web page that also included an account of her past process, present stage, and future plans for her work. Joy, who had been prototyping a mobile app for fellow commuters, decided to stop working on the free app-design platform she'd been using for low-fidelity prototypes because she was increasingly frustrated with its limitations and increasingly realizing (as she had been teaching herself coding along the way) that she wanted to commit to building from the ground up. In her presentation to her classmates, she offered a narrative of her design and prototyping process (supplemented with digital artifacts, including a QR code for classmates to scan with their smartphones and demo the app prototype as they listened to her), and she also shared with us her newly formed plans—as a result of her composing process and work on the app—to double major in English and Informatics and to return to her commuter app as a future project in a design course. Both Hanh and Joy demonstrated rhetorical skills that were highly responsive to and localized for specific contexts, users, goals, media, modes, and timeframes. As Sharon Crowley (1999) has argued, the work of boundary negotiation—what and who count, what and who matter—is rhetorical, and by

negotiating the terms by which their work is assessed with me, with their intended audiences/users, and with their own evolving goals, students are doing rhetorical work.

While this particular course was offered in the context of a multimodal composition sequence, these core pedagogical features have potential resonance for courses that are not explicitly multimodal/digital in their approach. For example, my commitment to sharing the work of designing and assessing localized projects with students resonates with conversations in postpedagogy (see, for example, Lynch, 2011; Santos & McIntyre, 2016), and my students' experience of discomfort with the non-linear composing process is similar to the productive disequilibrium that Marc Santos and Megan McIntyre advocate for. I follow decolonial approaches to pedagogy by not only having students read work in decolonial rhetorics but also by approaching composing and usability testing in ways that "are concerned with cultural histories and material bodies," as Angela Haas (2012) advocates in her decolonial approach to technical communication pedagogy. And my approach resonates with public rhetoric-oriented approaches to rhetoric and composition (see, for example, Sheridan, Ridolfo, & Michel, 2013) and social justice-oriented approaches to technical communication (see, for example, Jones & Walton, forthcoming) by making accountability as three-dimensional (literally and figuratively) as possible.

Part Two: Next Steps

Limitations of This Study

As I explained in Chapter Two, my study was designed to explore a phenomenon with which I was unfamiliar (a makerspace); thus the questions I ask and answer are mainly descriptive in nature, rather than comparative or experimental. In tracing how people, machines, ideas, objects, and communities are made to matter (or not), I recognize and account for my

entanglement—as researcher/research apparatus maker—in the making of knowledge. Relatedly, because this is a case study of one makerspace, I do not make claims about the larger maker movement or about the extent to which SMS is representative of makerspaces; any connections I make (for example, about issues of gender diversity and inclusion) are instances when my observations and experiences resonate with other observations of makerspaces and the maker movement. In this way, I locate both the reliability of my study in its account of entangled knowledge making, rather than in the specifics of the interactions/intra-actions I observed in SMS—just as Clarissa and I argue that the reliability of our collaborative case study is in both our collaborative methodology and in the heuristic we developed from our findings. Similarly, in the in-progress coauthored study of the Rhetoric in the Making course, my co-authors and I offer both our collaborative methods and our recommendations for course design as opportunities for further user localization, rather than as generalizable truths.

Still, even within the intended scope of this study and my findings, there are limitations. While emergence—of SMS itself, of makers and machines and objects in SMS, of the research apparatus, of my relationship to SMS, and of knowledge about making and SMS—is at the heart of the study, the many layers of emergence limit what I can claim to know about developments in SMS. Even though the study is longitudinal and covers more than a year's time, I spent the first several months of that time focused on orienting myself to an unfamiliar workspace (particularly its dynamic, permeable, fast-changing nature) and unfamiliar technologies, as well as building trust with the people in SMS. This had some advantages: I empathized with people like Tony (and also Eric) who came to the maker movement as amateurs and could see through empathetic eyes the challenges of making oneself into a maker. But a researcher already familiar with the maker movement and/or already familiar with 3D fabrication technologies would likely

have been able to observe and experience phenomena at a more fine-grained level than I was able to in the early months of my study.

Furthermore, my "low but steady level" of physical presence at the research site (Read, 2011) had both advantages and limitations. On the one hand, it afforded a more longitudinal, meso-to-macro view of developments in SMS and helped me more clearly trace and construct genealogies of mattering over time, particularly since I was constructing and refining both the accounts themselves and the genealogical apparatus. On the other hand, because the composition and organization of people, machines, and objects in SMS can (and often does) change so frequently, a more intensive, day-to-day view could have illuminated the micro (and potentially additional meso and macro) effects of these changes. Given these limitations, the current study functions as an in-depth pilot or first phase of my investigation into making and mattering phenomena, an issue I take up in my discussion below of future directions for this research.

Future Directions for Study

During this initial phase of research on making and mattering, I refined my research apparatus and my own knowledge of 3D fabrication and maker culture (as I experienced it in and beyond SMS), and I am eager to continue exploring making and refining my apparatus. My investigations in this phase of the study were necessarily focused on how best to understand and account for how people and things are made to matter (or not), in order to get a sense of the phenomena of making and mattering, but I envision several future directions for this study: a multi-site comparative study, a more focused investigation of writing in a media-rich, adhocractic space, and a more robust examination of maker-inspired writing and rhetoric pedagogies.

My decision to design an ethnographic case study of a makerspace was motivated in no

small part by my belief that as rhetoric and writing studies grow more interested in makerspaces and the maker movement as potential pedagogical models, we need to understand the material-cultural phenomena we are importing, particularly when the movement's own research shows a disproportional representation of men (Maker Media, 2015; hackster.io, 2016). (Interestingly, neither Maker Media nor hackster.io queried survey respondents about their race or ethnicity, and English was assumed to be the lingua franca of the movement.) Furthermore, in the broader, multidisciplinary, and emerging academic conversation about makerspaces and the maker movement, there are calls for more research on makerspaces (see, for example, Sheridan et al., 2014) to which my study responds and potentially contributes. My study offers a longitudinal examination of a makerspace working to establish itself in a city that is, by the participants' accounts, a graveyard of short-lived makerspaces. It also offers a longitudinal examination of a changing cohort of makerspace regulars as they face challenges of bringing their vision of inclusivity and diversity to fruition, and it offers a longitudinal examination of how makers are made (and unmade, and remade) in a makerspace.

But as I noted in my discussions of the study's limitations, my study does not generalize about makerspaces or the maker movement. The next step I see, then, is to examine multiple sites to begin to work toward an understanding of the similarities and nuances of the larger movement. As more universities (including my own) create their own makerspaces, it is worth comparing the kinds of making and makers that matter in a university makerspace with the making and makers that matter in a for-profit/public-benefit makerspace like SMS. While Sheridan et al (2014) have begun this work in their comparative case study, it would also be worthwhile to further investigate similarities and differences in a for-profit/public-benefit makerspace with a non-profit and/or grant-funded makerspace. While scholars such as Fox,

Ulgado, and Rosner (2015) have investigated feminist hackerspaces, a sustained comparison of a feminist makerspace and a not-overtly-feminist makerspace could further elucidate issues of gender and inclusion in the movement. And while my study has focused on a makerspace in the U.S. with English as its lingua franca, a comparative study of a makerspaces in different countries and with different cultural and linguistic practices could contextualize knowledge of makerspaces and the maker movement in a global (rather than a U.S.-centric) perspective. Whether the goal is to contribute to interdisciplinary academic and practical knowledge about makerspaces and the maker movement or to make more informed choices about the pedagogical and technological practices we import from them into our classrooms, writing centers, libraries, and campuses, understanding similarities and differences across financial, institutional, geographic, and cultural settings is important.

