Portfolio Exam

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*Please note that all works cited, except for references to primary historical sources and interviews (which appear as footnotes), are included as a **single list** at the end of the portfolio. Lists of works cited by theme or by essay are available from the author upon request.*

Do you remember,
When I had to theorize my love for you
Before I was attentive
Before I understood thick description
When I had a lot of feelings
But I was lost in their archive
In my pages of field notes
In my pages of field notes
In my pages of field notes
I was lost in the archive
And my pages of field notes
And I couldn't just remember where I had left the thread
    of   us

The one connecting your heart to mine
And jumbled like a Harawayan string figure
Tangled but I couldn't find the point to pick it up and
    unravel it
Carefully unravelling it
Until eventually it was not a love theorized and
    needlessly complicated
But one made out to be as it was:
Messy and needily complicated
With the theory falling out of its complexity instead of
    being stuffed in (like words in that paper you didn't
    want to write)
With the descriptions of you and I
As the sources of this beautiful, frustrating,
    inexhaustibly interesting but it makes me f***in
    wanna scream sometimes diffraction pattern,
The obvious discontinuities
And the subtle differences and repetition that we
    call   us

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Long Pieces

Introduction to the Portfolio

Quite possibly the first text I read in the Rensselaer STS PhD program was John Law's recent essay in the Handbook of Science and Technology Studies, "STS as Method" (2017). At the time, I do not think I fully appreciated the depth of Law's argument and the ways that he connects it to the histories of STS, but I immediately was sensitive to his main point that STS *studies* methods and STS is *made of* methods. The methods that Law had in mind as an "object of study" were clearly those of science and technological practice, but the essay substantially brings forward commentary on the methods of our own field, both those unique to STS, and STS's repurposing of other social science and humanities methods *in response to* our study of methods. This folding of method on method has undergirded my study of STS and has substantively informed my reading across diverse case studies and theoretical pieces; I always ask as I read, "How might this author's approach to analysis in this piece inform my study of *X*?"

I hope in this portfolio to demonstrate how my broad thinking on method has given me a unique perspective on the subject matter that occupies most of my work—engineering. The central pieces of the portfolio are excerpts from published and in-progress pieces commenting on issues in engineering and engineering education—notably ethics, the roles of LGBTQ and disabled people in engineering, so-called international development, and the organization of technical work more generally. I situate much of my writing in explicit service to my actual or potential pieces of writing that do empirical work describing or providing critical commentary on engineering practice.

Greatly informing *how* I approach my studies of engineering and method is an extensive body of literature in feminist STS. I have been particularly drawn to the work of Donna Haraway and Karen Barad, whose analyses of scientific practice have informed the kinds of critique I wish

to make and the modes of doing scholarship that I would like to occupy. To say that my interest in feminist STS is ancillary to my study of engineering would be a mischaracterization—rather, as a feminist STS scholar, these writings permeate my work. The core feminist questions of differential benefit and oppression, of hidden labor and structures of material and ideological oppression—indeed, questions of justice—are *why* I study what I do, and so inform *how* I go about that study.

Now roughly introduced, the three themes of this portfolio are **(I) Research Methods in STS, (II) Engineering Studies**, and **(III) Feminist Commentary on Technoscience**. Each of these themes appears consistently throughout my coursework, excepting the occasional essay which does not discuss engineering at all, or those where I allow questions of method to undergird the piece rather than receive explicit discussion. As such, there is significant overlap in my writings. Many pieces, particularly the longer writings included in this portfolio, relate to multiple themes at once. I hope to demonstrate through this introduction and the portfolio itself how I have integrated these interests into a fairly diverse but coherent body of thought, and prepared for my future dissertation work.

Theme I: Research Methods in STS

Following John Law's insistence that "What we detect in the world arises in the interference between our own practices and those of the world" (2017, 49) (itself consonant with the work of Haraway 1994; Barad 2007), I view the question of methods within social research as fundamental for both descriptive and normative reasons. Simply put, the way that social research is carried out directly affects the kinds of knowledge generated by it, and has material implications for those described, describing, and otherwise near the research. This means "the question of method" is not *merely* determining which method is best in a non-normative sense to

describe a given situation, but which is best to *interact* with it given a diverse set of goals, including faithful description and contribution to the well-being of implicated actors.[1]

In addition to this, my understanding of STS largely comes from a description of its several methods, among them: the strong programme in the sociology of scientific knowledge (SSK) (and others Bloor 1991), actor-network theory (ANT) (Latour 1987 and others), feminist situated knowledges (Haraway 1988) and standpoint epistemology (Harding 2004) approaches, the social construction of technology (SCOT) (Bijker, Hughes, and Pinch 1987), social worlds approaches and situational analysis (Clarke 2005), and the so-called "new political sociology of science" (NPSS) (Frickel and Moore 2006), and others. Each of these function as what Abby Kinchy (2017) has called "theory/methods packages," and can be applied toward a number of empirical sources, among them historical documents, scientific papers, numerical data, interviews, and other experiences in the field. Although each of these sources afford different readings, have different material effects, and require different orientations, all can be brought to bear in different ways depending on the theory/method packages and research traditions used to *approach* those sources. When I say that I am interested in investigating "research methods in STS," I primarily mean considering these approaches and traditions ("high method") more than the particular way that one generates data ("low method")—although I recognize that there is no firm boundary between the two.

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1. A quote that undergirds much of my thought on what constitutes the appropriate goals of research (and so appears multiple times in this portfolio) comes from (Haraway 1988): "I think my problem, and 'our' problem, is how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognizing our own 'semiotic technologies' for making meanings, *and* a non-nonsense commitment to faithful accounts of a 'real' world, one that can be partially shared and that is friendly to earthwide projects of finite freedom, adequate material abundance, modest meaning in suffering, and limited happiness" (579). To date, I have yet to find a more succinct description of my aims.

My particular stance on *using* method has been substantially informed by several authors who advocate for a flexible and loose deployment of method over strict application of any one given set of rules. It can broadly be described as "interpretive looseness." My orientation toward this looseness stems originally from my encounter with the writings of Paul Feyerabend, whose book *Against Method* (1993) famously declared that in the pursuit of knowledge, "anything goes!" However, Feyerabend is careful to clarify several times that his "epistemological anarchism" is not to be interpreted as implying that method does *not* matter, rather that it matters *too much to restrict analysis to any one method*. The question then becomes, as I have indicated before: 'which method(s) is/are *best* to interact with a case, given a particular set of normative and descriptive goals?' Other more practically-oriented writers, like John Law (2004), Kristin Luker (2008), Joseph Maxwell (2013), and Shankar, Hakken, and Østerlund (2017), have been helpful in giving practical advice on managing the "mess" of social data. Although I have been especially drawn recently to poststructural (Bacchi and Goodwin 2016), phenomenological, queer, affective (Ahmed 2006), and even "critical making" modes of inquiry (Downey and Zuiderent-Jerak 2017), and I make use of many of these modes in my work, I recognize that they are not always most appropriate—or most useful.

Theme II: Engineering Studies

I was initially drawn to this department to work with my former advisor, Dean Nieusma, on projects related to the professional cultures and politics of engineering practice. As such, much of my work has described engineering's professional cultures in different directions using different methods of analysis. Engineering studies is at the heart of my work (all of my work that does not directly engage engineering studies is, at most, two degrees away from it in my mind) and so lies at the heart of this portfolio.

A central aspect of my portfolio is a sampling of my core empirical work. In the last two years, I have engaged in four substantial projects to different degrees: 1) my research appointment with Dean Nieusma, in which I interviewed undergraduate engineering students at Rensselaer about engineering ethics; 2) an ethnographic project begun in Tamar Gordon's "Ethnography and Cultural Analysis" course, in which I participated alongside, observed, and interviewed engineering students in a student theatrical society; 3) a content analysis project for Nancy Campbell's "Policy Studies" course about the internal policies of Engineers Without Borders USA; and 4) a pilot historical project for Raquel Velho's "Disability, Society and Technology" course about the history of infrastructure, ability, and disabled students at Rensselaer. I include excerpts from one paper on each of these projects. For the purposes of demonstrating how my analysis connects to the work of others, my excerpting method on these papers tends to cut the actual empirical content in favor of discussion.

Engineering studies has had a strange position within STS for some time. Although STS has long been concerned with the study of technology, the study of technolog*ists*, particularly those with distinct professional identities and formations, tended to be neglected except insofar as they exist as relevant actors who contribute to a technology's construction. As Gary Downey and others noted in the late 80s (Downey, Donovan, and Elliott 1989), the modes of social/humanistic studies of engineering that occurred in the latter half of the 20th century were done largely tangential to the major conversations in STS. Sociology, philosophy, and history of engineering usually maintained a distinction between social and cognitive phenomena, and between social structure and practice; while ANT and SCOT approaches were gradually eroding those distinctions by recognizing the knowledge content of social-technical practices.

Since that article's publication, I see four major streams of scholarship genealogically connected to today's "engineering studies" (and perhaps not yet integrated to such)—(1) work that considers itself simply "technology studies" but nonetheless substantially studies the professional structure of engineering; (2) ethnographies of engineering schools and workplaces; (3) engineering education research and other social research traditions primarily internal to engineering; and (4) a feminist critique, emerging from studies of gender and technological production, that centers an explication of power in/of engineering. Worth explicitly noting here is that the third of these, engineering education research and other social research from *within* engineering, has traditionally focused itself primarily on "improving engineering" as a field. As a result of these traditions interacting and merging, this orientation to change has become an important characteristic of engineering studies as a whole (*e.g.*, engineering studies seems more capable of "talking back" to the professional culture of engineering than science studies has often been—our critiques have been better received).

My work in engineering studies has taken up this orientation to change, and this is reflected in this portfolio. I entered the department with an explicit interest in promoting peace and democracy from an analysis of engineering, and so my early research and independent readings with Professor Dean Nieusma emphasized formulating critiques of engineering practice and structures. Our work together had three overlapping goals—to enculturate me into an engineering studies tradition we call "engineering, social justice, and peace"; to orient Dr. Nieusma toward recent feminist and queer theoretical perspectives; and to locate the results of our interview project on engineering ethics within a broader understanding of engineering histories and cultures. Alongside my ever-changing work with Dr. Nieusma, I have worked to integrate my other coursework and readings with my interests in engineering, developing a

multi-sited critique that spans not just an understanding of the emic construction of "engineering ethics," but also the place of engineers in systems of technological-economic domination, how engineers construct gender, ability, and race, and how those positions and constructions *internally* structure the practice of engineering.

For me, the central questions of engineering studies are these: *(Sociological)* How are engineering social-technical practices structured, both in different cases and across national, professional, and temporal divisions? *(Cultural)* How does the idea of "professionalism" come into play, such that "engineering" is constructed differently from other modes of technical practice? *(Critical)* How do these social and cultural descriptions interact with various social-cultural systems of oppression and harm, and how might they help us understand these systems? *(Political)* What is to be done? Each of these questions is engaged in different parts of my work on engineering studies.

Although I primarily view my essays as space to explore these questions, a few important lines of argument have emerged as I have reflected on them in different contexts and read widely. I group these arguments into three themes, critical, methodological, and political.

(Critical) First, that engineering in the West, and especially in the United States, has been deeply influenced by the intersecting systems of capitalism, imperialism, patriarchy, ableism, and white supremacy, and engineering as a practice continues to reflect and act on behalf of these interests, sometimes in subtle and pernicious ways. Second, that the specific historical and cultural infrastructures of engineering promote "compulsory heterosexuality" and "compulsory ability" (drawing from McRuer 2006).

(Methodological) Third, that one useful method for studying engineering is an infrastructural approach that considers the histories and capacities of structures supporting

engineering and the ways that engineering structures *themselves* function as infrastructures for

other systems (Cf. Slota and Bowker 2017). Fourth, that another potentially useful method is

attending to the immediate, affective experiences of engineers themselves as a way of accessing

knowledge about these structures and attending to the intersection of social-technical and

structural-practical.[2]

    (Political) Fifth, that the division of labor between social and technical work, and the

related division between technological production and use, reified materially and ideologically in

the labor and educational structures of engineering, makes it difficult to orient engineering

toward social good. And sixth, that there are specific insights from the philosophical-theoretical

tradition of the feminist new materialisms and queer theory that can transform engineering for

the better, by promoting *realistic, distributed responsibility*, a renewed concern for practice,

attention to unfolding power relations, and an onto-epistemology of interconnectedness.

    Throughout this portfolio, my work explores and contributes to these arguments in

different measures.

Theme III: Feminist Commentary on Technoscience: New Materialisms, Feminist Theory,

Queer Theory, and Disability Studies as commentary on technical practice

    My third and final theme captures several important historical streams of STS, including

some that are currently quite popular. Although it is somewhat flattening to consider the new

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2. My articulation of this argument here is very much tentative, but has been developing from several intersecting pieces: an ethnographic commitment to the value of substantive (immediately descriptive) *and* formal (more broadly applicable) theory (Glaser and Strauss 1967); an understanding of the value of knowledge derived "starting from the lives of" people, especially those with unique and/or marginalized positionality (Harding 2004; Garland-Thomson 2005); and work on perception, phenomenology, and affect that has been hugely influential to my thinking on politically-oriented description (Cf. Hughes and Paterson 1997; Ahmed 2006; Bennett 2010; Kouri-Towe 2015; Abram 2017).

materialisms, queer theory, and disability studies as all subheadings under "feminism," I find feminism and the tradition of feminist theory and critique to be a useful framework for describing my preferred approaches for doing, as my friend and colleague Bucky Stanton describes, "scholarship that is attentive to power." The title of this theme is also mutually binding: although there are new materialisms, queer theories, and disability studies that are decidedly *not* feminist, I do not tend to work with them; and although there are traditions within feminist theory that are not directly related to these other traditions, I do not tend to work with them. Even so, I use this theme to describe a larger orientation in my work, some of which does not directly stem from *any* of these traditions, but which nonetheless occupies adjacent space in my mind of considering power, domination, oppression, and subordinated socialities.

My personal path through feminist theory has been deeply informed by disability studies and queer commentary since my introduction to it. One piece essential to my development (that I read two years *before* entering this STS program) was Alison Kafer's *Feminist, Queer, Crip* (2013), through which I encountered Donna Haraway, Robert McRuer, Judith Butler, Mel Chen, Eli Clare, Chris Cuomo, Chandra Talpede Mohanty, Ellen Samuels, and others that loom large in these pages and my scholarship more generally. Through my engagement with Kafer's use of "crip theory"—an application of queer theory to disability studies, in the vein of queer intersectional feminist theory—that I was introduced to many concepts now well-known to me, including intersectionality, cyborg feminism, the social regulation of the body, and ecofeminist analysis of the construction of nature. Each of these concepts continues to play a role in my work, in varying degrees, including as I return with renewed interest to disability studies as my primary scholarly tradition outside of STS.

One area of feminist thought important to me but not substantially reflected in this portfolio due to space limitations includes postcolonial feminism (*e.g.*, Sandoval 1982; Anzaldúa 1987; Mohanty 2008; TallBear 2013; Subramaniam et al. 2017), other postcolonial studies (especially influential to my thought: Said 1979; Rodney 1981; Fanon 2008; Coulthard 2014; Law and Lin 2017), and feminist critiques of the state more generally (see especially Fraser 1989; 1997). These traditions provide a critique of how the state and Western ideologies structure lives, regulate bodies and relations, and create structures of differential harm, often for the purposes of maintaining present ruling relations and material distributions.