Furthermore, while I certainly paid attention to communication in SMS (including what counts as writing, the role of writing, the role of writers, and attitudes toward writing, as well as the relationship between writing and other forms of meaning-making), this was not my primary focus in this phase. Still, as a researcher-teacher interested in preparing students to write in an economy increasingly comprised of media-rich "all-edge adhocracies" (Spinuzzi, 2015), I envision an investigation that could focus more specifically on those questions about writing. For example, a study of the visibility and value of writing (and, of course, what and who count as writing and writers) could undertake a more sustained examination of points of communicative failures, of how people engage with writing on a day-to-day basis, and/or of the visibility of writing (particularly as opposed to other forms of making) in the space. As Lucy Suchman (1997) has observed in the case of air traffic control, the visibility of work matters immensely to its relative importance, and invisibility makes work matter less and more difficult. My

observations of SMS suggest a similar issue with the visibility (and recognition) of writing and writers—particularly in Tony's case (Chapter Three), but also in the case of the SMS blog (with its periods of activity and dormancy) and other social media, as well as various workflow tools (wikis, Trello, Slack, Google calendars, machine maintenance and repair manuals, instructional manuals, release forms and waivers, etc.). More sustained investigation of this phenomenon at SMS and/or across sites could enrich my understanding of how and why writing and writers are made more or less visible (or to matter more or less). This, in turn, could inform how I teach writing, particularly to students whose occupational goals tend toward spaces where alphabetic communication both complements and competes with visual, aural, and 3D forms of communication.

Finally, as I describe in Part One of this chapter, my research on SMS led me to implement a pedagogy that both draws upon and pushes back against the influences of makerspaces and the maker movement (as I understand them), and it also led me to collaboratively study this pedagogy with my students. I am certainly not alone in my efforts to apply what I've learned from researching a makerspace to a writing classroom: I think of David Sheridan, who has incorporated fabrication technologies in the multiliteracy center he directs; John Sherrill, who conducted a master's thesis study on technical communication in a makerspace (2015) and teaches a first-year composition course on digital rhetorics that includes 3D printing; Jentery Sayers, who runs a digital humanities maker lab in which he and his students create exhibits and kits that examine material cultures; and Estee Beck, who partners with a fablab on her campus to include a fabrication-oriented unit in her undergraduate digital rhetorics course. The *Digital Rhetoric Collaborative* hosted a blog carnival on makerspaces and composition in March 2016 and a subsequent Twitter chat (April 14). I participated in both and

found the conversations about the possibilities and pitfalls of maker-inspired writing and rhetoric pedagogies to be lively and thoughtful. A next step would be to examine these pedagogies in their many iterations across departments, institutions, regions, and even disciplines, and I believe the methodology and methods I contribute in this study could be adapted for such work, particularly for attending to what and whom these pedagogies make matter, and what and who are excluded from mattering.

More immediately, I envision a broader study of the 3D assessment approach I developed and began to examine in this phase of my study—perhaps including multiple sections of a course with different teachers (who might be willing to try 3D assessment), or even multiple institutional settings. In addition to examining what and who are made to matter and what and who are excluded from mattering in such an approach, I can imagine exploring how 3D assessment might reorient teachers and students to knowledge transfer. My goal, in a 3D assessment approach, is to emphasize and account for that distribution and entanglement, and in a longitudinal study, I could test how such an approach could change not only how we define (and look for and assess) "knowledge transfer," but also how students experience and do "knowledge transfer."

Similarly, I envision broader applications, beyond my study of making and mattering, of the research methodology—particularly the genealogical approach to accounting for the entanglement of theoretical frameworks and research(er) apparatuses in the observed phenomena. I deliberately pay attention to the ways in which my work to make space for myself (and make knowledge about making space) in SMS is entangled with my understanding of experiences. I believe that accounting for the research(er) apparatus in this way can be an important step in crossing the boundaries by which narrative approaches like ethnographies or

case studies might be marked off from methods that account for research apparatuses through more quantitative measures like inter-rater reliability or p values, which are themselves apparatuses entangled with phenomena. In this way, I follow scholars such as Michael Williamson and Brian Huot (2012) and Rául Sánchez (2012), who advocate for moving beyond limiting binaries like quantitative/qualitative, experimental/nonexperimental, and theoretical/empirical, in favor of locating the real (and the potentially replicable) in the construction of and accounting for the research apparatus itself. Indeed, while my study thus far—and in the most immediate future iterations I imagine—has tended to draw primarily on ethnographic case study methods, I do not see this as exclusive of possibilities for big(ger) data research. A methodology that locates validity and reliability in accounting for the entanglement of the apparatus in the phenomenon could be the key to bridging case study and big(ger) data research, be it an accumulation of case studies, larger scale survey research informed by ethnographic study, or larger scale analysis of texts.

While I developed 3D interviewing with researcher POV video in the context of my research on a makerspace, the methodological orientations and techniques could support research and teaching in a number of ways beyond the scope of my study. An interview need not be about 3D making in order to be a 3D interview. As Laura Gonzales (2015) has shown, filming a focus group in which students talk about their composing practices across languages and across modalities affords an opportunity to examine students' gestures alongside their verbal accounts. Even when an interview in my makerspace study seems more traditional (for example, a Skype interview with a participant who has moved away), I still approach it as a 3D interview in that I'm attending to bodies in place and space (including virtual space), I'm triangulating multiple

ways of knowing that include and exceed the words we say, and I'm accounting for my own role in the making of knowledge.

3D interviewing with video has also informed my ongoing research on students' multimodal composing. While some research on multimodal composing has relied on written and verbal reflections as a means of data collection (see, for example, DePalma, 2015), other approaches, like that of Stuart Blythe and Laura Gonzales (2016), focused on acts of composing via screen capture technologies. I see 3D interviewing with video as a way to combine both these approaches: putting embodied acts of making (digital, 3D, alphabetic, haptic, visual, aural) alongside verbal or textual artifacts or reflections, and locating the researcher (via POV video) in the making of knowledge.

Since I developed 3D interviewing with video in the context of an ethnographically-informed case study, I can certainly imagine applications of the method to other ethnographic research, including case studies, workplace studies, classroom research, and user research, as a way of bringing multiple modes of meaning-making to the forefront, acknowledging and accounting for the researcher's participation and supplementing textual descriptions. But just as 3D interviewing need not be limited to 3D making, it also need not be limited to qualitative research. 3D interviewing helps account for the research(er) apparatus in a way that can be an important step in crossing the boundaries by which narrative approaches like ethnographies or case studies might be marked off from methods that account for research apparatuses through measures like inter-rater reliability. As a complement to a quantitative approach—for example, a corpus study—3D interviewing with video could illuminate the particulars of individual cases and contributors to the corpus. Or, as an autoethnographic technique, 3D interviews with video could help us, no matter what our approach, not just say but *show* our methodological work.

Final Thoughts

An unexpected but welcome outcome of this dissertation project has been the emergence of a philosophy that not only unifies various projects within my research agenda, but that also unifies my research and teaching in ways that I had not experienced before, despite nearly a decade of teaching. Accountability for boundary marking has become as much my teaching (and administrative) philosophy as it is my research and collaboration philosophy. In fact, the structure of this dissertation is itself a microcosm of the ways my theoretical-methodological apparatus developed in response to and in the context of my research and teaching and then re-infused itself into both my research and teaching. As the focus, sites, participants of my research and teaching evolve, what I hope to carry forward is an orientation to understanding and intervening in making (in its many forms) by accounting for boundary marks and who and what come to matter, as well as who and what are excluded from mattering.

BIBLIOGRAPHY

Ahmed, S. (2008). Open Forum: Imaginary Prohibitions: Some Preliminary Remarks on the Founding Gestures of the 'New Materialism.' *European Journal of Women's Studies* 15(1): 23-39.

Agboka, G. Y. (2013). Participatory localization: A social justice approach to navigating unenfranchised/disenfranchised cultural sites. *Technical Communication Quarterly*, *22*(1), 28-49.

Alexander, J., & Rhodes, J. (2014). *On multimodality: New media in composition studies*. Urbana, IL: National Council of Teachers of English/Conference on College Composition and Communication.

Alsup, J. (2010). Beyond member checks: Toward transformative data analysis. In sj Miller & D. Kirkland, eds. *Change matters: Critical essays on moving social justice research from theory to policy*. New York, NY: Peter Lang.

Arola, K., Sheppard, Jennifer, & Ball, Cheryl E. (2014). *Writer/designer: A guide to making multimodal projects*. Boston: Bedford/St. Martins.

Arola, K. L. & Wysocki, A. F. (2012). *Composing(media) = composing(embodiment): Bodies, technologies, writing, the teaching of writing*. Logan, Utah: Utah State University Press.

Atwill, J. (1998). *Rhetoric Reclaimed: Aristotle and the Liberal Arts Tradition.* Ithaca: Cornell University Press.

Banks, A. (2006). *Race, rhetoric, and technology: Searching for higher ground.* Mahwah, NJ : Urbana, Ill.: Lawrence Erlbaum; National Council of Teachers of English.

----. (2011). *Digital Griots: African American Rhetoric in a Multimedia Age*. Carbondale: Southern Illinois University Press.

Ballentine, B. D. (2009, Fall). Hacker ethics & Firefox extensions: Writing and teaching the 'grey' areas of web 2.0. *Computers and Composition Online*.

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.

Barnett, S. (2015). Rhetoric's Nonmodern Constitution: *Techne, Phusis,* and the Production of Hybrids. In Lynch & Rivers, 81-96.

----. (2015b). Chiasms: Pathos, Phenomenology, and Object-Oriented Rhetorics. *Enculturation 20*. Retrieved from http://enculturation.net/chiasms-pathos-phenomenology.

Bawarshi, A. (2016). "Accounting for Genre Performances: Why Uptake Matters." In N. Artemeva & A. Freedman, eds. *Genre studies around the globe: Beyond the three traditions*. Edmonton, AB, Canada: Inkshed Publications.

Bennett, J. (2009). *Vibrant Matter: A Political Ecology of Things*. Duke University Press.

Bolter, Jay David, & Grusin, Richard. (1999). *Remediation: Understanding New Media*. Cambridge: MIT Press.

Bowie, J. (2009). Beyond the universal: The universe of users approach to user-centered design. In Miller-Cochran & Rodrigo, eds. pp. 135-163.

Blair, C. (1999.) Contemporary U.S. Material Sites as Exemplars of Rhetoric's Materiality. In J. Selzer and S. Crowley (Eds.), *Rhetorical bodies*, pp. 15-67. Madison: University of Wisconsin Press.

Blythe, S. (2012). Composing activist research. In K. Powell & P. Takayoshi (Eds.), *Practicing research in writing studies: reflexive and ethically responsible research*, pp. 275-292. New York: Hampton Press.

Breuch, L. M. K. (2001). The Overruled Dust Mite: Preparing Technical Communication Students To Interact with Clients. *Technical Communication Quarterly, 10*, 193-210.

---. (2015). Glocalization in website writing: The case of MNsure and imagined/actual audiences. *Computers and Composition, 38*, 113-125.

Brown, M. E., & Hocutt, D. (2015). Learning to use, useful for learning: a usability study of Google apps for education. *Journal of Usability Studies, 10*(4): 160-181.

Bulmash, G. (2016, August 14.) Event Review: DevRel Summit. Retrieved from http://yiddish.ninja/event-review-devrel-summit/.

Butler, J. (1993). *Bodies That Matter: On the Discursive Limits of "Sex."* New York: Routledge.

Charmaz, K. (2006). *Constructing grounded theory.* Thousand Oaks, CA: Sage.

Chong, F. (2016). The Pedagogy of Usability: An Analysis of Technical Communication Textbooks, Anthologies, and Course Syllabi and Descriptions. *Technical Communication Quarterly,* 25:1, 12-28.

Clark, E. (2016). From selfies to self-representation in electronically mediated reflection. In Yancey (Ed.) *A rhetoric of reflection*, pp. 149-165. Logan: Utah State University Press.

Corbin, J., & Strauss, A. L. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory. Fourth edition.* Thousand Oaks, CA: Sage.

Crabtree, R. D., & Sapp, D. A. (2005). Technical communication, participatory action research, and global civic engagement: A teaching, research, and social action collaboration in Kenya. *Reflections, 4*(2), 9-33.

Crowley, S. (1999). Afterword. In J. Selzer & S. Crowley, 357-64.

Cummings, R. E. (2009). *Lazy virtues: Teaching writing in the age of Wikipedia*. Nashville, Tenn: Vanderbilt University Press.

Cushman, E. (2016, August). *Decolonial Rhetorics and Sequoyan*. Plenary address given at "College Writing": From the 1966 Dartmouth Seminar to Tomorrow, Hanover, NH.

DePalma, Michael-John. (2015). Tracing Transfer across Media: Investigating Writers' Perceptions of Cross-Contextual and Rhetorical Reshaping in Processes of Remediation. *College Composition and Communication* 66(4): 615-642.

Edbauer, J. (2005). Unframing models of public distribution: From rhetorical situation to rhetorical ecologies. *Rhetoric Society Quarterly*, *35*(4), 5–24.

Eyman, D. (2015). *Digital rhetoric: theory and practice.* Ann Arbor: University of Michigan Press.

----. (2009). Usability: Methodology and design practice for writing processes and pedagogies. In Miller-Cochran & Rodrigo, eds. pp. 213-228.

Faber, B. (2002). *Community Action and Organizational Change: Image, Narrative, and Identity*. Carbondale: Southern Illinois University Press.

Fleckenstein, K. S. (2010). *Vision, rhetoric, and social action in the composition classroom*. Carbondale: Southern Illinois University Press.

Fleckenstein, K., Spinuzzi, C., Rickly, R., & Papper, C. C. (2008). The Importance of Harmony: An Ecological Metaphor for Writing Research. College Composition and Communication 60(2): 388-419.