Instead, in addition to work attending specifically to disabled and queer positionality, this portfolio prefers an area of feminist thought more directly relevant to my scholarship: the new materialisms. The relative importance of this area for my work stems from our mutual attention to *practice*, making use of the traditional feminist science studies concern with knowledge production by applying it toward a *performative* account of the production of knowledge, power, and material arrangements in general. Since reading Jane Bennett's *Vibrant Matter* (2010) in Fall 2017, and later Karen Barad's *Meeting the Universe Halfway* (2007), the question that I have been drawn to has been 'what could attention to distributed agency and a performative account of matter and relationality mean for engineering practice?' I have attempted to answer this question several times, most notably in my final paper for "Advanced Social Theory" with Professor Akera in Fall 2018. Even when not directly engaging this question, I find Barad's account of material-discursive power and the materialization of bodies, and the more general queer-new materialist interest in performativity and relationality, to come up in my work in unexpected times and ways. The new materialisms have proven essential to my scholarship, for reasons I hope are compellingly explained in the pieces that make use of them.

An Emerging Scholarly Identity

In October 2018, I applied for and ultimately was awarded the National Science Foundation's Graduate Research Fellowship, stemming from my application which promised to investigate the experiences of disabled engineering students and practicing engineers from the simultaneous perspectives of engineering studies and disability studies. As I write my dissertation proposal, expanding on, clarifying, and re-scoping this fellowship application, I find myself drawn to reconsider each of the themes that I have identified. Substantially, I find this important because of the relative rarity of combining these perspectives.

To date, nobody has substantially connected the traditions of engineering studies and (feminist, queer, STS-inflected) disability studies. The most substantial connection has been a growing interest in examining the technical practices of disability, exemplified in the recent special issue of *Catalyst: Feminism, Theory, Technoscience* focusing on "crip technoscience" (Fritsch et al. 2019). This collection of works is substantial for disability and STS, and the implications for a critically disabled critique of technological production, but *crucially* leaves out one of my central concerns as a scholar of engineering studies—the construction of the idea of professionalism, its symbolic function, and the way that *its* construction and function relate to ideas of ability and disability—and the cultural structures of ableism and disableism. Works in feminist and anti-racist engineering studies, with its concern on the construction of "genders in/of engineering" (Faulkner 2006), the differential treatment and roles of women engineers and engineers of color, and the *embodied* aspects of those positionalities, serve as a kind of roadmap for integrating disability studies and engineering studies to understand the experiences of disabled engineers. Given the relevant intersections, it is clear that I must proceed not by *analogy to* these perspectives, but in *conjunction with*, using what Haraway and Barad have called a

"diffractive methodology" (Haraway 1997; Barad 2007), reading these literatures *through* one another.

The relatively open field of this intersection demands methodological flexibility and critical interrogation of not just *my own* methods, but also the methods of disabled engineers for making sense of their own experiences. Attending to these several overlapping questions and concerns is something that I am uniquely prepared to do, and I hope to make a modest contribution to the conversations I have entered into.

Mitch Cieminski

Troy, NY   2019-08-30

Theme I

Research Methods in STS

Ontology (Or, More Specifically, Ontological Multiplicity)
Concepts in STS Memo | 2018-11-19

In their article, "Embodied Action, Enacted Bodies," John Law and Annemarie Mol (2004) develop a set of ideas that they've worked alongside each other on for quite some time on, concerning the place of *ontology* in scientific practice. Though the word itself does not appear in this particular article, the article's discussion of the multiple, emergent meanings of Hypoglycaemia seemingly is yet-another enlightening example of what Mol has elsewhere referred to as "ontological politics" (1999; 2002). The notion of an ontological politics may at first seem like a contradiction in terms: it refers not only to ontology—the ways of naming the *nature of being* itself—but also to politics, suggesting that the nature of being is not "out there" to be accessed, but in a social-material realm to be discussed, analyzed, and enacted.

It is perhaps important to note here the crucial conceptual distinction[3] between epistemology and ontology, between the ways of *knowing* the world and the ways of *naming what it is*. Western philosophy has long maintained this distinction: in the standard view, *ontology* is a metaphysical exploration of being, exploring what things exist and how they are related to one another, and makes claims/arguments about what the world *is*, while epistemology is concerned with *how we can know* what the world is, and makes claims/arguments about what and how true knowledge is or is not accessible. Of course, there has always been overlap: the ways someone thinks about *knowledge* is surely grounded in and itself grounds what is known about the world. For Mol and Law, this distinction is even more muddled. In their discussion of

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3. I say "conceptual distinction" because, along with Barad (2007), I reject that there are in fact distinctions between ontology, epistemology, and ethics, favoring a model of "ethico-onto-epistemology."

hypoglycaemia, they identify several "ways of *doing*" it, only the *first* of which is "knowing it" (Mol and Law 2004, 46–48). They discuss two particular ways of knowing the event of hypoglycaemia, both through a measurement of a blood glucose level being 3.5 mmol/L, and through feeling such an event beginning or in-progress through the body. Yet there are other places where hypoglycaemia emerges: in its production by a treatment by "tight regulation" of blood sugar levels (that is, via several small doses of insulin), in its avoidance by those who fear it, and in it being counteracted by people who eat when they feel an impending episode (50).

Each of these modes, (measuring, feeling, countering, avoiding, and producing) have substantial overlap. The central point in a notion of ontological politics is *not* that there is one "real" version of a thing and that the others are false, or that each of these versions are somehow different perspectives of the same underlying *thing*, or even that the existence of multiple versions means that we can choose the "best" one in a given situation. Rather, it is that, in a given context, a thing *is* the *way it is done*, and things have multiple contexts and doings. As Mol says in "Ontological Politics":

> 'Multiplicity' entails … that, while realities may clash at some points, elsewhere the various performances of an object may collaborate and even depend on one another. … But this multiplicity does not come in the form of pluralism. It is not as if there were separate entities each standing apart in a homogeneous field. The various [versions of a single disease] that are performed in medicine have many relations between them. They are not simply opposed to, or outside, one another. One may follow the other, and, the most surprising image, one may include the other. This means that what is 'other' is also within. Alternative realities don't simply co-exist side by side, but are also found inside one another (Mol 1999, 83, 85).

Within the case of hypoglycaemia, we certainly see these several spatial-temporal relationships. Feelings proceed action, measurements occur in response to an event, some strategies for treatment aim to avoid those feelings, while others respond to particular measurements… each of the ways of enacting the body and hypoglycaemia interact and depend on the others in a context-bound way.

As I said earlier, Mol's interest in ontological multiplicity precedes this particular article. Her collaboration with John Law has often engaged this particular line of inquiry, dating back to their first co-authored piece, "Notes on Materiality and Sociality" (Law and Mol 1995). This piece perhaps situates their interest in *enactments*, the foundation of these claims about ontological multiplicity. In that piece, they try to write "materiality" into discourses about social construction, and ask how best to do it; and they engage this question through the telling of multiple, conflicting stories about cases and methods. They compare three different approaches for considering the material-social world and the apparent disjointedness between cases: the "semiotics" approach that claims that since the material is social, differences in cases just *look* different; the "strategic" approach that claims that each enactment of a thing is useful in its own way; and the "patchwork" approach that tries to cobble the pieces together by attending to local links between the stories, their social actors, and their materiality. In a (perhaps) thoroughly unsurprising move of folding method upon method,[4] Law and Mol do not suggest that any particular approach is best, but rather that they co-exist and inform one another.

Mol's interest in ontology was praised and taken in a slightly different direction by Karen Barad in her book *Meeting The Universe Halfway*. Barad calls for the need for STS to continue theorizing the role of ontology in science ("These attempts to say something about the ontology of our world are exceptions rather than the rule in science studies literature" (2007, 42)]), and assembles a sort of meta-ontology, consonant with Mol and Law, that insists 1) that ontology and epistemology are intertwined, and 2) that the world is constituted in its enactments and

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4. They both really have a way of doing this that I quite appreciate. John Law discusses the need for such moves in "STS As Method" (2017).

entanglements. Barad takes many examples from quantum mechanics, which show that scientists literally *make* what they observe *when they observe it* (at the quantum level, to see is to touch, there is no observation outside of interaction). Though this may seem a different sort of case than Mol's examples of diseases being enacted by practice, Barad claims and shows through several examples that they are two cases of the same phenomenon.[5]

As Mol, Law, and Barad show, ontology is not just the way that actors imagine the world to be, but *ontologies* are the *ways* that actors literally make the world become. But my accounting here of ontology in STS is but one enactment; no doubt a full discussion of the concept would need to give voice to those who oppose a notion of ontological multiplicity, those who think "ontology" is just a new name for an old theme in STS, and those who believe the "real" is more firm than Mol, Law, and Barad suggest.[6]

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5. Another book that perhaps better explains how science enacts its terrain is Pickering's The Mangle of Practice (1995).

6. e.g., Winner 1993; Woolgar and Pawluch 1985; van Heur, Leydesdorff, and Wyatt 2013.

Logic of Inquiry in Parthasarathy's *Patent Politics*.
Research Methods in STS | 2017-09-27

Summary

Shobita Parthasarathy's *Patent Politics* (2017) is a comparative case study that examines the patent offices, appeals systems, and interest groups in the United States and Europe as they consider the issue of granting patents on life forms and parts of life forms. Mostly, the author attempts to explain how it was that the European system (especially the European Patent Office (EPO) but also adjacent political structures) was sooner to regulate the patenting of life forms than that of the United States, despite the patent offices of each system appearing to operate in an identical manner.

The reason Parthasarathy gives to explain this phenomenon is the difference of approach to the regulation of markets (2017, 13–15). She points to the existence of *ordre public* clauses in European patent laws (2) as a reflection of these different attitudes (and histories) and a legal instrument by which the European approach to the public good could find a place to be acted upon in an otherwise technical system. Though she recognizes that these clauses themselves are not the cause of the European approach to patenting life forms, their existence was a crucial point around which the Biotech Patent Directive (BPD; a major European patent law) was shaped (77). As a consequence of these differences, the case of certain particular patents played out differently in the two contexts. For example, opposition to a patent on the basis of public concern would not be seriously considered in a U.S. appeals processes, while the same was given substantial weight in the European system (to varying degrees as processes changed) (191–192).

Methodology

The methodological note in the appendices of the book (207–15) seem to show that the process Parthasarathy undertook was primarily inductive and wide-reaching. She describes reading thousands of news articles and patent office/court documentation, interviewing more than 100 people involved in the cases examined, and attending appeals hearings in both locations (207–11). From looking at the notes and imagining a rough timeline of exploration, it's fairly clear how inquiry was carried out and resulted in the book itself, though we cannot quite audit every step of the way (for example, when did she first come across the analytic frames she uses?).

However, as I read the book, I had the increasing feeling that the work was somewhat deductive as well, seeking to justify a particular constellation of political stances: that the U.S. patent policy in particular is morally or democratically deficient; that the techno-legal model of patents in general should not be used; and that life form patents should be regulated against. My identification of these orientations as expectations is mostly conjecture, but the emphasis on analysis of the U.S. system and its portrayal as insensitive to moral issues are fairly apparent. That being said, the advocative piece of the conclusion (195–99) allows for alternative opinions and encourages reform/consideration of all social-technical systems, not just the patent policy.

Inductive Inquiry

On the whole, the work is well-researched, well-triangulated, and does a good job of being true to the data examined (insofar as I can tell from here; I've not personally gone over the sources Parthasarathy compiles). The framing of the European system as "market-shaping" and the U.S. as "market-making" is in many ways apt and apparent throughout the book. This frame was not completely induced; it was certainly influenced by the work of Jasanoff, Fourcade, and

other STS scholars (14–15, 221). However it was likely found as a good explanation for the data available through the triangulation process of the comparative method Parthasarathy engaged.

Beyond the author's claims in the methodological note, it seems likely, from the structure of the book, that the narrative was indeed shaped by the data. Critical incidents within each case are identified and given their own sections, organized thematically instead of simply chronologically, and connected in a way that creates a consistent narrative. Time and again, it did not seem that she was seeking to interpret the data into her explanatory mechanisms of different approaches to markets and meanings of patents, but that the mechanisms made sense in light of the data she presented.

For example, the American system's response to lawsuits against the Quigg memo was summary dismissal, which clearly showed the American preference for considering patents as techno-legal objects that primarily affected market players, not the public (90–91). The fact that there was no way other than one which preferred market players to appeal patents indicated the built-in bias of the system, and its worldview. Even in light of such strong evidence toward her crafted narrative, Parthasarathy occasionally shows deviations from it, times when the narrative radically shifted, and the inclusion of various perspectives and interpretations, which suggests that she truly is showing all the relevant data. Though the analysis may be incomplete in its use of "triangulation" and "the double hermeneutic," there are currents of both approaches that indicate reflexivity and integrity of the analysis.

As discussed, the author moves from examination of particular historical events to the general picture previously discussed quite well. There is another dimension of Parthasarathy's generalizations which come only in the conclusion but are well-evidenced: a claim of the inherent political nature of patent systems (and, by extension, all socio-technical systems), and

an argument that this book shows a need for reform in technosocial attitudes more broadly, toward welcoming different forms of knowledge and increasing participation in science and technology policymaking (193–94). The former widely accepted as true within STS circles and is essentially true by definition of "political," while the latter seems to make sense when as a consequence of both her analysis and political stance.

Network-Oriented Methodologies in Ethnography

Using Situated Knowledge and Actor-Network Theory to Examine Ethnographic Methods in Engineering Education Research (EER)

Research Methods in STS Final Paper | 2017-12-15

Engineering education research (EER) is a distinct emerging research field with important intersections with STS research, especially engineering studies. In this paper, I consider how research is often conducted in EER, and examine one interpretive ethnographic piece describing how students become engineers (Stevens et al. 2008). I consider the ways in which the work does and does not represent a form of the situated knowledge theory-methods package occasionally used in STS, and I consider the substantive differences between such an approach and actor-network theory (ANT), looking toward how an ANT approach might change the analysis in the considered ethnography.

Introduction to Engineering Education Research (EER)

Engineering education research (EER), as a field which both studies engineering students and their learning environments, has been emerging as a distinct interdisciplinary field of research for at least twenty years (Froyd and Lohmann 2014, 3). In the U.S., EER has its roots in the post-secondary instruction of engineers; instructors and intuitions were interested, in how best to teach engineers to fulfil requirements of industry. EER agendas are historically influenced by large technical institutions, and research in education more generally (5–9). Originally, this configuration meant that EER was conducted by both disciplinary engineering faculty and education researchers. Diversifying the research arena, new doctoral programs in engineering education have been established and producing PhD graduates, and STS/engineering studies scholars have increasingly turned their attention to engineering education.

In this diversity of engineering education researchers, there is, of course, a diversity of methods. As a young field of inquiry, it appears as if EER has yet to articulate distinct research methodologies for itself, and as a field with a preponderance of trained engineers, tends toward using methodologies that are easily quantifiable (9). However, even when used, qualitative research is often understood within a positivist framework lacking the insights of contemporary interpretive social science (Johri 2014, 553). Interpretive research represents for EER a potential to move away from the instrumentalized forms of knowledge about engineering education that EER has historically created: often, identifying 'the best' ways to teach engineers in a way that aligns with particular standards.

Within EER, ethnographic methods are understood both as a way to conduct research and as an object of study. In recent attempts to teach engineering students more interpersonal skills, ethnographic methods have been studied as a pedagogy in order to encourage listening and foster alternative paradigms of engineering practice (*e.g.*, Lambrinidou et al. 2014). These efforts generally come from researchers themselves somewhat experienced conducting ethnographies. However, ethnographic methods, when employed to study engineering education processes, are used to examine a wide range of phenomena.[7] The combination of these different uses of ethnography in EER presents potentially unique opportunities for both researchers and student participants, enabling new understandings of ethnography as methodology and new ways for students to understand their participation as the subjects of EER ethnographies.

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7. A complete analysis of the ways ethnographic methods are used in EER is outside the scope of this paper, though a few are discussed at varying lengths in these papers and their notes: Downey 1998; Stevens et al. 2008; Lambrinidou et al. 2014.

Exemplar EER Ethnography: "Becoming An Engineer"

In the *Cambridge Handbook of Engineering Education Research,* one chapter on qualitative methodologies identified as an "exemplar" ethnography Stevens and others' "Becoming an Engineer" (2008; Case and Light 2014, 541). Stevens *et al.* examined engineering students at multiple universities over a four-year period; they learned from the students by accompanying them through their typical school days and conducting long ethnographic interviews, with the goal of gaining an understanding of how students become engineers (2008). The methodological approach the authors take is one of "person-centered ethnography" (355), which focuses on individuals within a particular social context. The goal of this, according to a work they cite (Jessor 1996; as cited in Stevens et al. 2008, 355–56), is to emphasize the *agency of social actors* (in this case, students), as opposed to attributing causality to the *variables* that surround them.

Within their methodological focus on the individual, they developed an analytical framework that allows them to track what they determined to be salient components of "Becoming an Engineer:" use of disciplinary knowledge, identity formation, and navigation to/through obligatory passage points (355–57). In order to locate and address the agency of the students and their surrounding context, each of these dimensions was chosen *because* they were unpredictable beforehand and only made sense through the students' experiences. These dimensions were defined and explained through multiple examples, then the paper proceeded comparing two individual students' pathways via the analytical framework. The students, one woman and one man, demonstrated stories sadly common in engineering education: the man was able to find a way to build a career as an engineer despite lackluster early performance, while the woman dropped out of the engineering program despite her strong high school grades.

"Becoming an Engineer" and Situated Knowledge Approaches

The methodological approach Stevens *et al.* show is one that clearly draws heavily from a situated knowledge paradigm. This is evidenced by the use of a person-centered ethnography with the intent of uncovering individual agency and the components of their "Becoming an Engineer" analytical framework, which together address which knowledge is considered legitimate, and how students achieve (or not) a place in the engineering community. However, this framework differs in important ways from the situated knowledge paradigm described in STS (*e.g.*, Haraway 1988; Rocheleau 1995; Naples and Gurr 2014).

It is perhaps no coincidence that the use of a situated knowledge paradigm led to insights for how students' experiences as engineering students are gendered, and how that contributes to their success. In many ways, focus upon the agential individual and their relationship to their context was a structure for analysis that allowed to see both the agency of the individual and the structure that binds their agency. Additionally, the explicit comparison of the two students allowed for an insight that would have otherwise gone unnoticed: that success in becoming an engineer was not simply a matter of succeeding or failing in a single, universal process, but rather was contingent on specific conditions and choices, in other words, a multiplicity of experiences. Stevens *et al.* play with metaphors to make this explicit: the traditional metaphor of a "pipeline" through an engineering degree that is somehow "leaking" women is insufficient to explain the realities of the examined students, so they propose the image be replaced with a field fraught with complex, intersecting pathways that must be navigated (2008, 365).

At their core, situated knowledge frameworks seem to have in common a sense of both the multiplicity of meanings and attention to structure. Indeed, the term *situated knowledge* implies that meanings are as numerous as situations to occupy, and so analysis of situated

knowledge must first acknowledge the situation. Situated knowledge frameworks give attention to agency situated within structure: in fact, the knowledge itself can be considered to be a product of the interaction of the human and the knowledge object's agencies. Haraway makes this clear: "Situated knowledges require that the object of knowledge be pictured as an actor and agent, not as a screen or a ground or a resource, never finally as slave to the master that closes off the dialectic in his unique agency and his authorship of 'objective'" (1988, 592).

Haraway's articulation of *knowledge object as actor* (1988) is one that seems to be unattended to in Stevens and colleagues' paper (2008). In that ethnography, discussion of agency and actors is seemingly limited exclusively to the humans studied and their own actions.[8] Knowledge is addressed in their analytical frame, but they focus on which knowledge is considered legitimate engineering knowledge at what time. This reduction of the abundant knowledge present in the ethnographic sites to "accountable disciplinary knowledge (ADK)" (2008, 357) is more an analytical tool than a theoretical one, as it allowed for the ethnographers to focus on how the students become engineers instead of wondering what role the articulations and constructions of knowledges (perhaps, facts) play in engineering education.

However, this choice has theoretical limitations as well, as the authors' focus on ADK does not examine which knowledge is *not* counted as legitimate, nor does it give attention to the

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8. Other works seem to be split on attention to knowledge objects as agents. For example, while Lambrinidou et al. 2014 joins Stevens et al. 2008 in only considering human agents, Downey 1998 considers nonhuman agents, mainly the agencies of computers as students learn to use them. Though his notion of nonhuman agency is occasionally articulated as crystalized human agency, or a fuzzy boundary between human and nonhuman, he certainly notes how computers themselves shape the knowledge production processes. Downey's work, definitely aware of actor-network theory and situated knowledge, is perhaps worth its own methodological discussion, at another time. Downey is critical of ANT for seemingly being anti-technology and anti-human, casting them both as apparently militant forces seeking to control their network. Outside of Downey, I am unaware of EER ethnographies that address the agency of the nonhuman, beyond perhaps discussion of 'contextual limits' on human actors.

production or reproduction of bodies or knowledge, an area that Haraway notes can be especially informed by situated knowledge theory (1988, 595). For Stevens and others' "Becoming an Engineer," I suspect that attention to how production of knowledge and bodies could be expanded to the question of how the creation of 'facts and artifacts' are related, informed by the multiple, situated meanings, and connect to embodied experiences, the 'matrix from which engineering is born' (Haraway 1988, 595; to imagine how her paraphrasing of King 1987 might apply to engineering). This understanding could have enhanced the suggestions for practice Stevens *et al.* give, exploring how the students' emerging situations contributed to the types of engineering practice each was expected, likely, or willing to do, and giving definition to what knowledge is considered legitimate.[9]

Attention to the knowledge that is considered legitimate is important to one work that helped construct Stevens and others' analytic framework: Lave and Wenger's *Situated Learning* (1991). This work extends notions of situated *knowledge* to situated *learning* (a set of activities for knowledge generation) and, notably, "legitimate peripheral participation." Legitimate peripheral participation identifies the process by which a community of practice invites new members and instructs them in sociotechnical competency in both knowing and doing. Stevens *et al.* use Lave and Wenger's insights on community membership and learning to highlight the importance of identity formation to knowledge production, and justify examination of it.

However, this particular use of Lave and Wenger's work places Stevens and colleagues on one side of an ideological split in feminist methods, examining identities instead of affinities.

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9.   I realize that this type of analysis is outside the scope of that article; still, the situated knowledge frame reveals questions that remained unanswered in the method Stevens and colleagues use.

Rocheleau suggests that a focus on affinity (for example, to engineering practice, faculty, or schools) "leaves room for complex and shifting affiliations and simultaneous membership in a number of overlapping groups" (1995, 461). While Stevens *et al.*'s method enables them to identify the psychology of belonging's role in becoming an engineer, it does so by unreflexively identifying engineers as a homogenous identity *to be had*. An affinity-based approach, however, allows for the question "who counts?" (Rocheleau 1995, 460). Ultimately, it remains unclear how the psychological world of a student's identification compares to the social world of their affiliations, when considering what is salient in the process of becoming an engineer.

Actor-Network Theory as a further challenge to "Becoming an Engineer"

The turn to affinities over identities as a potential way to improve the use of situated knowledge in "Becoming an Engineer" seems to lend itself well to considering how an Actor-network theory (ANT) approach might change the insights in the work. Actor-network theory (ANT) is a heterogeneous account of interactivity, serving as a theoretical (and practical?) guide to examining human and nonhuman interests and agency (Sismondo 2010a).

Situated knowledge as Rocheleau (1995) discusses it and ANT are united in their examination of shifting and multiple affiliations. One feature that distinguishes a feminist attempt to examine these affiliations and the traditional ANT way of considering them is the definition of the network. Actor-network theory, as articulated by Latour, Callon, and Law, looks at the affiliations formed as a symmetrical process, with certain actors (generally speaking, technoscientists and the objects of technoscience) attempting to amass power by building a well-coordinated network (Sismondo 2010a, 81). In contrast, feminist methodologies consider power based on relationality and positionality; one can be 'in power' and 'empowered' in a situated knowledge framework, but these ideas make less sense in ANT. Both frameworks seem to fit an

intuitive understanding of power: "the ability to get things done" (Bartlett 2009, 180), not as a static property of actors but an emergent property based on their material conditions and relationship to the network.

The difference between these considerations of power may simply be consideration of the symmetry of relationships. The materiality of ANT implies a sort of perfected symmetry: the lack of difference between human and nonhuman actors, the denial of "action at a distance," and the view of social and material worlds as both merely products of networks (Sismondo 2010a) implies a symmetry seemingly understood as something akin to Newton's third law: two bodies exert equal and opposite forces upon one another. The work of an actor attempting to amass political power, in ANT, is by performing a process of translation so as to orient the interests of two actors parallel to another, creating mutual aid akin to that between counterbalanced dancers. In contrast, feminist theories of power often discuss moves toward power as establishing in-groups and out-groups, and a hierarchical relationship between them.

This difference is perhaps not as wide as it may appear. While ANT's description of power-oriented action seems practically normative in identifying a goal of coordination, it seems possible that the power moves described by situated knowledge frameworks are a way of achieving such a coordination configuration. Subjugation of another actor in an ANT approach is viewed as a translation of interests that, while potentially morally odious, is effective at achieving coordination and expanding one's network. An ANT network analysis may support normative observations, but normative analysis is, by default, absent. I contend that feminist situated knowledge contains within it normative critique; articulation of a situation is akin to evaluating it from within that situation, including attention to affect, and that affect being normative, it is adopted by the knower.

Haraway critiques the "god trick" of traditional science: the claim that one may "see everything from nowhere" (1988, 581). It is the folly of bad ANT practitioners that they can do just this by writing themselves out of networks[10]. In contrast, situated knowledge frameworks understand the researcher as a knower, and when using standpoint theory as methodology, the researcher attempts to achieve a standpoint by means of articulating experiences and arriving at consensus through work with others in the network (Naples and Gurr 2014). To the question of how the network is sensed, the ANT practitioner might try to observe the network without interacting with it (of course, impossible), while the feminist researcher understands that seeing is an act done in relation to our situation, and that the ability to see is contingent upon our situation (Haraway 1988). Haraway claims that understanding this, the real nature of relationships to the researcher, accounts for a sort of objectivity that is absent in accounts that fail to understand situatedness.

Despite these supposed shortcomings, it seems that ANT can have something substantial to say about conducting ethnographies among engineering students, indeed, it was born of a desire to 'follow the technoscientist' (Latour 1987). Returning at last to Stevens and others' "Becoming an Engineer" (2008), it would appear as if the actor-network approach might provide a finer analysis of the relationships between the engineering students and other actors (including institutional ones), especially by re-framing the navigation of 'pathways' to a translation of interests and coordination of networks, a process students are variably successful. I further

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10. Here, when I discuss networks, I mean something akin to Jane Bennett's (2010) discussion of assemblages, that networks are contingent, interlocking, and interconnecting, and that all material things can be considered to be a part of a single, networked reality.

suspect that ANT's supersymmetric approach of treating material and social worlds as equally emergent from material relationality would have also brought attention to the realities of the school, such as the resources available to each student which, while discussed in the text, were not identified as substantive actors in their own rights.

Despite these potential advantages of an ANT approach, were this study done without a situated knowledge framework, I doubt the authors would have been able to express the ways in which the network of the university constrained the students' agency, or given as much attention to which knowledge is or is not considered legitimate.

Conclusion

While certainly not the only ethnography in EER, "Becoming an Engineer" provides some insight to a mode of interpretive analysis that may be considered a type of situated knowledge framework. Through exploring the differences between the data analysis method articulated by Stevens *et al.* (2008) and feminist methods articulated by Haraway (1988) and Rocheleau (1995) we can begin to understand the advantages of such a methodology and how adherence to the STS-style situated knowledge framework may have made for more robust analysis. Finally, by comparing the situated knowledge theory-methods package to actor-network theory, we were able to see how an alternative conception of power relationships and interactionary politics may have allowed for different insights from the same ethnographic data. Ultimately, both STS-style situated analysis frameworks and ANT have the potential to be applied in interpretive research in EER and generate useful insights to engineering formation and power relations in engineering educational contexts.

Critical theory of technology vs. ANT: Is Feenberg right to be concerned?
Science Studies "Rumination" | April 9, 2018

This rumination begins from a few questions at the uneasy interfaces between Feenberg's critical theory of technology as a theory-method package, actor-network theory (ANT), and other social constructivist approaches from which ANT emerged (notably, symmetrical analyses favored in controversy studies/the strong programme). Can symmetrical analysis of the participants of controversies be responsive to bad intentions or a lack of reason? How are analysts to make sense of ideology or other social objects as salient actors in technological development? Do symmetrical approaches such as ANT allow for moral critique of actors or processes without compromising the quality of that analysis? I find that Feenberg's critical theory of technology (2017a; 2017b) can be meaningfully considered an extension of ANT mostly compatible with it, and that Feenberg would do well to take even more seriously certain insights of ANT and other symmetrical approaches by re-invigorating critical theory of technology with a commitment to symmetry. I end with a few brief suggestions for STS practice concerned with political implications and moral judgement.

Can symmetrical analysis consider bad intentions?

Feenberg makes the claim that symmetrical analysis of controversies was introduced to acknowledge the supposed fact that "the social aspect of science is not primarily a matter of motives" (2017a, 642). In response, he suggests that symmetrical analysis should only be used when it analyzes "real controversy," in which "actual knowledge is invoked with reason and conviction on all sides, other motives notwithstanding" (656). Feenberg would have his readers believe that symmetrical analysis is only useful when actors' interests have no explanatory power, and that *asymmetrical* analysis is necessary to uncover or respond to interest-based

explanations. However, this approach seems to ignore the very power that a principle of symmetry among actors intends to have.

Early work in the sociology of knowledge gave one of the first articulations of symmetric principles, and the reasons it pursued symmetry are compelling. The strong programme as articulated by Bloor attempted impartiality in respect to truth and falsity, rationality and irrationality, and success and failure; it pursued a symmetrical method that could explain any beliefs or knowledge-building practices of any scientist (Bloor 1991; as cited in Sismondo 2010c, 47).[11] The purpose of the strong programme's methodological commitments were to be able to step outside of internalist, rationalist explanations of true scientific beliefs, in order to contend with a problem arising from the problem of induction: how do scientists generate knowledge about the world, given that such knowledge does not naturally proceed from experience (Sismondo 2010c, 48)?[12]

The process of generating knowledge from experience certainly involves integration of several sorts of knowledge and experience across several actors. We do not know in advance which knowledges or experiences are salient, therefore, our methods cannot exclude plausible explanations without first examining them. The power of a claim-symmetrical method, and by extension an actor-symmetrical method, is its ability to cut across "internalist" and "externalist"

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11. Another aspect of the strong programme was an insistence on reflexivity—that the same explanations would be used for sociology of knowledge and its objects of study. I wonder the extent to which this flexibility has been lost in Feenberg as well.

12. The problem of induction, generally, is that properties of objects cannot be generalized to properties of classes with any certainty (at least, this is one interpretation of David Hume's critiques of induction). Hume showed that inductive reasoning could not be justified because it relies on potentially faulty extrapolations of evidence and appeals to unknowable truth criteria. For more on this problem and some contemporary responses to it, see Henderson 2018.

explanations of scientific processes. The difference, in a nutshell: internalist explanations focus on social forces within a community, while externalist explanations look to social forces that extend beyond that community (Sismondo 2010c, 50). Strong programme-style symmetry is capable of blurring the boundaries between internal and external forces: all explanations are on the table when the truth, rationality, and success of a claim are ignored. In contrast, Feenberg's call to use symmetrical and asymmetrical methods in different cases re-inscribes the divide between externalist and internalist explanations. He prescribes symmetrical methods to analyze cases with expected internal explanations that rely on rationality and truth, and asymmetrical methods for expected external explanations that rely on broader values/cultures. One must ask: how is a Feenbergian analyst to perform a fair initial evaluation of a case to determine the appropriate method? It seems that Feenberg's method might lead the analyst to find the explanation they're looking for.