Fox, S., Ulgado, R. R., & Rosner, D. K. (2015). Hacking Culture, Not Devices: Access and Recognition in Feminist Hackerspaces. In Proc. of CSCW '15, March 14-18, 2015, Vancouver, BC, Canada. http://dx.doi.org/10.1145/2675133.2675223

George, D. (2002). From analysis to design: Visual communication in the teaching of writing. *College Composition and Communication, 54*(1), 11-39.

Getto, G. (2014). Designing for engagement: Intercultural communication and/as participatory design. *Rhetoric, Professional Communication, and Globalization, 5*(1), 44-66.

---. (2015). Editor's introduction. *Rhetoric, Professional Communication, and Globalization, 7*(1), 1-11.

---, & Moore, C. (2017). Mapping personas: Designing UX relationships for an online coastal atlas. *Computers and Composition, 43*, 15-34.

Gonzales, L. (2015). Multimodality, Translingualism, and Rhetorical Genre Studies. *Compositium Forum* 31. Retrieved from www.compositionforum.com.

----, & Zantjler, R. (2015). Translation as a user-localization practice. *Technical Communication, 62*, 271-284.

Glaser, B., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Pub.

Grabill, J. (2013). On Being Useful: Rhetoric and the Work of Engagement. In Coogan, D., ed. *The Public Work of Rhetoric*. Columbia: University of South Carolina Press.

---, & Simmons, M. (1998). Toward a critical rhetoric of risk communication: Producing citizens and the role of technical communicators. *Technical Communication Quarterly*, 7, 415-441.

Gries, L. E. (2015). *Still life with rhetoric: A new materialist approach for visual rhetorics*. Logan: Utah State University Press.

Haas, Angela. (2007). Wampum as Hypertext: An American Indian Intellectual Tradition of Multimedia Theory and Practice. *Studies in American Indian Literatures* 19(4): 77-100.

Hallenbeck, S. (2012). "Toward a Posthuman Perspective: Feminist Rhetorical Methodologies and Everyday Practices." *Advances in the History of Rhetoric* 15(1): 9-27.

Haraway, D. (1991). *Simians, Cyborgs, and Women: The Re-Invention of Nature*. London: Routledge.

Hariman, R., & Lucaites, J. L. (2007). *No caption needed: Iconic photographs, public culture, and liberal democracy*. Chicago: University of Chicago Press.

Hawhee, D. (2009). *Moving Bodies: Kenneth Burke at the Edges of Language*. Columbia: University of South Carolina Press.

Hawhee, D. (2004). *Bodily Arts: Rhetoric and Athletics in Ancient Greece*. Austin: University of Texas Press.

Herndl, C. & Graham, S. (2015). Getting Over Incommensurability: Latour, New Materialisms, and the Rhetoric of Diplomacy. In Lynch & Rivers. 40-58.

Herrington, T. K. (2010). Crossing global boundaries: Beyond intercultural communication. *Journal of Business and Technical Communication, 24*, 516-539.

Horner, B. & Selfe, C. (2013). Translinguality/Transmodality Relations: Snapshots from a Dialogue. *The Working Paper Series on Negotiating Differences in Language and Literacy*, University of Louisville. Retrieved from http://louisville.edu/workingpapers/copy_of_working-papers.

Horner, B. (2016). Reflection-action, cross-language literacy, and language dispositions. In Yancey (ed). *A rhetoric of reflection*, pp. 105-124. Logan: Utah State University Press.

Inoue, A. & Richmond, T. (2016). Theorizing the reflection practices of Hmong college students: Is 'reflection' a racialized discourse? In Yancey (ed.). pp. 125-147.

Jasinski, J. (2001). The status of theory and method in rhetorical criticism. *Western Journal of Communication* 65(3): 249-270.

Jones, N. N. (2014). Methods and meanings: Reflections on reflexivity and flexibility in an

intercultural ethnographic study of an activist organization. *Rhetoric, Professional Communication, and Globalization, 5*(1), 14-43.

----, & Walton, R. (Forthcoming). Using narratives to foster critical thinking about diversity and social justice. In M. Eble and A. Haas (Eds.), *Integrating theoretical frameworks for teaching technical communication*.

Jordan, J. (2015). Material Translingual Ecologies. *College English, 77*(4), 364-382.

Kerschbaum, S. (2014). *Toward a new rhetoric of difference.* Urbana, IL: Conference on College Composition and Communication/National Council of Teachers of English.

Koelsch, L. (2013). Reconceptualizing the member check interview. *International Journal Of Qualitative Methods, 12*, 168-179.

Kress, G. (2005). Gains and losses: New forms of texts, knowledge, and learning. *Computers and Composition*, 22: 5–22.

Lauer, C. (2009). Contending with Terms: "Multimodal" and "Multimedia" in the Academic and Public Spheres. *Computers and Composition* 26: 225-39.

----., & Brumberger, E. (2016). Technical communication as user experience in a broadening industry landscape. *Technical Communication, 63*, 248-264.

Long, E. (2014). Engaging public administrators in training: Technical communication as a responsive rhetorical art. *Professional Communication Conference (IPCC), 2014 IEEE International,* 1-5.

Lu M.-Z, & Horner B. (2013). Translingual literacy, language difference, and matters of Agency. *Coll. Engl. College English*, *75*(6), 582–607.

Maker Media. (2015). Fact Sheet. Retrieved from http://makermedia.com/press/fact-sheet/.

Mara, A. & Hawk, B. (2009). Posthuman rhetorics and technical communication. *Technical Communication Quarterly* 19: 1-10.

Marback, R. (2009). Embracing Wicked Problems: The Turn to Design in Composition Studies. *College Composition and Communication, 61*(2): 397-419.

McGee, M. C. (2009). A Materialist's Conception of Rhetoric. In Biesecker, B. A., & Lucaites, J. L. eds. *Rhetoric, materiality, & politics*. New York: Peter Lang.

McKee, H., & DeVoss, Dànielle Nicole. (2007). *Digital writing research : Technologies, methodologies, and ethical issues* (New dimensions in computers and composition). Cresskill, N.J.: Hampton Press.

McNely, B., Spinuzzi, C. & Teston, C. (2015). Contemporary Research Methodologies in Technical Communication. Technical Communication Quarterly 24(1): 1-13.

Miller-Cochran, S. K., & Rodrigo, R. L. (2009). *Rhetorically rethinking usability: Theories, practices, methodologies*. Cresskill, NJ: Hampton Press.

Mucklebauer, J. & Hawhee, D. (2000). Posthuman Rhetorics: "It's the Future, Pikul." *JAC: A Journal of Rhetoric, Culture, and Politics* 20(4): 767-74.

Murray, S., & Ankerson, M. S. (2016). Lez takes time: Designing lesbian contact in geosocial networking apps. *Critical Studies in Media Communication, 33*(1), 53-69.

Neilsen, J. (1993). *Usability engineering*. Boston, MA: Academic Press.

Palmeri, J. (2012). *Remixing composition: a history of multimodal writing pedagogy*. Carbondale: Southern Illinois University Press.

Panthee, R. K. (2014). Re/designing online platforms by citizen designers and its contribution to the digital writing and research. In M. Limbu B. & Gurung (eds.), *Emerging pedagogies*

in the networked knowledge society : Practices integrating social media and globalization. pp. 280-293. Hershey, PA: Information Science Reference.

Pink, S. (2015). *Doing Sensory Ethnography*. Thousand Oaks, CA: Sage Publications.