Feenberg seems to venerate scientists who exist in the ideal space of "actual knowledge" and "reason" and can mostly ignore "other motives;" he even refers to such practice as "real science" in contrast to "the manufacture of propaganda" (2017a, 656). While this is obviously a performance of the type of asymmetry he attempts to justify, I am suspicious of such idealization, especially in light of the intensely consistent logic internal to propaganda projects (*e.g.*, Klemperer 2006; Wolf et al. 2011) and the seeming impossibility of separating supposed reason and evidence from external social and cultural symbols. I wonder if Feenberg implicitly believes in a difference between "reason" and "rationality," for Feenberg does not invoke the *rationality* of such scientists uncritically. For him, rationality internal to technoscience is just as normative as values external to it, and this rationality actually provides an avenue for non-

experts to challenge technology (2017a, 656–57).[13] I believe that Feenberg's notion of technical

rationality can be read as what he might call "impure reason," as it brings together technical and

normative aspects.[14] Still, might it not be possible that Feenberg's valorization of scientific

reason promotes the technical rationality he seeks to critique?

Regardless of Feenberg's view of reason and rationality (though obviously an important

part of his broader theory), I want now to return to the power of a symmetrical method. Unlike

Feenberg, I doubt that the principles of methodological symmetry were introduced to eschew

interest-based explanations altogether. Instead, it was strong programme-style symmetrical

analysis that generated motivational explanations that illuminated Woolgar's still-relevant

critique of interest-based explanations (Woolgar 1981). For Woolgar, such analyses established

interests as powerful explanations for action, yet left those interests themselves unexplained. The

eventual formulation of actor-network theory and articulation of its "supersymmetry" between

the social and material worlds was in part born of Woolgar's critique of the "social realism" that

was common in interest-based explanations (Sismondo 2010c; 2010a). This advance would not

have been possible were it not for the strong programme's occasional use of interest-based

explanations for scientific processes.

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13. I wonder if in believing this, Feenberg falls into an familiar discursive mode that we saw during the science wars, in which the political left believes that the master's [epistemic] tools can dismantle the master's house. Scheman responded to this tendency, arguing that modernist epistemologies are not good enough, nor are they well-suited, to radically critique modernity (2012, 475–76).

14. This belief is drawn from the title and content of Feenberg 1999. There is sadly little in that essay that directly explains how its content (a theory of the essence of technology called "Instrumentalization Theory") relates to its title—still, I think I've drawn the right sort of conclusion in saying that Feenberg believes "technical rationality" to be a form of "impure reason."

Since (and before) Woolgar's critique, STS has struggled with the use of interests as explanatory mechanisms. On the one hand, the use of interests seems to 1) reduce participants to their memberships in social groups (contested, multifarious categories), and 2) reduce one's actions to *reactions* to their interests. On the other hand, as Feenberg rightly insists, interests *are* salient explanations in certain cases (*e.g.*, climate change denial). Any use of *technical rationality* as a component of contemporary social life is bound to eventually invoke interests as information that inform actors' rational decisions.

Despite the prevalence of interests in technical systems, I disagree with Feenberg that the asymmetric methods of "muckraking and ideology critique" are the ones best suited to analyze the systems in which they're salient. Symmetrical methods are more than equipped to see and consider *intentions*, and by extension, their causes, including interests and beliefs. Let us consider the types of symmetry Feenberg sets out to critique: a symmetry of participants and a symmetry of humans and non-humans. Leaving the latter aside for now, a symmetry of participants by itself is likely *enough* to consider bad intentions, if attention is paid to the claims all participants make, the beliefs they have, the ways they are connected, the actions they do, and the power/knowledge they are able to use—in other words, a total consideration of their position as a legitimate participant. Considering the *totality* of a position would likely lead to an even more powerful critique of bad motives than muckraking or ideology critique alone, as it would detail the motives and the ways that they interact with actors. Capitalist ideology, for example, would cease to be a spectre haunting science, and instead become a materialized, multi-faceted and multi-sited belief (perhaps, a palimpsest) that behaves in particular ways and can be responded to in others.

Returning now to what I set aside, symmetrical analysis of humans and nonhumans actually *aids* in the goal of considering the totality of an actor's position. Considering human and nonhuman actors turns the analytic eye toward the connections, interactions, and translations that make actors intelligible to one another. Feenberg is rightfully concerned that this method might fail to fully consider "macro entities" such as state, ideology, class, or culture, but as I will explain in the next section, such entities can be meaningfully incorporated as actors in their own right. Bad intentions are certainly considered in ANT, whether as a feature of actors or as actors which float and shift material formulations. With such a wide-spanning basis for analysis, are we really to say (as Feenberg does) that "responsibility" must occasionally be defeated by symmetry? Symmetrical analysis provides an adequate basis to ask "why," and "for what," and perhaps, to make moral judgements.

Where does ideology exist?

My friend Bucky often asks the question of "the centaur" as a metonym for "social objects" like ideology, class, or even shared notion of a mythical creature. It goes something like this: "how does this social theory account for the idea of a centaur?" In the world of actor-networks, this question must be addressed, for if the centaur has no material form, how can its persistent mental image be explained by a network of materials? The answer is of course that the centaur *does* have material existence: in the paint on a Grecian urn, the ink in books, electrons in computers, chemical activity across synapses, and the vibrations of air that we call speech.[15]

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15. These are all far more volatile existences than a living, breathing centaur might have. I wonder the role of volatility in considering social objects as actors.

What then groups these material existences of an *idea* into a sensible object? I suggest: little more than that which groups more solid matter. The act of naming an object involves the delineation of boundaries and the grouping of smaller objects together, down to the level of particulate matter (*e.g.*, one's body might consist of limbs, organs, *etc.*; which consist of skin cells, blood cells, *etc.*; which consist of proteins, carbohydrates, *etc.*; which …).[16] Though it is not coincidental that we tend to delineate such boundaries spatially, the fact that objects exist situated within and moving through time troubles our notions of spatial bounds (does my body include the air in my lungs? What about when those molecules enter my bloodstream? What about when I exhale them?). Even further, *similarity* of objects leads to boundary-defining at the level of similarity across them, regardless of time or space (consider collectives—*e.g.*, a species of finch in the Galapagos—or uniform commodities). In light of these complications, why not define objects by their informational similarity instead of their material similarity (if, as Barad makes clear, "matter and meaning are not separate elements" (2007, 1))? Why not set aside requirements of physical or temporal proximity? Instead, objects can be considered clusters of connections between objects, where connections can be spatial, temporal, material, or informational.

What do we make of this improved ontology of networks? Well first, we see that social objects such as the centaur exist within the network. But more than this: they have their own

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16. This actually leads to a related problem in network-oriented ontologies I will call "the problem of nodes." If a network consists of nodes and connections between them, how are nodes meaningfully defined? The answer here, as this section hopefully makes clear, is that nothing is by itself indivisible nor individual. It's networks all the way down. To an extent, this echoes Latour's own consideration of nodes as haivng "as many dimensions as they have connection" in contrast to imagining them as two- or three-dimensional objects (1996, 370; as cited in Fischer 2007, 561). The nodes are not separate from one another, nor do they have clearly defined interactions.

existence within the network, and we can meaningfully think of them as actors in their own right,

having manifold connections to other actors, each interface unique and situated and multifaceted

(*e.g.*, my connection to "capitalism" is different than yours, but we can meaningfully be

considered connected to the "same" "capitalism"). This actually almost perfectly echoes what

Feenberg says of social things:

> Analysis must identify the ontological differences in the construction and meaning of objects at each stage in their development. This is a de-reifying approach that treats social 'things,' such as artifacts, institutions, and laws, as assemblages of functional components held together by their social roles. The components disaggregate and recombine as society changes. (Feenberg 2017a, 651)

So Feenberg agrees with a characterization of social things as real, yet real only in their

manifestations in other objects, not as things-in-themselves (this is what is meant by terming it "a

de-reifying approach"). What I have provided beyond this is 1) a way to use the same approach

to de-reify objects defined by spatial/temporal boundaries (for they also are not things-in-

themselves but real only in their manifestations in other objects) and 2) a way to meaningfully

re-incorporate social objects such as ideologies or centaurs into networks, *not* as ghostly macro-

entities to be explained by material networks, but as salient components of the networks

themselves.[17] In doing this, I think I have shown that Feenberg's method for dealing with social

objects as concretized palimpsests is compatible with ANT as analytical method *and* ontology (at

least, in my admittedly odd conception of ANT). This, combined with a symmetry of actors,

should allow for social objects to avoid definition *solely* by powerful actors or even a majority of

them. I believe this intervention responds to Feenberg's fear that ANT might allow concepts of

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17. As I understand it, social objects are still explained by their connections in networks, but so are all other parts of those networks. Social objects are not a special class of object to be determined by material networks; ANT's supersymmetry demands symmetry between sociality and materiality.

"nature" (or other categories) to be defined by networks as essentially discriminatory (Feenberg 2017a, 644). Thus ANT's treatment of social objects need not favor victors. Does this make Feenberg's introduction of a symmetry of program and antiprogram redundant, or does his recommendation still serve as a useful reminder for considering the meanings of social objects?

Does Symmetrical Constructivism Allow for Moral Critique?

Finally, I'll leave with the question that I struggle with the most in this space, the question of if moral critique is allowed by symmetrical or supersymmetrical approaches, and, if it is not, if performing moral critique upon the results of a symmetrical analysis somehow invalidates it. I have no satisfactory answers to this question, and so the section will be rather short.

This question was tackled memorably in Langdon Winner's paper "Upon Opening the Black Box and Finding it Empty" (1993). Responding to then-recent work developing the social construction of technology (SCOT) and actor-network theory (ANT) approaches (Bijker, Hughes, and Pinch 1987; Latour 1987), Winner found that social constructivism could leave consequences out of view, exclude certain social groups as "irrelevant," ignore the possibility broader culture/structure playing a role in technology, and fail to evaluate the moral and political meaning of technologies. Though I think my essay has successfully responded to the second and third fears, I wonder if the first and fourth still hold. To the first, I'll say that the ontology I described above might allow for a de-centering of contemporality, and therefore allow the re-incorporation of consequences (in other words, consideration of the future effects of a network seems well-allowed by ANT). But to the final fear: that the "empirical program of relativism" remains committed to not rendering judgements, I have less of a response.

Does it suffice to say that descriptions are value-laden, and therefore judgement and analysis are already simultaneous? To say as much would join Winner in indicting many constructivist accounts as implicitly conservative, as the style of judgement they prefer is non-judgement and tacitly endorses the status quo. What if we said that to describe an unjust status quo is *not* to endorse it? This on its face seems true, yet it is not by itself sufficient grounds for moral critique. Could actors be said to be treated "symmetrically" if one is called bad and another good? Perhaps symmetry merely requires, as I said earlier, that the analyst totally consider "[an actor's] position as a legitimate participant." Such legitimacy might be considered the basis for affording a modest level of respect to all actors on epistemic *and* moral grounds; we must respect actors in order to learn, and all actors deserve such respect. We know from other moral/political realms that it is possible to provide someone with basic respect while condemning them or their actions (this is the basis of the rule of law and some stateless conceptions of justice). Symmetry and judgement might not be incompatible.

However, it's certainly true that many (most?) analyses with commitments to symmetry do *not* render judgement. Let's assume for the sake of inquiry that moral critique cannot, for some good reason, be a part of symmetrical analysis. Is it then possible to "step out" of symmetrical analysis when the analysis is complete? Aalok Khandekar and colleagues certainly suggested such an approach in their chapter "STS for Development," which prescribed first symmetrical analysis as a way of uncovering hidden narratives, and then a "next step" that amplifies those narratives (Khandekar et al. 2017, 683).[18] My skeptical side is cautious of such

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18. They note that the same approach is advocated by other authors, including Woodhouse, Jasanoff, and Sismondo.

an approach. Especially if the analyst knows that they are to render judgement at the end of their

project, might not they not pre-figure analytical categories that are conducive to their eventual

critique? Even if unintentional, would not this be an example of 'ontological gerrymandering'

(Woolgar and Pawluch 1985)?[19] I think this is a serious concern, and one that social scientists

must contend with, but no more so than other concerns of "bias" in social analysis. As social

scientists, we have a duty to describe reality in whatever way makes sense to our subjective

experience and the subjective experiences of our interlocutors (this is a replacement of an

unquestioned notion of "objectivity" with a more compelling notion of "intersubjectivity" [*cf.*

Abram 2017, 31–39]).

Ultimately it seems that STS must move itself from describing the world to both

articulating why its descriptions matter and *making* them matter.[20] This move has not only

political implications for STS practice, but epistemic ones as well. Re-centering our inquiry on

the ways our research and its subjects have *political implications*, not just *politics*, might allow

us to be more attentive to our subjects as complex and legitimate participants, and turn our own

knowledge production to a project of filling the edges left by methodologies that ignored

subjected or oppressed people, and in so doing, promote justice.[21]

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19. Interestingly, I think Woolgar and Pawluch's article (1985) might provide a meaningful critique of the ontological/methodological approach I outline in the middle of this paper. Are not social objects as I conceive them a category of claims accepted as fair while categories of actions are opened to uncertainty? Did not ANT as I described it emerge from this kind of critique of social realism? Did ANT even respond to this critique of social realism? Certainly this puts a knot in my otherwise clear entanglement.

20. Cf. Marx's statement that "Philosophers have only interpreted the world, in various ways; the point, however, is to change it" (1978, 145), or Latour's call for moving from "matters of fact to matters of concern" (2004).

21. The argument that ethics and epistemological concerns are wrapped into one another, and the implications of this for feminist studies of science, is articulated in Scheman 2012.

Science Studies as Theory/Method

Incorporating the Insights of Science Studies to a Reinvigorated Study of Technological Practice

Science Studies Final Paper | 2018-05-04

[removed]

Introduction: What is STS? The View from Science Studies.

Science and Technology Studies is, upon first glance, a collection of cases. This is apparent to anyone who's received academic literature recommendations from an STS scholar: at least colloquially, works are often easiest to identify by their objects of study, be they the Wassermann reaction, parapsychology, the safety bicycle, scallops and fishermen, OncoMouse™, or environmental toxicology.[22] However, the very idea that these are *cases* forces us to consider what they are a case *of*—the use of technique within thought collectives, how a field legitimates itself, the social construction of technology, translations among actors, the surprising phenomena of contemporary multicultural biotechnology, and changing practices of environmental governance.[23] Although the work of the word "case" encourages us to think about such type-token relationships, it is important to recognize that the set of articulated type-token relationships is what is meant in a first pass by *theory*, and the process of making a case so that it can be recognized *as* a case is what is meant by (research) *method*. Naturally, theory and method

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22. Fleck 1979; Collins and Pinch 1979; Bijker 1995; Callon 1984; Haraway 1997; Shostak 2013, respectively. I've chosen these examples because they represent a diversity of distinctly STS methodological commitments—in order of appearance, a philosophical argument with a historical case study, a work in the social construction of technology (SCOT), an article in actor-network theory (ANT), a book using situated knowledges, and a book with social worlds analysis that foregrounds certain benefits of the new political sociology of science (NPSS).

23. The case types here are in respect to the objects in the preceding sentence. The idea of determining case types is informed by, among other writings, Luker 2008.

are invariably entangled. *N.B.*: it is not merely that theory is caused by method applied to a case, but that *theory and method are co-produced and co-functional in the context of a case*.

Works in STS are, of course, *about* their objects of study, but they also are about the theory and method that they articulate and perform. Even further, when a work in STS is considered as a "case of" *STS*, we build relationships between that work as theory/method/case and other works as theory/method/case. What emerges is an entangled string figure called STS, which can be oriented and refigured to seem in different moments as a set of theories, a set of methods, or a set of cases. I find the orientation/figuration to "a set of cases" to be a particularly difficult one: often, the figure falls apart without at least some orientation to the theoretical/methodological dimension.[24] Furthermore, the diversity of cases inclines me to a particular conclusion: it is most convenient to think of STS not as essentially a collection of cases, but as a collection of theory/methods that entangle that diversity of cases and is capable of entangling further ones still.

From the frame of thinking about STS as fundamentally a collection of theory/methods, we can conclude what STS *is not*.[25] Put simply, STS cannot know those things that its methods foreclose it from knowing (see Feyerabend 1993; Fleck 1979). In the sense that *any* method forecloses certain knowledges, STS is exactly like other fields (*e.g.*, biology does not have the

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24. Of course, the objects of study are themselves entangled as a part of a shared material world. This naturally implies that not only their matter, but also their meaning and their doings, are entangled. In other words—as soon as we try to consider STS as purely a collection of objects or texts, their entangled meanings/doings/beings force us back into the realm of theory/method (cf. Barad 2007). Conversely, an orientation into "pure" theory/method (without cases) is impossible, though it may seem that this essay attempts to do just that.

25. We could never conclude what STS could never be, as all cultures have a seemingly infinite capacity for reconfiguration (cf. "the infinite potentialities of humans to consciously regulate and transform the sensous nature of existence" in Arboleda 2017, 15).

methodological tools to investigate the movement of stars and therefore cannot know about it). But most unlike other fields, the methods of STS are sufficiently broad so as to be capable of taking practically *anything* as its object of study. The methods of STS attempt to make sense of knowledge production, material-semiotic movements and translations, connections among agents, ways that objects contain and suggest their past, affective experiences of interactions, micro-level practices, ways that social/material objects change, and the meanings of culture, among other things. I find it useful to say it as such: if science is how "we" *know*, and technology is how "we" *do*, then science and technology studies is the study of knowing and doing, which are together the totality of the practices of any subject.[26]

In this wide view of STS, it's hard to imagine a case of humans or nonhumans to which its methods could not be applied for *some* analysis. This is simply because the entirety of the material world consists of material/semiotic exchanges, systems that behave as minds, and things that neither exist in isolation nor without motion. STS is therefore *not* like the fields divided by their objects of study (*e.g.*, biologists do not study the stars because they study life), despite a name that might imply otherwise. To say that STS is a field of only studying things like "biology" or "nanotechnology" is to claim that science and technology are each essential categories that exclude certain practices of knowing and doing. Again, this is not to say the objects of study are unimportant, but that the ways we understand those objects are figured by our practices. [removed]

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26. By "subject," I mean anything with subjective experience or anything that behaves as a subject in a grammatical sense. In other words, to be a subject is to be a knower or a doer. My use of this category intends to include all nonhumans as potential subjects, as a matter of symmetric, hylozoistic, and grammatical principle.

By shifting the question of science studies from "how does science represent the world?" to "what does science do in the world?," Pickering made a similar movement to the one this essay has made so far, from considering STS as fundamentally *about* its objects of study to the theory/method used to study them

My analysis of STS as a collection of theory/methods is informed by an application of science studies' understanding of knowledge and knowledge cultures to STS itself. One of the central insights of science studies has been that knowledge and practice are intertwined (Pickering 1995; Barad 2007). The shift from understanding science as "representation" to science as "For those who attempt to systematize either of these categories, such as scientists or STS scholars themselves, this means that theory and method are just as close. John Law, in his essay "STS as Method," argued that method is both what STS examines and what STS does, both its object and its practice (Law 2017). Though so far, I've been unable to distinguish STS from science studies, this essay attempts to use science studies as a set of methods that can be used to understand epistemologies more generally, and, through application to STS itself, be used to generate a more robust understanding of technology.

My method proceeds in three steps. First, I attempt to identify some of science studies' methods, generating from a list of commonly used methods in STS and focusing only on those methods that STS uses to examine epistemic practices (*i.e.*, the naïve view: what I presume to be "science studies" as opposed to "technology studies" before explicitly engaging that question). I then use the frame of method to try to pull science studies from technology studies, and with them, pull science from technology. Last, I return to science studies, this time focusing on the theoretical insights that can be gleaned from my paper as both description and practice of science studies. I take these insights and attempt to graft them onto technology studies, along with

methods as they are needed, to suggest a few ways in which science studies can enhance a study of technology.

The Methods of Science Studies

If STS is best understood as method, then what exactly are the methods of STS?[27] [removed] Much of STS theory has been built up from particular cases, or at the least uses rudimentary analysis of cases in order to defend conclusions arrived at from deductive processes. These cases are known through a combination of field methods, which attempt to see what's going on; historical methods, which attempt to understand what's happened in the past; and various comparative/argumentative methods, which try to sort through evidence and analysis to compellingly arrive at a single consistent description, or intentionally disparate ones, in order to make claims that have a better chance of being true beyond the cases analyzed. Together, these methods work not inductively, but *abductively*, intending to explain phenomena as best as they can, not creating universalizing principles.

If research were analogous to farming, field methods would simply be the process of finding a field and digging into it (with any luck, to grow something). Science studies scholars tend to do this in a few ways: participant observation/ethnography, interviews, and content analysis (Luker 2008). Some people may bristle at my use of "content analysis" as a field method. After all, it's primarily textual! However, when thinking semiotically about the ways that matter contains meaning, and the ways that texts inscribe their contexts (see *e.g.*, Latour 1987), it's apparent that critically reading a text for understanding of its cultural meaning has as

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27. For this section, I am indebted to Abby Kinchy for participating in her wonderful class on research methods in STS (2017).

much capability of gaining insights to the contemporary world as interviews or ethnography. Indeed, many interviewers or ethnographers use tools of content analysis to analyze their own notes as texts, while some document analysists have recently called for an "ethnography of the document" in order to better understand a text's relationship to the circumstances of its creation (Shankar, Hakken, and Østerlund 2017). In other words, the methods are more entwined than one might believe. Content analysis can occur at several levels, from the application of literary theory to a text, to simple interpretation of its "plain" meaning. In its broadest sense, this even includes the work of finding, citing, and incorporating relevant scholarly literature to your work—previously analyzed cases, though far from "raw" data, are their own data sources as well.[28]

The document, thought of as a text that inscribes the present world, serves as a useful bridge to past-oriented methods as well. Historical methods, like present-oriented content analysis methods, attempt to consider documents and artifacts as inscriptions of a past reality. However, unlike content analysts, the purpose of historical methods tends to be the generation of a story, much as an ethnographer would do, as a way to compellingly describe a scene, a process, or a moment (Cronon 1992). Like ethnographers, historians tend to be exceptional *bricoleurs* (Hammersley and Atkinson 2007), piecing together several artifacts inscribed with increasingly inaccessible shadows of some object in the past in order to construct an image of it. More than making clear pictures of stories or objects, though, historians and ethnographers must also piece together the *cultural context* inscribed in their objects of study, and attempt to adequately

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28. Of course, there is no such thing as "raw" data. Scientific articles, even those in your own field, can be read with the same methods as old letters, current newspapers, and classical literature. In fact, mixing these modes of reading is likely to result in richer understandings of texts and can help aid in understanding the work that the author's and audience's cultures have in mediating meaning.

describe that context so that the story and its entwined meaning are understandable to audiences outside of that context. In other words, they must engage in translation processes, moving meaning inscribed in objects and situations, and constructed in the mind of the researcher, to be intelligible to people who cannot see those objects and situations, and who do not share the researcher's particular insights.

Though I've now illustrated both historians and ethnographers as storytellers, and storytellers skilled at cultural translation at that, there are still two further basic methodological categories that have been unilluminated, which are the processes of integrating the stories and data that have been found and constructed. I find in these two broad categories; comparative methods which seek to bring disparate data pieces together to discover patterns and name theory (see, *e.g.*, Clarke 2005; Hammersley and Atkinson 2007), and a method that I term "elucidation," which seeks to attach data to extant theory. In research processes, both of these activities occur side-by-side, and at many different levels. For example, the researcher may compare documentary evidence and their own experience in the field to create some tentative articulations of theory, then ask an informant to describe an example of some component of it. Or they may read a document that presents a view arrived at by comparing disparate data sources, and use in as an example in their own work, which someone else may use to cobble together novel theory. In the representational idiom, all social scientists are behooved to understand some aspects of this multi-sited meaning-making process of piecing together evidence and explanations (*e.g.*, their own knowledge-building process and the way their informants have built their knowledge, in order to uncover a more accurate representation). However, a science studies scholar must attend to the meanings built upon meanings, and the meanings in meanings, and the meanings

interacting with meanings. In many ways, the science studies scholar is among the best situated

to view their informants as legitimate partners in the knowledge production process.[29]

In the performative idiom, field, historical, and comparative methods are viewed as not

only trying to describe the empirical world, but to engage with it in order to have useful things

appear for description. No ethnographer is merely an observer, no interviewer merely records the

voices of their participants, and no historian merely lets the archives speak for themselves.

Instead, ethnographers choose where to look, and interviewers choose what to ask. The content

analyst chooses their abstractive cuts; the historian seeks out yet-unseen documents, and the

comparative methodologist chooses new cases and theories to proceed beyond their initial

theories.

So far I've spoken in general terms that could apply to the studies of nearly any social

process. I'll now turn to a few specific methods that science studies scholars in particular use,

paying special attention to the ways that they illuminate epistemic practices.

The genealogy of science studies is often told as if it truly began with the "Sociology of

Scientific Knowledge" (SSK), also called "the strong programme," though in reality the study of

science is far older, dating back at least a to the beginning of medical anthropology, and perhaps

dating to the earliest articulations of science itself. However, in this brief litany of science studies

method, I think it stands out as the first articulation of a method unique to science studies itself.

SSK emerged from debates in the 1930s and 60s about the proper place of science and

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29. The place and meaning of participants is a contested topic in social research, but I tend to see research that strives to achieve justice as needing to respect human subjects as knowers in their own right. The most radically inclusive form of this is participatory action research, or PAR, which strives to include "practitioners in the research process from the initial design of the project through data gathering and analysis to final conclusions and actions arising out of the research" (Whyte 1991, 7).

technology in society, the philosophical basis for true knowledge, and the relationship of

knowledge to sensuous experience (Fischer 2007, 542–55). Coming from these debates with a

desire to learn new truths about scientific knowledge, the strong programme marked the first real

"turn to practice" within science studies. The strong programme attempted to systematically

understand the content of scientific knowledge as something socially produced. The strong

programme attempted impartiality in respect to truth and falsity, rationality and irrationality, and

success and failure; it pursued a symmetrical method that could explain any beliefs or

knowledge-building practices of any scientist, including science studies scholars themselves

(Bloor 1991, 5; Sismondo 2010b, 47).

Emerging from the strong programme was a critique of it(s associated theories): that it

gave too much precedence to the functions of the social world, and in so doing, fell into the trap

that natural scientists were in. Each believed in certain "real" objects of study that required

correct representation (for scientists, natural realism, for sociologists, social realism). Actor-

network theory (ANT) was a response to this critique. It is, first, "supersymmetric," meaning that

it "[treats] both the social and material worlds as the products of networks" (Sismondo 2010b,

87). ANT focuses on the activities and connections of actors, not their macro-level connections

(such connections are important insofar as the actors actually make use of them); it conceives of

actors as fundamentally network-builders, and their activities fundamentally processes of

translation that turn some material interactions into others. At this level of abstraction, it does not

initially concern itself with cognitive explanations or essential qualities of actors, but only

concerns itself with their function in the network (Latour 1987, 258–59). These methodological

commitments doubtless have certain limitations, primarily, an ignorance of social forces outside

the analysis, like broader cultural currents or the "unofficial" activities of science (Fischer 2007, 559–63).

[removed] Published around the same time as early works in ANT, Donna Haraway's essay "Situated Knowledges" (1988) made some of the most important contributions in feminist science studies, by critiquing traditional notions of objectivity and the idea of science as merely a "language game" at the same time—interestingly, two critiques also leveled at the methods of ANT. However, the method that Haraway advocates for in this essay is a seemingly similar one to ANT: a way to look at the connections of actors, a way to understand 'semiotic technologies' (or were they methods of translation?), and a way to understand the interactions of the social with knowledge-making practices. The important difference between the two approaches was Haraway's commitment to recognizing and embracing *partial perspective*, instead of many previous social studies' implicit goals of generating theory as universalizing as possible. For Haraway, this commitment to partial perspective is the result of a central problematic interested in saving science as a system of knowledge *and* feminism as a system of politics:

> I think my problem, and 'our' problem, is how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognizing our own 'semiotic technologies' for making meanings, *and* a non-nonsense commitment to faithful accounts of a 'real' world, one that can be partially shared and that is friendly to earthwide projects of finite freedom, adequate material abundance, modest meaning in suffering, and limited happiness (Haraway 1988, 579).

Though Haraway's method is duplicated outside science studies, situated knowledges' requirement to first view epistemic limitations of the researcher *qua* situated knower, and a commitment to respecting external knowing subjects, moves the science study scholar towards less instrumentalization and more understanding of the situatedness of external knowers' knowledge. [removed]

Science Studies/Technology Studies; Science/Technology

Now that we've given attention to science studies as method, let us use the frame of method to split science studies and technology studies. I have tried to limit myself so far to discussion that would be primarily useful in considering "science studies" as "the study of epistemic practices." I think that now, with the additional information about the methods that are employed in science studies, it's clear that science studies methods are capable of not only attending to epistemic practices as such, but to *all* practices carried out by knowing subjects. Science studies gives attention to practice and the methods subjects use to make meaning *from* practice. [removed]

The methods of science studies, when considered *qua* methods of science studies, become unified by their ability to foreground questions of knowledge production, while the same case, analyzed with nominally the same method, but conceived as "technology studies," foregrounds technological production instead (*e.g.*, a study of how scientists use inscription devices can easily become a study of the social construction of an inscription device). [removed]

Onward: the Theoretical Insights of Science Studies for a Study of Technology

I'll end this paper looking to collect some theoretical insights that science studies has generated, both that I've noted in this paper and that I've noted from the process of writing it. I intend to use these insights to enhance a future technology studies. [removed] Here are some fragments of a motley study of technology, building from my examination of science studies.

1. **(Source omnivorousness)** All sources of knowledge are potentially useful, especially to understand the work of cultural extension (Feyerabend 1993, sec. 4; Pickering 1995, 3). Incorporate methodological insights from history, anthropology, and content analysis to be capable of seeing the myriad ways technology inscribes meaning upon the world.

2. **(Translation and inscription)** Cultural extension and material/semiotic exchange can be viewed in the lens of translation (*i.e.*, ANT). How do actors give one another new information? What is done with that information? The view of this ought to illuminate the (potentially emergent) purpose of a technology; it can be a useful analytical cut.

3. **(Multiple hermeneutics)** Recognize that not only are material/semiotic exchanges occurring, but that each actor has their own capacity to reconfigure and make sense of those exchanges. If we call this process "understanding" (or a hermeneutic; recognizing that there could be an incredible diversity of understanding practices), we see that the world consists of interacting understandings.

4. **(Variable discursive practices)** Pay attention to the multiple intersecting social worlds (places with consistent discursive norms) and their disparate material basis. This will give a better understanding of not just a *single* meaning, purpose, or experience of the technology, but will open those forms which appear to have achieved closure. In other words, the understanding of the technology as an inscription of culture will be made clearer, and the potential to change culture or inscribed meanings will emerge from diverse analysis.