--. (2011). Multimodality, multisensoriality and ethnographic knowing: social semiotics and the phenomenology of perception. Qualitative Research 11(3): 261-276.

Powell, K. M., & Takayoshi. (2012). *Practicing research in writing studies: reflexive and ethically responsible research*. New York: Hampton Press.

Powell, M. (2012). 2012 CCCC Chair's Address: Stories Take Place–A Performance in One Act. *College Composition and Communication, 64*(2), 383-406.

Prins, K. (2015). *Materiality, craft, identity, and embodiment: Reworking digital writing pedagogy.* Retrieved from ProQuest Dissertations and Theses.

Prior, P. (2005). Moving multimodality beyond the binaries: A response to Gunther Kress' "Gains and losses." *Computers and Composition* 22: 23–30.

Rai, C. (2016). *Democracy's lot: rhetoric, publics, and the places of invention*. Tuscaloosa: University of Alabama Press.

Ratcliffe, K. (2005). *Rhetorical listening: identification, gender, whiteness*. Carbondale: Southern Illinois University Press.

Read, S., & Swarts, J. (2015). Visualizing and tracing: Research methodologies for the study of networked, sociotechnical activity, otherwise known as knowledge work. *Technical Communication Quarterly, 24*, 14-44.

Redish, J. (2010). Technical communication & usability: Intertwined strands and mutual influences. *IEEE Transactions on Professional Communication*, *53*, 191-201.

Redish, J., & Barnum, C. (2011). Overlap, influence, intertwining: The interplay of UX and technical communication. *Journal of Usability Studies*, *6*(3), 90-101.

Reiff, M. J., & Bawarshi, A. (2011). Tracing Discursive Resources: How Students Use Prior Genre Knowledge to Negotiate New Writing Contexts in First-Year Composition. *Written Communication*, *28*(3), 312–337.

Reynolds, N. (2007). *Geographies of Writing: Inhabiting Places and Encountering Difference*. SIU Press.

Rice, J. (2012). *Distant publics: development rhetoric and the subject of crisis*. Pittsburgh: University of Pittsburgh Press.

Rickert, T. J. (2013). *Ambient rhetoric: the attunements of rhetorical being*. Pittsburgh: University of Pittsburgh Press.

Ross, D. (2013). Deep audience analysis: A proposed method for analyzing audiences for environment-related communication. *Technical Communication, 60*, 94–117.

Saldaña, J. (2009). *The coding manual for qualitative researchers*. Los Angeles, CA: Sage.

San Diego, C., Persing, S., & Fifield, T. (2016). Anyone can throw together developer communities, right? Retrieved from https://medium.com/@SandraPersing/anyone-can-throw-together-developer-communities-right-790822b28dfe#.zca53tywj

Sano-Franchini, J. (2015). Cultural Rhetorics and the Digital Humanities: Toward Cultural Reflexivity in Digital Making. In J. Ridolfo & W. Hart-Davidson, eds. *Rhetoric and the Digital Humanities*. pp. 49-64. Chicago: University of Chicago Press.

Sayers, J. (2015, July). Making in the Academy: A Long View. *UVic Maker Lab* blog. Retrieved from http://maker.uvic.ca/union/.

Sayers, J. (2011). Tinker-centric pedagogy in literature and language classrooms. In McGrath, L., ed. *Collaborative approaches to the digital in English studies*. Logan, Utah: Utah State University Press/Computers and Composition Digital Press.

Schadler, C. (2014). Key practices of transition to parenthood: The everyday figuration of parents' and children's bodies and personalities through the lens of a new materialist ethnography. *Current Sociology* 62(1): 114-131.

Schell, E. and K. J. Rawson, Eds. (2010). *Rhetorica in Motion: Feminist Rhetorical Methods and Methodologies.* Pittsburgh: University of Pittsburgh Press.

Schell, E. (2012). Materializing the Material as a Progressive Method and Methodology. In Powell, K. & Takayoshi, P., 123-40.

Schumacher, R. (ed). (2010). *Handbook of global user research*. Burlington, MA: Morgan Kaufmann.

Scott, J. B., Longo, B., & Wills, K. V. (2006). *Critical power tools: Technical communication and cultural studies*. Albany, NY: SUNY Press.

Selber, S. (2004). *Multiliteracies for a digital age* (Studies in writing & rhetoric). Carbondale: Southern Illinois University Press.

Selfe, C. (2009). The Movement of Air, the Breath of Meaning: Aurality and Multimodal Composing. *College Composition and Communication* 60(4): 616-63.

----., & Selfe, R. (1994). The politics of the interface: Power and its exercise in electronic contact zones. *College Composition and Communication, 45*, 480-504.

Selzer, J. & S. Crowley. eds. (1999). *Rhetorical bodies*. Madison: University of Wisconsin Press.

Selzer, J. (1999). Habeas Corpus: An Introduction. In J. Selzer & S. Crowley, 3-15.

Sherrill, J. (2014). *Makers: Technical Communication in Post-Industrial Participatory Communities*. Unpublished thesis. Purdue University, U.S.

Sheridan, D. (2010). Fabricating Consent: Three-Dimensional Objects as Rhetorical Compositions. *Computers and Composition* 27: 249-265.

Shipka, J. (2011). *Toward a composition made whole*. Pittsburgh, Pa.: University of Pittsburgh Press.

Shipka, J. (2016). Transmodality in/and processes of making: Changing dispositions and practice. *College English* 78(3): 250-7.

Shivers-McNair, A. (2017). 3D Interviewing with researcher POV video: Bodies and knowledge in the making. *Kairos: A Journal of Rhetoric, Technology, and Pedagogy, 21*(2). Retrieved from www.praxis.technorhetoric.net/tiki-index.php?page=PraxisWiki:_:3D%20Interviewing.

----., & San Diego, C. (2017). Localizing communities, goals, communication, and inclusion: A collaborative approach. *Technical Communication*, *64*(2), 97-112.

Silver, N. (2016). Reflection in digital spaces : publication, conversation, collaboration. In Yancey (Ed.). *A rhetoric of reflection,* pp. 166-201. Logan: Utah State University Press.

Sirc, Geoffrey. (2003). *English Composition As A Happening*. Logan: Utah State University Press.

Spinuzzi, C. (2008). *Network: Theorizing Knowledge Work in Telecommunications*. Cambridge: Cambridge University Press.

----. (2015a). *All Edge: Inside the New Workplace Networks*. Chicago: University of Chicago Press.

----. (2015b). Symmetry as a Methodological Move. In Lynch, P. & Rivers, N., eds. *Thinking with Bruno Latour in Rhetoric and Composition*. Carbondale: Southern Illinois University Press, 23-39.

St. Amant, K., & Rich, R. (2015). Online writing in global contexts: Rethinking the nature of connections and communication in the age of international online media. *Computers and Composition, 38*, v-x.

Stark-Meyerring, D., Duin, A. H., & Palvetzian, T. (2007). Global partnerships: Positioning technical communication programs in the context of globalization. *Technical Communication Quarterly, 16*, 139-174.

Stevens, S. (2004). Debating Ecology: Ethnographic Writing that 'Makes a Difference.' In Brown, S., & Dobrin, S., eds. *Ethnography Unbound : From Theory Shock to Critical Praxis*. Albany, NY, USA: State University of New York Press, 157-180.