5. **(Subjective experience of diverse actors)** Attention ought to be paid to the affective and subjective experience of technology. Note the lack of specificity: this includes the experience of technological users and producers, but also to nonhumans who interact with the technology as well, including potentially the technology itself.

6. **(The Haraway Question)** Given that our perspective is always limited, all knowledge is radically situated, and all action is historically and culturally contingent, how might we

generate real knowledge about the world that can actually contribute to earthly

flourishing?[30]

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30. I use the term "flourishing" in the vein of Wright 2013; Haraway's thought focuses on more "modest" material
    achievements until the development of her notion of "multispecies flourishing" (Haraway 2008; 2012) drawing
    from Cuomo 1998.

Theme I

Research Methods in STS

Noble, D. F. (1979). *America by design: Science, technology, and the rise of corporate capitalism.*

Summary and Review, prepared for Engineering Cultures Independent Study
2017-09-25 *(Draft! I'd like to return to this commentary in the future)*

David Noble's *America by Design* (1977) is a Marxist consideration of the history of engineering and corporate captialism in the US, especially from about 1870 to 1930. Noble's thesis is that the history of technology in the US is inextricably linked to the rise of corporate capitalism; throughout the book, he explores the ways that corporations and engineers shaped the function and interrelationships of regulatory apparatuses, extra-corporate organizations, the engineering educational system, and the corporations themselves to maximize capital and create the contemporary system of corporatism that pervades engineering cultures today. Ultimately, he argues that the capitalist system created and used science and engineering as practiced today in establishing the dominance of the corporation in American life, and as a means to generate and control capital. Engineers became both the "foremost agents of modern technology ... [and] the agents of corporate capital" (xxiii).

Of importance to us in our reading with a queer/crip theoretical lens is a particular question presented by Herbert Marcuse and here paraphrased by Noble: "How has technology become solely a vehicle of class hegemony and not also a vehicle of liberation?" (xxi). We can reframe this question away from considering the Marxist subject of "class hegemony" and towards cisheterosexism and ableism. This framing also shows the errors in the assumptions of the question; technology *has*, to an extent, served as a vehicle of liberation for disabled and queer communities (in the case of some disabled people and technologies, taking the form of literal vehicles), though corporate-technical practice often has not, and the liberation provided is partial at best and incoherent with total liberation at worst.

Part One of this work (3–65) focuses specifically on the development of engineering education. Though Noble focuses on the capital-accumulating motivations, I read a few motivations that could be described as thoroughly modernist, and by extension, ableist. Valorization of the "hard hands" and "sagacious heads" (as quoted on 22) of the engineer crafted the engineer as an ideally *able* body and mind, able not only in contrast to the perceived inability of non-engineers and the past itself, but able to use science directed toward practical ends. The ends in mind were naturally exclusionary: "the comfort, the convenience and elegance of life" (21), excluding and potentially suggesting the destruction of the uncomfortable, the inconvenient, and the inelegant.

We also see in the relationship between technical education and the humanities the continued valorization of ability. At first, technical education and classical education excluded one another on the view that the other was inferior; classical education was viewed as not useful (use of course defined by the technical educators), and technical education was viewed as not cultured (culture defined by the classicists) (24–26). Over time, as technical education became politically favored, the humanities were re-cast as tools by which the engineer could be more effective (31). The frame of utilitarianism in the 19th century's technical education saw only defects and tools in whole fields of knowledge instead of self-justifying assets, a frame that, when applied to disabled people, is fundamentally unjust.

Furthermore, I see that the motivation to make industry scientific, to advance technique and expand markets, and to "transform … technological progress into a well-ordered product of [the large corporations'] own" (19)—the motivation to design America—places value on conformity, and as such makes the exclusion of bodies and practices that fall outside of the mainstream a goal of corporate-technical practice. We see this primarily in the

standardization/efficiency movement of the early 1900s (ch. 5) and the direction of scientific research (ch. 7). This point should be expanded.

Additional note to be written about later: the rhetoric of "subduing nature" is fairly gendered and even evocative of sexual violence. I don't remember where I previously encountered this idea (possibly in Hill 2016) but it's worth discussion at a later time. I'm especially interested in how this rhetoric reinforces heterosexism.

I do see some parallels between disability and the development of a professional identity for engineers. Within a corporation, professional engineers embody and practice negotiation within a contradiction; they are "struggling to attain professional autonomy and define standards of ethics and social responsibility within a context of professional practice that demanded subservience to corporate authority" (35). Much of the book explores different articulations of corporate engineering professionalism that live within this contradiction. Disability advocacy seems to embody a similar contradiction: a search for autonomy and freedom from compulsory able-bodiedness within a system that demands able-bodiedness. For example, advocating for increased access to a space at once rejects the necessity of ability as value but appeals to the creation of ability because it is valuable. I wonder how engineers might learn from disability advocacy efforts in their continuing attempts to define professional engineering within a corporate context, and *vice versa*.

Engineering Cultures Readings: Wendy Faulkner
Independent Study | 2017-10-02

1. The major insight of Faulkner (Faulkner 2000b; 2007) is that there seem to be two dualisms at play in her ethnographic practice: techno/social and hard/soft. These look on the face of it to be the same dualism, but they are not. They are interrelated to the additional dualism of men/women (or masculine/feminine).

2. These dualisms affect all engineers who feel like they move away from the technical into the social. Women may feel that they're leaving "real engineering" while moving into a more "gender-authentic" experience. In contrast, men may feel that they're embracing the "hard" of the hard/soft dualism, moving into a field that grants them more power (e.g. money, social capital). On the other hand, both of these moves may be inauthentic to their notions of engineering?

    a. I interpret this process as establishing particular types of power that are highly gendered; women are to value the power that lets them manipulate their immediate environment lest they become more feminine, while men are to value the power that moves the social world lest they become more feminine. Both are driven from a fear of femininity? Fear of losing power?

    b. I also notice that many of the strides in accepting women into the workplace seem predicated on valorization of ability. ('We can respect this woman because she is able, we can respect this career move because it increases their ability,' etc). Where do we read the experiences of disabled people here?

    c. One place where I do see it is in (Faulkner 2007, 346). "The 'nuts and bolts' identity takes its marker from hands-on work with technology; it is modeled on

the technician engineer—virtually none of which in the UK are women. This engineering identity therefore resonates with a working class "muscular masculinity" involving physical mastery." It seems that women joining the nuts-and-bolts identity only reinforces the muscular (read, hyper-able) image of the engineer.

3. This draws from some of Faulkner's other early work (Faulkner 2000a), which poses the question of *why* the connection between technology and masculinity is so strong. This piece ("a research agenda for 'making gender stick' to engineers") attempts to identify the fractures in this edifice; the ways that this durable connection is always already falling apart. Faulkner proposes doing ethnographies that focus on the "interplays between gender identity and gender symbolism with respect to technology" (Faulkner 2000a, 110) and the tensions between the broader cultural conceptions of gender in/of engineering and individual engineers' immediate subjective experience (111). Faulkner takes up this "agenda" in her later work, specifically her ethnographic project in the early 2000s (Faulkner 2006; 2009a; 2009b).

4. My experience at Olin seemed to run in contrast to Faulkner's insights, and I wonder why that is. On the one hand, I think Oliners were not explicitly taught the pursuit of power as the goal of engineering. Furthermore, I think that Oliners pursued a heterogenous experience of engineering (Law 2011).

    a. I wonder to what extent this is influenced by the fact that Olin's curricular culture emphasizes "Women's Ways of Knowing" (Chua 2017, 10) and in what way that all comes together

The Vision of Development: Policy of Social-Technical Practice in Engineers Without Borders USA

Policy Studies "Position Paper" | 2018-12-07

Introduction: Seeing Like an Engineering Development Organization

With over 14,000 members and 600 completed projects, in its mere 16 years of work, Engineers Without Borders USA (EWB-USA) has become one of the largest engineering aid organizations active today.[31] "Engineering aid" is here considered as the pursuit of any engineering project undertaken for the purposes of "third world development", that is, as Catherine Caufield succinctly defines it, "the art—for it is certainly not a science—of improving life in the countries of Asia, Africa, and Latin America" (1996, 1). Caufield's science-excluding definition of "third world development" perhaps sits uncomfortably with definitions of engineering that emphasize the technical, for example, "Engineering is the science, skill, and profession of acquiring and applying scientific, social, and practical knowledge, in order to design and also build structures, machines, devices, systems, materials, and processes."[32] Despite this apparent tension, EWB-USA's distinct combination of the American engineering profession's epistemic and technical culture and its position as a third-world development actor gives it a very particular way of managing its projects.

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31. Engineers Without Borders USA, "Mission & History," Engineers Without Borders USA, accessed October 9, 2018, https://www.ewb-usa.org/mission-and-history/

32. "Engineering," in *Wikipedia, The Free Encyclopedia*, November 17, 2012, https://en.wikipedia.org/w/Engineering, as quoted in (Blue, Levine, and Nieusma 2014, 5) Perhaps even more technically defined, engineering is "the application of science to the common purpose of life" (quoted from Count Rumford *ibid.* 3).

Through the organization's Planning, Monitoring, Evaluation and Learning (PMEL) program, EWB-USA pursues only "engineering related" (that is, technical) projects, while also navigating the "art" of development and a contested landscape. Situated at the nexus of these two worlds, each with its own relationship to positivist epistemologies and its own outlook on "success" and its achievement, this program manages each EWB-USA project from conception to completion and beyond d. As we will see, this program defines and produces such success through the way that it forms, enacts, and evaluates projects. Its highly bureaucratized way of planning and reporting projects manages the heterogeneity of development situations to formulate specific technical requirements and evaluation criteria.

Drawing on the work of both Donna Haraway and James C. Scott, I present *vision* as a guiding metaphor to consider the work of EWB-USA and the PMEL program (Haraway 1988; Scott 1998). In one sense, EWB-USA's vision is this:

> Our organizational Vision is a world in which the communities we serve have the capacity to sustainably meet their basic human needs and that our members have enriched global perspectives through the innovative professional educational opportunities that the EWB-USA program provides.[33]

In a very different sense though, their vision is not this world that they imagine, but their way of seeing the present world and their own work in it with the aim of producing such a place. *This* vision—the way of 'seeing like' EWB-USA—describes how the organization, its administrators, and its members perceive the communities they work to improve, themselves, and their projects. I distinguish these two senses of the word as EWB-USA's *aspirational* vision and its *perceptual* vision. Explicating the organization's perceptual vision is important not only because it describes

33. Tiffany Martindale, "Planning, Monitoring, Evaluation and Learning Program: Program Description" (Denver: Engineers Without Borders USA, February 2014), 4, https://s3.amazonaws.com/ewbgeneral/COMPILED%20PMEL%20Program%20Description.pdf.

a *perspective* and therefore helps us to *situate* the knowledges produced by that perspective—locating and restricting knowledges that seem, as most scientist knowledges do, dislocated and unrestricted (Haraway 1988)—but also because that perceptual vision takes great role in doing development and shaping the lives of implicated actors. In other words, my interest in EWB-USA's perceptual vision is *not* just in describing the knowledges it constructs but the *realities* it enacts.[34]

Perhaps unsurprisingly, an excellent starting point for understanding EWB-USA's perceptual vision is its aspirational vision. Within their vision of the world to come is a description of the world they see: one of "communities we serve" and "basic human needs," of "our members," "global perspectives," and "innovative professional educational opportunities." It also shows a direction they wish the world to move, and actions by which that motion happens: *serving* communities, *building* capacity, *sustaining* need-meeting, *enriching* perspectives, *innovating* education, and *providing* opportunities. We already are beginning to see what realities are enacted, but of equal importance is the realities these enactments leave out. Already hidden from view are communities that serve themselves; desires beyond "basic needs"; local perspectives; and boring, stagnated education, among countless others. However, we have yet to account for the ways that actual actors in this perception contribute to the exclusion of certain realities. Especially important to consider are the discursive artifacts of the PMEL program, the ideological commitments of EWB-USA, and the productive tensions of various actors. Throughout this paper, I will describe the ways that the perceptual vision of EWB-USA flattens

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34. My sense of the word "enactment" is drawn primarily from (Mol 2002). Mol's other work, including (Mol 1999) and (Mol and Law 2004) is also instructive.

the social world it encounters as it attempts to manage it, chooses which accounts are accounted for, and creates success through discursive, epistemic, and material means.

What does the PMEL program represent the problem to be?

The work of EWB-USA can primarily described as a "volunteer sending" model of development; EWB-USA chapter members (mostly, undergraduate engineering students in the United States) work with "partner communities" in the third world to develop projects, and conduct several visit to these communities to gather information, implement a project, and observe its effects. Guiding EWB-USA in this work is its wide-ranging theory of change and project policy, the Planning, Monitoring, Evaluation and Learning (PMEL) program.[35] This program and its concordant set of forms, documents, and processes guide and govern the way that EWB-USA projects are conceptualized from beginning to end (and beyond), create a roadmap for how EWB-USA interfaces with other actors in the development arena, and set out the organization's aspirations for continuous improvement. In short, the PMEL program is *the* policy of EWB-USA. Through it and its applications, the organization's activity can be analyzed. [PMEL] contains clear implications for every actor and connects previously disparate activities. Although the policy does not directly cover "project implementation," perhaps imagined to be the most important activity of EWB, it frames implementation in such a way that it's almost an afterthought, an effect of proper planning and the object of continuous analysis.

Strictly speaking, the PMEL program describes the way that EWB-USA's projects are planned, monitored, evaluated, and assessed for their "impact."

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35. Martindale, "Planning, Monitoring, Evaluation and Learning Program."

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The project planning process begins to connect relevant groups, delineates the boundaries of what is or is not an appropriate project, establishes the modes by which monitoring and evaluation will occur, divides particular types of labor between the different actors, and constructs "a problem" that can be addressed by "an engineering solution." Through many back-and-forth interactions between the partner community, the chapter, and EWB-USA staff, their respective roles come to be defined and a technical project emerges. Though the project requires "strong collaboration" between the EWB-USA chapters and the partner communities, the chapter is considered the primary interface between EWB-USA's staff and those communities once a match is made. The chapter submits regular reports to EWB-USA's headquarters, which describe the results of the "participatory and inclusive" design approaches and "strong collaboration" with the partner agencies and local community.[36] It is through these reports that the chapter determines the prevailing need of the local community that can be addressed by a technological intervention, decides and designs an "appropriate" solution, and shares the details of how that intervention will be implemented. Planning activities also become EWB-USA's first site of monitoring and evaluation—a set of appropriate planning documents must be filed and reviewed by EWB-USA's headquarters before each trip, whether for assessment, implementation, or evaluation.

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36. Martindale, "Planning, Monitoring, Evaluation and Learning Program," 9.

The PMEL program has several ways of explicitly and implicitly excluding "non-technical" aspects of engineering work from their projects. […] The tendency for limiting EWB-USA projects to a purely technological arena is more contingent on actual project conditions than we may have first imagined. Looking at these critical success factors also complicates our notion of the "exclusion" of non-technical aspects of a given project: these aspects are not hidden from view, but rather put in the background and seen in another light, that is, offloaded to other actors and considered primarily in relation to a project's technical goals. The perceptual vision of EWB-USA comes into clearer focus.

One important aspect of what the perceptual vision sees and enacts with regard to the non-technical aspects of engineering practice is how the organization produces subjects around itself. Members of a partner community are enrolled in strange ways: as need-havers, maintainers, sources of financial support, and managers of community behavior, to name a few. Within actual project reports, people and their actions are even more flatly related to the project: as "potential barriers" and "potential facilitators" to project success.[37] They are also seen as a resource in another way: as a source of "lessons learned," short points which every post-trip report dutifully collects.[38] These lessons intend to improve both an individual chapter's approach to doing project work, and EWB-USA's overall approach. Members are encouraged to pay

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37. University of Illinois at Chicago Chapter and Jennifer <Redacted>, "Document 522—Post-Assessment Report" (Chicago: Engineers Without Borders USA, October 7, 2009), https://s3.amazonaws.com/ewbgeneral/522%20-%20Post%20Assessment%20-%20Guatemala%20-%20Water%20Treatment.pdf.

38. Martindale, "Planning, Monitoring, Evaluation and Learning Program," 29. The phrase "lessons learned" appears in the PMEL document twenty-seven (27) times.

attention in the form of exhortations to reflect: from every interaction is a potential "lesson learned."

Built upon this perceptual vision that flattens the social world into technological problems are what I identify as three co-existent representations of "the problem" of engineering development within the PMEL program. These are:

1. That people in partner communities do not yet have their "basic human needs" met;

2. That EWB-USA's members need "enriched global perspectives," "transformative experiences," "innovative professional opportunities," and to become "responsible leaders"; and

3. That the work of building technological interventions must improve over time and be protected from failure.

These problem representations create what I identify as four core components of the PMEL program that make it distinct from similar planning, monitoring, or evaluation policies in other contexts:

1. An intentional limitation of EWB-USA's work to a purely technological arena;

2. A project planning process that defines what constitutes a "successful" project, shapes new projects so that they avoid common missteps, and lays out methods and metrics for monitoring/evaluation/assessment;

3. A monitoring, evaluation, and assessment scheme that ensures that projects are being executed "correctly" and describes a given project's effects; and

4. A system for organizational learning based on the outcomes of the monitoring/evaluation/assessment, with effects at the membership, project, chapter, and administrative levels.

Historical and Cultural Location of the PMEL Program

<u>Bureaucratic Form: PMEL as Engineering Management</u>

The culture of EWB-USA is predominantly engineering-oriented and tends to treat any given project as if the overall project system—not merely the technological intervention, but all of its related processes, social configurations, and effects—were an object to be engineered, *i.e.*, researched, designed, implemented, and monitored. This interest in regulating the social sphere with the same processes that apply to technological products is reminiscent of the engineering managers anthropologist Gideon Kunda studied in his book *Engineering Culture*, and indeed is prominent within Silicon Valley today.

Kunda's managers attempted to "engineer" the culture of their large corporation to achieve certain outcomes, mostly by treating "culture" as an overall context their action is situated in, an object to be controlled, and a mechanism for controlling employees. However, this interest certainly has a long history, from Taylor's "scientific management" to Elton Mayo's "human relations" and more recent developments in integrating cognitive science with managerial practices (Kunda 2006, 2–12). Indeed, the development of management *qua* science largely coincided with the emergence of the modern corporate form, happening since the Civil War and heavily depending on American industrialization (Chandler 1977). This also coincides with the emergence of engineering as a profession, and engineering culture's consistent tension between focusing on the technical and social aspects of engineering (Noble 1977). Since the Second World War, this culture has been increasingly characterized by heavily scientized and

regulated practice in large corporations, fueled by the large-scale military projects of the Cold War (Lucena 2005). Today with the emergence of massive information communication infrastructures, we've seen the drive to "engineer culture" take a new form in the management of social media platforms via collection and application of "big data" (Vogel et al. 2017).

It's in this historical-cultural context that we should consider the PMEL program's clearly delineated "project process," which specifies certain activities for chapters to perform while they work on a project, requires certain reports to be filed with Headquarters at particular times, and describes the content of these reports to a level of detail commonly found in various engineering standards. This amount and type of documentation and reporting is well-known within some engineering environments, especially in established industries and corporate contexts (*e.g.*, some civil engineering firms, large aerospace companies, etc.), and is a type of bureaucracy that would be familiar to most engineers working at mid-sized to large firms. Comparing EWB-USA to such engineering corporations can help to explain many of the particulars of its approach to project work; however, the general approach to it *as development* still must be analyzed.

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Ethics Education as Enculturation:

Student learning of personal, social, and professional responsibility

Dean Nieusma and Mitch Cieminski | Published June 2018 | American Society for Engineering Education 2018 Annual Conference and Exposition (peer-reviewed)

Introduction

This paper explores how engineering students understand the meaning and role of ethics within their own life experiences, the context of their education, and their projections of professional practice. While the majority of work in engineering ethics educational research seeks to implement and assess new educational activities, approaches, or paradigms, this project seeks merely to better understand *students' understandings of ethics*, in their own words and on their own terms. The project takes a grounded-theory approach, seeking to identify what is most relevant about ethics and ethics education from the perspective of the students whom we interviewed, but we also draw some tentative lessons from the project that might guide future engineering ethics educational activities and, to a lesser extent, engineering education generally.

The paper draws on 18 semi-structured interviews with students, each lasting approximately 90 minutes, and additional direct observations of relevant activities, including an "ethics code" orientation, socialization, and signing event hosted by our institution for incoming first-year engineering students. The paper is the result of early steps in the implementation of a longer-term, NSF-funded research project that extends the inquiry to the development of students' understanding of ethics over the entire arc of their undergraduate educational experience.

Our argument unfolds in five steps. In the section that follows this introduction, we situate our inquiry within the broader field of engineering ethics research, connecting in particular to work on "macroethics" (Herkert 2005) as it intersects with scholarly work in our

primary fields of science and technology studies (STS) and engineering studies. The next section

reviews in greater detail this project's research design and data set as well as the methods used to

collect and analyze our data. The third section reviews our key findings for this stage of the

research process, drawing extensively on students' articulations of the role of ethics in their

individual lives, their educational experiences, and the profession. In the fourth section, we

identify implications of our findings and how they offer insight both into the teaching of ethics to

engineering students and into the broader challenges facing engineering educational

environments having to do with educational and disciplinary cultures. Finally, we conclude the

paper by reviewing our key findings and reflecting on what they portend for the project, and

engineering ethics teaching and research, moving into the future.

Contextualizing the Project: Engineering Ethics Education Research and Practice

Over the past decade or so, engineering ethics education has witnessed tremendous

innovation and, along with that innovation, has experienced much-needed diversification. This

diversification is seen in both instructional approaches and research agenda. On the instructional

front, educators are preparing students to attend to a wide range of modalities of ethics decision

making. On the research front, scholars are tuned in to this instructional diversity and are

investigating the effectiveness of ethics instruction across many dimensions, including

comparisons of instructional modalities and strategies for integration with technical

content/practice (Canary et al. 2012), student competencies across instructional modalities and

institutional contexts (Zoltowski et al. 2016), student experiences with ethics instruction (Alpay

2013), and student understandings of the social and professional responsibilities of engineers

(Loui 2005).

In her 2008 book, *Engineering and Social Justice*, Donna Riley identified challenges surrounding the engineering "worldview," in which engineers "see themselves and the profession as apolitical, objective, and value-neutral, allowing implicit assumptions about the world to govern our choices" (2008, 109). Such worldviews could be somewhat eschewed by case-based approaches to engineering ethics, in which the cases themselves might call the reader's attention to the political, subjective, and value-laden nature of engineering. Such approaches are common within mainstream engineering ethics textbooks (Harris, Pritchard, and Rabins 2000; Martin and Schinzinger 1996). However, such ethics textbooks, and the educational contexts in which they are used, exist within a broader engineering social milieu that tends to occlude these particular insights; case-based approaches are susceptible to mechanistic views of ethical problem solving, allowing students a false sense of objectivity in responding to abstractions that do not challenge them as to *why* such cases occur in the first place (Winner 1990; Tang and Nieusma 2017).

This reduction is perhaps the result of a tendency to focus on what engineering ethicist, Joseph Herkert, has called "microethics," a concern with ethical decision-making by individuals, instead of the contrasting "macroethics," which turns attention to the engineering profession itself, the institutions in which it operates, and its collective responsibilities to society (2005). From our disciplinary home within science and technology studies (STS), we see a promising approach to emphasizing the political agency of engineers by attending, not only to the combination of, but also to the connections between the micro and macroethical levels. Far from casting aside the microethical concerns that clearly make up the bulk of an engineers' experience with ethics, our project intends to demonstrate the ways that immediate, situational ethics connect to the structural dimensions of engineering and engineering ethics.

Given that individuals are typically quite sophisticated in their abilities to read subtle social cues regarding appropriate/desired/expected behaviors, it is not surprising that engineering students "learn" ethics by observing how behaviors and decisions are modeled across their educational experiences. But we also know people frequently disregard understood norms for reasons that are more difficult to pin down. In the case of student cheating, for example, it is untenable to argue that students simply do not understand that cheating is agreed to be wrong. While it is more tenable to suggest that students' moral reasoning skills are impaired, that approach concentrates attention on the individual cheater—and micro-ethical reasoning—rather than the systemic problem of cheating as it exists across many engineering education institutional contexts. We aver that understanding the root cause of cheating among students requires taking a systemic view of the educational context: What, in students' experiences, "causes" cheating (among other students or for themselves), what enables them to justify actions they know to be "wrong" in a strict sense, and what situational or organizational features are effective in preventing such actions?

While cheating may be interpreted as a prototypical microethical challenge, a macroethical lens invites us to respond to it as a systemic outcome of engineering education. This not necessarily to say cheating is a pervasive problem, or that the problem of cheating is homogenous across educational settings, but merely that the problem of cheating goes beyond "a few bad apples" and that there are contextual dimensions of the problem that are missed when focusing on shoring up the ethical fortitude of individual students as isolated ethical agents acting in a disinterested social context.

As Godfrey has noted, diagnoses of "the problems" in engineering education—and in our case, engineering ethics—often rest on "incontestable assumptions" (2014), such as the

assumption that engineers are individual, rational actors or the assumption that engineering

culture endorses unethical behavior. Godfrey points out that change-oriented engineering

education researchers must turn our attention to the *specific cultural conditions* encountered

within our educational institutions in order to identify spaces for cultural change. Furthermore,

the authors recognize that engaging students in conversations about changing their educational

experiences could contribute to a culture of mutual respect, for which this project strives, and

facilitate transformative change (Duncan-Andrade and Morrell 2008; Robinson 2016). In light of

these methodological considerations, the present analysis uses a grounded theory and student-

oriented approach to problem framing, data collection, and interpretation in order to attend to

students' own meanings and experiences regarding ethics (Glaser and Strauss 1967; Maxwell

2013).

Research Design and Methodology

The larger project within which this analysis is situated aims to trace the development of

students' understanding of ethics over the entire arc of their undergraduate educational

experience. One of the major goals of that project is to track change over time within individual

students and across a student cohort. The present analysis, in contrast, seeks to provide a

snapshot in time of a small set of students, many of whom are very early in their educational

program. This analysis seeks to answer: *What commonalities do we see across students' diverse*

understandings of and experiences with ethics, and how do these commonalities provide insight

into the overarching educational culture and its most salient features in shaping students' ethical

imaginations, community norms, and individual practices?

Eighteen undergraduate students at Our Institution (anonymized for review) were interviewed for this analysis, with each interview following a semi-structured interview script and lasting approximately 90 minutes. Students volunteered to be interviewed after a brief introduction to the project by the authors during the participants' engineering courses; further students were invited to participate via snowball sampling. The students in this analysis represent a diverse array of majors in engineering and lab-based sciences, at all levels of their respective undergraduate careers, a variety of socioeconomic and regional backgrounds, multiple political perspectives, and a distribution of genders (including trans/gender non-conforming students).

The interview protocol moved from rapport-building questions, through open-ended questions about students' thinking about and experience with ethics issues, and on to more focused questions about specific dimensions of ethics, including instances of both negative and positive ethical outcomes and where opportunities existed for better attending to ethics within the engineering educational context.

Since many early-stage engineering students in our institutional context have had limited exposure to ethics explicitly in an educational content, our interview protocol used a progressive query technique to encourage students to expound on their tentative articulations. For example, all interviewees were first asked to describe ethics in their own words and to illustrate it with examples from their own experiences. Later, students were asked, respectively, about the personal, professional, and social responsibilities of engineers. At each stage, the interviewer asked student to elaborate on relevant themes by drawing on the student's own terminology, sometimes asking for clarification, specific illustrations, or comparisons between the student's individual experiences and how the student understood the experiences of others. The logic of

this protocol is to avoid preempting students' own thinking by providing our framework or our

terminology before they have had multiple opportunities to provide their own articulations.

Interviews were transcribed in full or using thematic/summative overviews, and

transcripts were then closely read and annotated independently by the authors. Transcript

annotations were compared within and across transcripts to identify broad themes, with attention

to how the different interviews complemented, refuted, or nuanced our understanding of the

themes identified. In this way, our analysis worked progressively toward themes that performed

both categorizing and connecting functions (Maxwell 2013, 105–15). Examples from the

transcripts were selected for inclusion in this analysis both for their representativeness and their

ability to articulate especially useful insights to the meanings of the themes.

Key Findings: How students experience and make meaning around ethics

Our analysis identified four key findings responding to our research questions: 1)

Students perceived deficiencies in their understanding of and/or attention to ethics; 2) Despite

initial reticence, most students desired to discuss their ethics-related experiences, and identified a

range of instances from their lives relevant to our queries; 3) Students framed ethics issues

almost exclusively in the negative—avoiding harm or disaster—and struggled to describe

positive instances of ethics; and 4) Students identified trust and safety/security within the

educational context as prerequisites for improved ethical outcomes. Each of these findings will

be illustrated by drawing on student experiences captured during interviews.

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Ethics experiences beyond coursework and extracurricular activities included a range of

infrequently identified, but substantially elaborated issues—often sensitive ones. Two students

spoke passionately about residential life issues related to living in a fraternity, including

challenges around illicit alcohol or drug use. In particular, they had each experienced acute

tension between the ethical imperative of protecting the health and safety of their peers while

also negotiating what was perceived as Our Institution's "no tolerance" policy regarding alcohol

and drug infractions. Another student spoke about war, working with the military, and weapons

policy in the US. Another spoke of an experience where a peer consistently mocked another

student with a disability, and framed the whole experience of harassment as "what's wrong with

engineering." A separate interviewee described an experience with sexual harassment in a

research lab.[39]

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Implications: The need to change the frame within which ethics is interpreted

In this section, we identify some of the implications that may be drawn from our findings

described above: 1) For ethics to be central in students' experiences, it should to be treated

explicitly and repeatedly throughout their education; 2) Ethics discourses should be disentangled

from any perception of moralizing, especially on the part of instructors or administrators; 3)

Engineering education reformers committed to centering ethics discourse should attend to the

diverse components making up students' educational cultures and not just individualized student

knowledge about ethics or capacities for moral reasoning. Each of these implications will be

briefly discussed in this section.

Explicit and Recurring Reference to Ethics

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39. These examples are included because of their importance and relevance to understanding the breadth of "ethical experiences" students shared with us. Despite the importance of these particular experiences, however, the authors do not elaborate on these data points due to the scope of the present argument and the nuance required to treat these issues appropriately.

We believe student reticence to discuss ethics in our findings is a direct result of their lack of exposure to discussions explicitly about ethics, and we see this as a generic challenge facing engineering education. We do not assume or imply that "explicit treatment of ethics" need follow any particular ethics or educational framework. To the contrary, we suspect that even informal, non-scholarly attention to ethics would be beneficial compared to the current situation, at least at Our Institution. As with the students we interviewed, we suspect many engineering instructors also experience reticence in discussing ethics due at least in part to fear their knowledge of ethics is inadequate to "teach" it in the classroom, and, hence, ethics-oriented discussion is avoided. This applies not only to specialized ethics topics, such as moral reasoning, but even in the most general terms, such as, for example, the issue raised by one of our interviewee: the "ethical imperative" that engineering students learn their course material if they intend to become working engineers. Students can practice ethics discourse, even if ill-structured and without the support of formal ethical framework, by being exposed to such discourse throughout their courses, in discussions with their instructors and advisors, and in many other ways.