Suchman, Lucy. (2002). Located accountabilities in technology production. *Scandinavian Journal of Information Systems* 14(2): 91-105.

Sullivan, P. (1989). Human-computer interaction perspectives on word-processing issues. *Computers and Composition, 6,* 11-35.

Sun, H. (2012). *Cross-cultural technology design: Creating culture-sensitive technology for local users*. New York: Oxford University Press.

Quesenbery, W., & Szuc, D. (2012) *Global UX: Design & research in a connected world*. Burlington, MA: Morgan Kaufmann.

Walton, R., Zraly, M., & Mugengana, J. P. (2015). Values and Validity: Navigating Messiness in a Community-Based Research Project. *Technical Communication Quarterly 24*(1): 45-69.

----., Mays, R., & Haselkorn, M. (2016). Enacting Humanitarian Culture: How Technical Communication Facilitates Successful Humanitarian Work. *Technical Communication, 63*(2), 85.

Winsor, D. (2003). *Writing Power: Communication in an Engineering Center*. Albany: State University of New York Press.

Wysocki, A. F. (2005). awaywithwords: On the Possibilities in Unavailable Designs. *Computers and Composition 22*: 55-62.

----. (2004). The multiple media of texts: How onscreen and paper texts incorporate words, images, and other media. In *What writing does and how it does it: An introduction to analyzing texts and textual practices*. Charles Bazerman, Paul Prior (Eds.). Lawrence Erlbaum, Mahwah, NJ., 123–163.

Yancey, K. Ed. (2016). *A rhetoric of reflection*. Logan: Utah State University Press.

APPENDIX 1. VIDEO TRANSCRIPTS

Chapter Two

Figure 6. Richard operates the laser cutter

[7 seconds of machine noise]

Richard, a white man with a beard and brown hair (save for a pink ponytail) stands in front of an industrial laser cutter in a warehouse space. Behind the laser cutter is an unfinished mural, predominantly in blue and yellow, of people working with tools. Richard leans over the machine and slides his right hand through a small opening in the front of the machine designed to create airflow across the cutting bed.

>>ANN [behind camera]: Oh, is the board curving up?

>>RICHARD: Yeah, warping a bit.

Richard pauses for a moment and the camera, which is mounted on Ann's head, pans down slightly to reveal the notebook she is holding and writing in.

>>RICHARD: Probably actually shouldn't be doing this, but … [trails off]

>>ANN: [laughs] Living on the edge, there.

>>RICHARD: Yeah, that's how it works sometimes.

[12 seconds of machine noise]

Richard watches the laser beam closely as it passes near his fingers, which are pressing the warped piece of plywood flat.

>>RICHARD: What do they call that? A "do as I say, not as I do"?

The camera moves up and down slightly as Ann nods in response.

Figure 7. Alex and Tony discuss 3D printing

Tony, a man who describes himself as a "product of the French occupation of Vietnam," wears glasses and a black t-shirt with jeans. He stands in front of a computer station with a monitor mounted on a steel peg board and with several small 3D printed objects scattered on the work surface. Alex, a white man with brown hair and glasses, stands just out of the camera frame to the left. In the background are an assortment of machines and tools in the warehouse space.

>>TONY: So we've got two layers on the bottom, and when it finishes it'll have two layers on top—

As he talks, Tony mimes the movements of the 3D printer creating layers, moving his flattened hand side to side.

>>ALEX: Yep.

>>TONY: But I'm wondering like, structurally? I think we'll probably only need two perimeters. Because it's round, it's gonna get a lot of like … tension on the outside. So you want it to maintain—

As he talks, Tony points to the screen then mimes the round shape of the object, moving his curved hands in a circular motion.

>>ALEX: No, we did actually print those with one—

>>TONY: OK—

>>ALEX: But two would be better for this particular one—

>>TONY: Right—

>>ALEX: Because you do have that overhang and that curve around the outer edge. And that would help you get that curve with less droop. Some of that stuff you had to clean out, or off, might have been because there was only one perimeter.

Alex, now in the camera frame, mimes the object's curves and edges with his hands as he talks.

>>TONY: OK.

>>ALEX: So go ahead and do two.

Figure 8. Tony operates the 3D printer.

[6 seconds of machine noise]

Tony, a man who describes himself as a "product of the French occupation of Vietnam," wears glasses and a black t-shirt with jeans. He stands in front of a large black metal shelf with two 3D printers (one in black and green, and one in dark brown and red), leaning on the workspace in front of the printers, one of which (the red one) is operating: the extruder moving side to side as it lays down layers of melted plastic filament. The camera (mounted on Ann's head) zooms in tight on the 3D printer, then back out to include Tony.

>>ANN [behind camera]: So this is like one key, right?

>>TONY: [nods] He just wants to see one so he can measure it—I think, to get the dimensions—the real life dimensions.

>>ANN: Oh, OK.

The camera pans down slightly to include the top of the notebook Ann is holding and writing in.

>>TONY: I mean, he could probably get them from the software, but there's nothing quite like having something physically in your hand.

As he talks, Tony mimes holding an object in his hand. The camera moves up and down slightly as Ann nods.

>>ANN: Mmhm.

The camera pans slightly down again to show Ann's left hand writing in her notebook.

Chapter Three

Figure 13. Tony Sews and Solders.

>>TONY: We can slide that in there right side up…

[sewing machine noise]

Tony removes the jacket from the sewing machine and holds it up, opening the inside of the hood. There are three small plastic strips, about four inches long and a quarter of an inch wide, attached across the base of the hood, with space for more.

>>TONY: And you can see it's coming together. I've got two more left to go.

>>ANN [behind camera]: Oh, nice!

>>TONY: Yeah and I gotta solder everything. That'll be fun.

Tony is soldering small strips to which he will connect LEDs in order to light up the hood of his jacket. He holds the soldering iron in his right hand and the solder in his left hand, while a helping hand tool holds the strip. A small fan wrapped in leftover cardboard sits just behind the helping hand, venting the lead fumes from the solder away from Tony, who is hunched over his work and looking intently at the solder. Initially off camera, Alex, who designs and makes 3D printers, sits across the table from Tony, working at his laptop. Behind him is a metal shelf with Alex's 3D printers.

[background machine noise]

>>ALEX [off camera]: Mmm. I just read your rewrite—

>>TONY: Oh, OK, is it good?

>>ALEX: Yeah.

>>TONY: Good.

Tony continues to work intently on his soldering as he responds to Alex. The camera pans to Alex, who is sitting across the table from Tony working on his laptop.

>>ANN [behind camera]: Rewrite of what?

>>ALEX: The communications to a company in New York that's buying two of our printers.

>>ANN: Oh, awesome!

>>ALEX: Trying to, you know, do that whole "sound professional" thing.

APPENDIX 2. RHETORIC IN THE MAKING SYLLABUS

Rhetoric in the Making

Instructor: Ann Shivers-McNair asmcnair@uw.edu

Examples of student projects in this course include handmade paper flowers and an accompanying tutorial, a data visualization (using colors and shapes) from a web-based survey, a dress (in dark blue fabric with a gathered seam) with an accompanying pattern and instructions, a humorous blog for business students that includes posts like "Interview with a ghost," choreography for competitive pole dancing with an accompanying rubric for rhetorical elements of dance, and high school teaching materials (for Shakespeare and pop culture).

Course Description

This course offers students in a variety of disciplines—humanities, business, arts, sciences, engineering, etc.—an opportunity to learn and practice skills in writing and communicating across media. The course provides a creative, collaborative space for you to work on projects connected to your interests and to share communicative, cultural, disciplinary, and technical resources.

Over a series of weekly studio activities, you will have the opportunity to learn and apply ethical, empathetic rhetorical strategies for research and design, for prototyping and usability testing, and for encountering failure and being accountable. At the end of the quarter, you will present on and submit a final project that combines writing and other forms of making to accomplish a rhetorical goal.

Goals

- Learn and draw on concepts and strategies in writing studies, rhetoric, design, and technical communication
- Draw on and expand your communicative, cultural, and technical resources to explore projects related to your interests
- Create space for nonlinear composing processes and for encountering failure
- Set appropriately challenging goals for your projects and be accountable to them
- Participate in a feedback-rich environment
- Develop contextualized, culturally-sensitive measures to assess your work-in-progress
- Collaborate ethically with others

Resources

Meetings with Ann

Padelford A-11
T/Th 11:30-12:20
or by appointment

Course materials

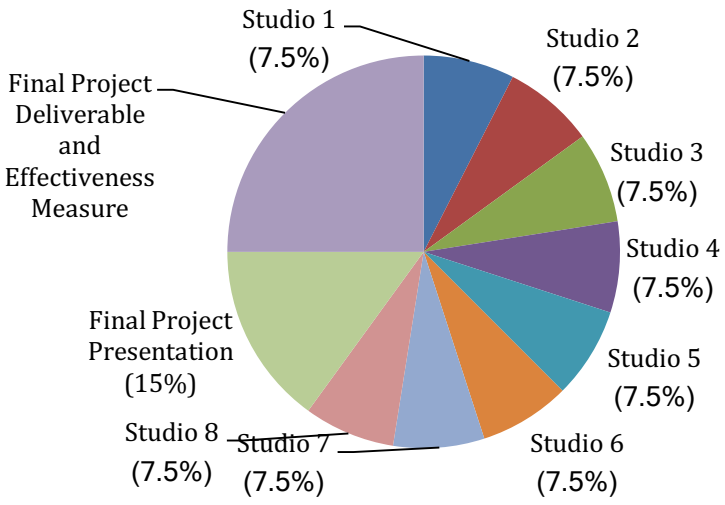
canvas

Sites

Inclusivity and Accommodations

Your success in this class is important to me. If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. We can work together and with the UW Disability Resources for Students Office (DRS) to develop strategies to meet both your needs and the requirements of the course.

Grades



Each graded component is scored on a 10-point scale, and you are guaranteed 8 points if you complete the requirements. You can earn higher scores by demonstrating exceptionally thoughtful, thorough work. (See rubrics on Canvas.)

Sixty percent of your grade will come from eight weekly studio activities (7.5% each). The remaining 40% of your grade will come from the final project, which includes a presentation (15%) and a deliverable accompanied by an effectiveness measure (25%).

Shared Expectations

Collegiality

This course works best for everyone when we all commit to respect each other and do our part to create a safe, supportive environment for learning.

Participation
Students who participate actively in class will get the most out of the course, and I invite you to define what active participation looks like for yourself. You are welcome to use technologies such as laptops, tablets, or smartphones to support your participation in class. I ask that you be mindful of how your actions—including your technology use and your participation choices—affect your classmates. I am happy to discuss additional strategies with you.

Deadlines and Grace Periods
Presentations: I will create a randomized schedule for studio presentations and the final project presentation, but you are welcome to trade days with a classmate if you find you need extra time to prepare or will have to miss class on your scheduled presentation day.

Assignments submitted through Canvas: Everyone will have two grace period days to apply to any assignment(s)—meaning either you could turn in two assignments one day late, or you could turn in one assignment two days late.

If you feel you may be unable to complete your work on time and you've used both your grace period days or are unable to trade presentation days, please contact me as soon as possible before the deadline. After reviewing the work you've done on the assignment, we will set a new deadline together. Otherwise, late work submitted will be eligible for partial credit determined by how many days late it is submitted (one point grade deduction per day).

Academic Integrity
The UW student code of conduct calls for students to practice "high standards of academic and professional honesty and integrity." Plagiarism, or academic dishonesty, is presenting someone else's ideas, images, work, or writing as your own, instead of citing your sources. We will discuss ethical practices in class, and please consult with me if you are not sure how to cite a source.

Complaints
UW Expository Writing Program policy states that if you have any concerns about the course or your instructor, please see the instructor about these concerns as soon as possible. If you are not comfortable talking with the instructor or not satisfied with the response that you receive, you may contact Professor Candice Rai, Director of the Expository Writing Program (crai@uw.edu; Padelford A-11; 206-543-0758). If, after speaking with Professor Rai, you are still not satisfied with the response you receive, you may contact English Department Chair Brian Reed (206-543-2690).

Schedule Overview

Week One

Concepts and Readings	Studio Activity
Technologies, media, and rhetorics • Adam Banks' (2006) Race, Rhetoric, and Technology (excerpt) • Angela Haas' (2007) "Wampum as Hypertext: An American Indian Intellectual Tradition of Multimedia Theory and Practice" • David Sheridan's (2010) "Fabricating Consent: Three-Dimensional Objects as Rhetorical Compositions"	Introduction to studio format and overview of the studio arc and final project; discussion of readings and concepts.

Week Two

Concepts and Readings	Studio Activity
Boundaries and translation • Lucy Suchman's (2002) "Located Accountabilities in Technology Production" • Laura Gonzales and Rebecca Zantjler's (2015) "Translation as a User Localization Practice"	Make something that involves both writing and another forms of making (visual, aural, 2D, 3D, performed, etc.). Record process artifacts from all stages of the making and writing process, paying attention to boundaries (what counts as "writing" or "not writing," who and what count as designer/maker/user, etc.) and translations of meaning and function (across media, languages, time, bodies).

Week Three

Concepts and Readings	Studio Activity
Design and kairos • d.School's (2010) "An Introduction to Design Thinking" • Sharon Crowley and Debra Hawhee's (2012) "Kairos" (excerpt)	Identify a community—and you can define this in your own way, according to your interests—that you are interested in and have access to, and come up with a list of questions about the community to which you hope to find answers. How might you find answers to those questions?

Week Four

Concepts and Readings	Studio Activity
Empathy and accessibility • Jordan Kushins' (2015) "Empathetic Design" • Shawn Henry's (2007) Just Ask: Integrating Accessibility Throughout Design (excerpt) • Melanie Yergeau et al.'s (2014) "Multimodality in Motion: Disability and Kairotic Spaces"	Spend time in the community. What are their goals and interests? How do your goals and interests intersect? What would a kairotic, empathetic, accessible in(ter)vention look like? Record notes and other audio/visual artifacts with permission from participants.

Week Five

Concept and Readings	Studio Activity
Prototyping and cultural usability • Todd Warfel's (2009) Prototyping: A Practitioner's Guide (excerpt) • Huatong Sun's (2006) "The Triumph of Users: Achieving Cultural Usability Goals with User Localization"	Make a prototype of your in(ter)vention, incorporating your research and experiences with the community you're inventing/intervening in.

Week Six

Concept and Readings	Studio Activity
Usability testing • Dana Chisnell's (2009) "Usability Testing Demystified" • Jennifer Bergstrom's (2013) "Moderating Usability Tests"	Design and implement a usability test for your prototype.

Week Seven

Concept and Readings	Studio Activity
Metanoia and failure • Kelly Myers' (2016) "Metanoic Movement: The Transformative Power of Regret" • Kate Losse's (2016) "The Art of Failing Upward"	Refine and retest your prototype, or go back to research and design, or create a genealogy of failures or exclusions (the things that didn't work and/or that you decided against along the way).

Week Eight

Concept and Readings	Studio Activity
Rhetorical strategies for presentations • Handout	Keep working on your prototype, or make a plan/outline for your final project presentation.

Weeks Nine and Ten

Final Project Presentations – schedule to be determined and posted on Canvas

A detailed daily schedule that includes a schedule of studio presentations will be posted on Canvas. Please note that the course schedule, readings, and activities are subject to change. I will not add any further required readings or assignments, but I may alter or substitute readings and assignments. I will announce any changes in class and on Canvas. All readings and assignment materials are available on Canvas.

Studios Overview and Rubric

Logistics: The weekly studio activities are designed to provide flexible structure for you as you work toward a rhetorical in(ter)vention. The prompts provide a more-or-less linear structure, but you can return to earlier prompts or adjust them to align with your particular project and goals. Each week's studio includes three components: the activity itself, a brief informal presentation with feedback, and a report. Studio activities can be individual or collaborative (all group members will receive the same grade except when there is significant evidence that a group member has not contributed substantively). I will serve as a project manager/mentor and will help you set and be accountable to appropriate goals.

Timeline: There will be a total of eight studio activities during the first eight weeks of the quarter. The presentation schedule will be posted on Canvas, and reports will be due at 5 p.m. the Monday immediately following the studio (see daily schedule).

Studio Requirements

Studio Activity

- ✓ Follow the weekly prompts or develop your own activity
- ✓ Record (in writing and other media) your process, including how you're defining your community, goals, role, and in(ter)vention

Informal Studio Presentation

- ✓ Give a five-minute demonstration or discussion of your work in progress that includes specific questions or prompts for classmate feedback or (if classmates are intended users) a usability test

Studio Report

- ✓ Document (in writing and other media) your process, including
  - the activity and course concepts involved
  - the presentation and the feedback you received
  - your contributions to peers' projects
  - plans for your next steps and questions for me

Ways to Score a 9 or 10

- ✓ Exceptional effort to make your studio materials accessible and usable
- ✓ Exceptionally thoughtful and thorough work in your activity, presentation, and report
- ✓ Exceptional engagement with your classmates in soliciting feedback on your own work and in providing thoughtful, helpful feedback to them

We will analyze a past student's high-scoring materials in class.

Feedback Opportunities

- Studio Q&A/discussion (prompt us for specific concerns)
- Studio feedback (prompt me for specific concerns)
- Office hours/appointment with me
- Email/Canvas message

Final Project Overview

Logistics: The final project should build from the studio activities in this course, but it does not necessarily have to be something that is "finished" or "working" in the ways you originally envisioned—especially if you realize you need to go back to the drawing board during the studios. Final projects can be individual or collaborative (all group members will receive the same grade except when there is significant evidence that a group member has not contributed substantively). I will serve as a project manager/mentor and will help you set and be accountable to appropriate goals. I will also help you design ways to measure the effectiveness of your project deliverables.

Timeline: In weeks nine and ten, all students will present on their work-in-progress. You will be asked to account for the ways in which you are working ethically and empathetically across differences (in media, languages, genres, knowledges, disciplines, cultures, bodies, etc.) and to solicit feedback from your presentation audience (classmates and me) on your deliverable and effectiveness measures, which you will continue developing and submit during finals week in lieu of a final exam.

The deliverable could be

- a genealogy (even a celebration) of failures, or
- a new prototype that addresses problems that arose from testing earlier versions, or
- the ready-to-go-live version of something designed and tested over the quarter

Past student deliverables include

- content audits of organization websites with proposals for revisions and new content
- a low-fidelity (back to the drawing board) board prototype of a database after a series of usability tests revealed issues
- mid- or high-fidelity prototypes of websites, mobile apps, teaching materials, artistic creations, dress patterns, and tutorials

The effectiveness measure could be

- a usability test/combination of tests, or
- an analysis of a recent usability test and proposed timeline for further testing, or
- a self-assessment of how your goals for yourself, the deliverable, and the community have been met or have changed, or
- a combination of all of these

Past student effectiveness measures include

- project progress reports on research and design, individual and community goals, prototyping and usability testing, changes, and projected future development, testing, and deployment
- web-based and/or in-person usability tests of a mid-fidelity prototype, with analysis of results
- artist statements
- collaboratively developed rubrics

Final Project Rubric

Deliverable

Digitized in an appropriate medium (photo, audio/visual recording, digital file, link, etc.) with an accompanying description (included in the same medium or in a separate medium such as a cover letter/memo or report) that clearly explains

- ☐ What kind of rhetorical in(ter)vention the deliverable (or a future version of the deliverable) is intended to make
  - Who is it intended for and why?
  - What is its purpose and why?
  - How is it empathetic and kairotic?
- ☐ The completed and projected stages of your design/making process (i.e., research, design, early stage [alpha] prototype, later stage [beta] prototype, testing, finalized, etc.)—you can draw on studio materials for this
  - What stage of the process does your deliverable represent?
  - What immediate goals does it accomplish?
  - What longer term goals does it move you closer to (for your in/ter/vention specifically, as well as more general professional/creative/personal goals)? Or what did you learn about yourself?

Effectiveness Measure(s)

Digitized in an appropriate medium (photo, audio/visual recording, digital file, link, etc.) with an accompanying description (included in the same medium or in a separate, appropriate medium such as a cover letter/memo or report) that clearly explains

- ☐ How this effectiveness measure or combination of effectiveness measures (including usability tests and self assessment) lets you know whether or not your deliverable is accomplishing your immediate goals at this stage of the design/making process for your rhetorical in(ter)vention
  - What were your goals for the deliverable?
  - How did you measure whether or not those goals were met? Be specific about you designed and implemented the measure(s)
  - Did the effectiveness measure lead you to revise your goals? If so, how?
- ☐ How the effectiveness measure(s) fits into or reshapes your longer term goals
  - For your rhetorical in(ter)vention
  - For yourself and the community

Upload your clearly labeled deliverable and effectiveness measure artifacts to your digital archive by 5 p.m. Friday, December 16. The deliverable and effectiveness measure will be scored together (out of 10 points) and will be worth 25% of your grade in the course.

VITA

Ann Shivers-McNair is an assistant professor and director of professional and technical writing in the English department at the University of Arizona. Her work has appeared or is forthcoming in *Technical Communication*, *Kairos*, *Across the Disciplines*, *Basic Writing e-Journal*, *College Composition and Communication*, and *FORUM: Issues about Part-Time and Contingent Labor*, as well as edited collections and conference proceedings. She received her PhD in 2017 from the University of Washington, where she was a predoctoral instructor and assistant director of the expository writing program. Previously, she was an instructor and coordinator of basic writing at the University of Southern Mississippi.