Despite initial reticence, it is also clear from our interviews that students are willing and capable of discussing, with nuance, ethics across personal, professional, and social dimensions. The private setting of the interviews may have encouraged a candor less likely to occur in a classroom setting; nevertheless, educators hoping to increase the frequency of ethics-oriented discussion can tend to the *quality* of those discussions by fostering an open and supportive environment and consider ways to facilitate discussions of ethics that are not guided exclusively according to the instructor's expertise. Instructors and other educational staff can also consider ways of "teaching" the importance of ethics within any given organizational context by creating

opportunities for ethics discussions outside of formal classroom settings. The Ethics Code event at Our Institution is one example of such an opportunity, even if the desired quality of discussion about ethics was missed in this particular implementation. Though diagnosis of the specific ways such events could achieve high-quality discussion and student engagement is outside the scope of this paper, ethics-committed educators should take care to learn from similar "ethics-broadcasting" events in their own institutions.

Countering Perceptions of Ethics Discourse as Moralizing

While we are not at all surprised by the finding that students overwhelmingly frame ethics in the negative, we see opportunity here to create ethics learning opportunities' that are not associated with ethical failures and individuals' ethical deficiencies. Especially at Our Institution, we see significant potential in reframing the discussion away from "ethics" as above inadequacies and ignorance. What if we could shift the way we talk about ethics to highlight students' already-present capacity for ethical reasoning, the nuances with which they assess real-world ethical dilemmas, and to identify the innumerable positive instances of ethical behavior always already surrounding us? This shift could encourage students to leverage their strengths and elaborate on what they already assess to be ethically robust behavior, especially in the face of abundant opportunities for compromising ethics. The shift could also change the way engineering course instructors think about "ethics" in their classrooms, providing openings for integrating ethics discourse across their lesson plans.

Our proposal here mirrors P. Aarne Vesilind's (2010) shift away from "negative peace" to "positive peace" in his treatment of "peace engineering," creating a proactive effort to establish engineering ethics as a site of potential good (125). One articulation of such a positive ethics from the literature is George Catalano's proposed fundamental ethics canon: "Engineers,

in the fulfillment of their professional duties, shall hold paramount the safety, *health*, and *welfare* of the identified integral community" (emphasis ours) (2006, 37). Though this canon only addresses the professional dimensions of engineering ethics, attention to ethics that emphasize the health and welfare of others—and *the social good* more generally—in the personal and social spheres promises to be a fruitful approach to integrating the microethics of the day-to-day with the macroethics associated with institutions and broad social systems.

Attending to Educational Culture and Not Just Student Knowledge

Finally, we find that if engineering educators desire to change how students develop and practice ethics, attention must be given not only to students' demonstrated ethical knowledge, but also to the institutional cultures in which that knowledge is expressed. In the case of Our Institution, students would certainly have benefited from having certain scholarly ethics vocabularies available to them, but the experiences that they identified as relevant to ethics, and their individual responses to those experiences, were shaped far more by institutional culture than by the degree to which they had commend of ethical theoretical frameworks. To some extent, this implication was prefigured by our interest in macro-ethics, the systemic barriers to ethical outcomes, as well as the grounded-theory methodology used to carry out the study. Even so, cultural change seems to be a ripe area for intervention in ethics education for engineers.

As we saw in our interviews, students' value of trust is directly relevant both to how students imagine professional engineering experience and to students affect toward other students, instructors and university administrators and staff. Valuing trust could be considered an articulation of a positive ethics, just as a violation of that trust is related to things going wrong ethically. Certainly, our data showed a direct correspondence between perceptions of distrust and instances of unethical outcomes. Cultivating institutional cultures of trust are one tangible way

that educational cultures might be changed to facilitate ethics discourse and ethical behaviors. Other potential sites of change that could improve the cultural conditions of Our Institution in regards to ethics outcomes include attention to "real-world" applications of engineering knowledge as way of building competence in engineering and engineering ethics. This shift to ethics knowledge as "skills that must be practiced in order to be learned" could fit nicely with the contemporary emphasis on project-based learning approaches in engineering education.

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Theme III

Feminist Commentary on Technoscience:

New Materialisms, Feminist Theory, Queer Theory, and Disability Studies as commentary on technical practice

Summary and Review of McRuer's *Crip Theory: Cultural Signs of Queerness and Disability*

Review of Introduction and Chapter 1

Independent Study | 2017-09-14

McRuer's *Crip Theory* (2006) represents a few justifications and possibilities for our research and readings of engineering studies. First, it shows a variety of contexts which can be read "queer" or "crip" which do not invite those queer/crip readings by their structure. Indeed, the fact that queer/crip readings are not invited by these contexts is an example of what we might call "compulsory heterosexuality and able-bodiedness" that McRuer points out is so central to mainstream culture and so necessary to oppose. The opposition of this compulsion is at the core of queer/crip theory. McRuer's reading of disability into such contexts as various non-crip feminist texts, the history of the Crips (the gang in Southern California), and others provides us a guide we can use to **locate disability in engineering cultures which I hypothesize subordinate disability** by pretending that it does not exist or is not relevant, or by portraying it as undesirable.

Second, *Crip Theory* justifies queer/crip readings and other disability-oriented work in a light of what I would call an asset model of disability and disability studies. Extending McRuer's comparison (82) of how disability images and cultural geography could find mutually-beneficial symbiosis, I argue that *any* field of thought and investigation can benefit substantially from critical engagement with disability, as disability activists and thought can benefit from those fields. This too is, at this point, a hypothesis.

Lastly, *Crip Theory* troubles notions of better and worse, and presents substantial critiques to its own work. This is the most challenging part of integrating a crip theory into our studies. McRuer's applications of crip theory are self-critical. Many disability-oriented

interventions presented in the book are presented in both a positive and negative light, and nothing is considered as totally unproblematic. I was struck by McRuer's example of the Treatment Action Campaign's "HIV POSITIVE" t-shirts (pp. 67-70) as a critical device that questioned the very nature of positivity, both, in this case, as a factual evaluation (e.g. "the test came back positive") and as a value judgement (e.g. "A positive light"). McRuer came out as HIV-positive at an academic meeting, though he himself was HIV-negative. While such a lie on the one hand might be considered a negative thing, such an evaluation is questioned by the critical work that his coming out did in the context it occurred. Throughout the book, McRuer refuses to take a position on the question of coming out crip, much as those who wear the TAC t-shirt generally refuse to take a position of if they indeed have HIV. This refusal to categorize things in tidy value judgements (e.g. good/bad) is in many ways the essence of crip theory, and this makes our work increasingly difficult.

Notably, we must be aware and be critical of the ways in which our use of a queer/crip lens is problematic. By reading disability into nondisabled situations, we run the risk of objectifying disability as a rhetorical tool to be used for our intellectual benefit. However, if we are to adopt the position that critical engagement with disability is beneficial, this use is essentially unavoidable. This is why our queer/crip readings is a critical practice, and why we must treat it as such: in our practice, as in the world, nothing is predictable, nothing is without problem, and nothing is wholly self-consistent. It is only through a process of critique and reflexivity that we can make our application of these theories become a reflection of our values and goals.

As we go forward, we should remember the tentative principles of crip theory that McRuer identifies: that crip theory claims disability identity politics while contesting identity

politics, that it claims the queer history of coming out while "talking back" to its parent cultures, that it demands the possibility of an accessible world, that it demands the possibility of a disabled world, and that it must question the ways ability and disability are conceived and practiced (84–5).

Review and discussion of selected sections of Bennett's *Vibrant Matter*
Technology Studies Weekly Response | 2017-10-24

Summary

I began my readings with the unexpectedly challenging *Vibrant Matter* (2010) (I was deceived by its length! Its content had me thoroughly engrossed though, and I felt compelled to hang onto each word instead of merely skim though its arguments). Jane Bennett's work felt both familiar and ambitious; she set out to name and describe what she means by "vibrant matter" and demonstrate its existence, to break the binaries held in naïve conceptions of the world, especially that of life vs. matter, and to propose a type of political analysis which includes the nonhuman (x). She moves through the opening chapters with a description and analysis of certain assemblages, naming the actants within as distinct-yet-related, each having some actancy in that they do things: take on particular meanings, constrain and enable other things, and move about. She aptly names this power of things "thing-power," which she sees as a property of matter itself that lies firmly in a material realm but beyond complete understanding. Agency is conceived in this world of assemblages as an emergent property of them. "There is not so much a doer behind the deed as a doing and an effecting by [an] … assemblage" (28). This insight, paired with the simple fact that everything is an assemblage, cuts through the previously believed notion of "human agency" in favor of a messier, interrelated distributive agency.

Ultimately, the goal of this work is to expand the political dimensions of ethics. Ethics is often squarely considered a realm of humanity and occasionally animals (insofar as they are alive and therefore like humans) and less-often, things (insofar as they are related to humans). For Bennett, the world is too anthropocentric and naïve of the real way of things, a way that troubles human agency and the life/matter divide. She not only demonstrates that thing-power affects humans (e.g. the power of a blackout-assemblage, or a food-body-assemblage), but that thing-

power affects other things in an extra-human way. This was most readily demonstrated in Chapter 4, "A Life of Metal," in which Bennett looks directly at the most-dead thing imaginable, and sees it as a lively assemblage of atoms and crystalline structures, with a history of formation and re-formation. Surely, she argues, if this is vital, so is all matter!

Toward the book's end is a brief case study on the so-called "culture of life" that characterized evangelical U.S. politics in the early 21st Century. This ideology is identified as an only superficially-vibrant vitalism, as its position of a soul and of fundamental differences/hierarchies among stuff/life/humans/God makes it anti-material and denying the central claim of the book, a radical monism (one-thing-ness) of reality. Of course, a by-product of historical Christian thought among this ideology is a pure, singular, and causal agency of the sort that Bennett earlier denied. Bennett asks how a culture with such a pure sense of agency and life-value could be so violent; she suggests the hierarchies inherent in the ideology are but a stone's throw from a hierarchy of people. If vitalism implores the "strong to protect the weak" (88), what is to stop the paternalistic impulse from finding new foes?

The final work of the book is to lay out a new sense of politics than has been considered before (though not unlike Latour's "parliament of things" or Winner's understandings of artifacts as having politics beyond the humans that use them). Bennett finds the definition of public that suits her broader purposes between the work of John Dewey, who understood the public as a set of bodies convened around a problem and dissolved when the problem had been addressed, and Jacques Rancière, who imagined disruptions of a preexisting public by a second, disempowered one, who by exercising their embodied power is able to "repartition the regime of the sensible." At the intersection of these ideas of political power, Bennett finds space for the non-human to

assemble and address a problem, even without specific agency or language generally afforded to human beings.

Discussion

I can tell that *Vibrant Matter* is a book I'll read and re-read as I grow as a scholar. I recognize its political goals and method as relevant to both my present and future study: my present study of ethics within engineering, and a long-long-term project desiring to develop a theory of justice or reconciliation within a world of interconnectedness and what Bennett terms *distributive agency*. In light of these interests in the realm of ethics, I will discuss in more detail Bennet's distributive agency and a part of the work that I felt lacked, in which she re-establishes the hierarchy of human>object that she worked to break down.

For me, Bennet's notion of distributive agency emerges in part from Adorno's nonidentity, the inherent distance between humans and the world (or more broadly, the distance between all actants). It also is created in a component of the vital force of matter: *efficacy*, "to affect and be affected" by other actants (32). I see efficacy and non-identity come together to create an agency that is distributed, in degrees, among actants, according to the degrees to which they are disconnected or connected. As actants move and act and react, behavior emerges. The notion of the cause is moved away from and toward a more-non-causal, plural *origin* (33). The state of things that moves against eachother to create particular micro-politics from which phenomena emerge borrows from Jullien's *Propensity of Things* the concept of *shi*, which means something like context-state-power-potential (35). The friction and minute changes in the *shi* of an assemblage is what distinguishes a functional grid from a blacked-out one, or an office at noon from an office at 4:00 PM, each one allowing different emergent behavior.

The idea of distributive agency gives rise to the question of responsibility. Bennett certainly recognizes that distributed agency distributes and attenuates responsibility as well, though she says it does not trouble it to the point of being unintelligible (37). Distributive agency's expansion of potential sites for moral blame is, in her view, good in that it generates a better opportunity for corrective (just?) action. Ultimately, that distributive agency lessens the blow of moralism is considered (by both her and myself) a good thing. It can guard against retributivism and the tired moral outrage cycle that only accomplishes the propagation of anger.

I further wonder what distributive agency could imply for a reconsideration of justice. For example, distributed agency seems to give a new opportunity for empathy, distributing not only responsibility but also victimhood. I also wonder the implications of capacity on the distributed agency construct: Bennett says that one of the lines by which agency is distributed is by actants' capacity to act and their power. Especially in a context of disability studies, agency attenuated in proportion to capacity seems that it could be de-humanizing and remove agency from certain (human) actants while conferring it upon (nonhuman) ones. While we see already this possibility in the so-called "insanity defense" in criminal courts, this reconstruction of agency is dangerous in its promise to further de-agent certain actants who are already politically disempowered.

This question came up again for me again toward the end of the book, when Bennett shows that an expanded notion of politics to include nonhuman actants is not necessarily fair to those actants.

> While every public may be an ecosystem, not every ecosystem is democratic. And I cannot envision any polity so egalitarian that important human needs, such as health or survival, would not take priority.… My conatus will not let me 'horizonatlize' the world completely. I also identify with members of my species.… The political goal of a vital materialism is not the perfect equality of actants, but a polity with more channels of communication between members (104).

I'm frankly amazed that Bennett wrote this, for it seems to fly in the face of so much that she wrote so far (I'm sure other readers who were excitedly following along were disappointed by this as well). However, we see the origins of this idea in the earlier tie-up of capacity for action and degree of agency. It's clear that a lack of capacity or perceived importance, especially for nonhuman actants, would disqualify them from having their "voice" heard in a political process and so likely justify a further removal of their agential capacity. I can't help but relate the process proposed to the question raised so well by *Blade Runner: 2049*, 'Can one 'enslave' a tool (*e.g.* a replicant)?' Frames that recognize robots and other objects as less-that-human or otherwise diminished actants certainly will work against an ethic of care for *all* objects and certain groups of humans. It seems the polity of Bennett's more-than-human world ends up just as unjust and undemocratic as it is bound to be.

Yet I'm unsure of a way out of this bind, because the solution of "just give full rights to all objects" seems to miss the mark as well, potentially because doing so would create new political hierarchies related to other qualities. Somehow, it seems that the empowering of objects is disempowering to people, as one of my friends warned me when I discussed "enslaving robots" with her. Doing so denies the real (human) struggle and historical reality of slavery in two ways: by positioning slavery as an unknown future (not my point here), and by echoing repugnant justifications for slavery that gave enslaved people the status of a sub-human object. Perhaps the central issue is the lingering hunch that objects are still sub-human, and that emphasizing an ethic of care toward objects would remove this stigma. However, this chicken-and-egg problem seems unlikely to be resolved in the forseeable future. Perhaps I, like Bennett, should resign to the inherent inequality of future imaginaries.

Haraway and the myth of original unity (A Manifesto for Cyborgs)
Reading memo for Advanced Social Theory | December 2018

In Donna Haraway's classic text "A Manifesto for Cyborgs" (1985), she explores the difficulty of thinking about/with a human subject when 1) "the boundary between human and animal is thoroughly breached, and 2) the "leaky distinction … between animal-human (organism) and machine." There are two main theoretical groups that the essay intends to challenge: 'Marxist feminism' and 'radical feminism', both for their latent essentialism. Marxist feminism for the essentialization of 'labor' and its relation to the human subject, and radical feminism for its essentialization of 'woman'.

I'm in part interested in the work that this essentialism does for each camp. I see each essentialism as enabling a particular type of critique of oppression, both economic and sexual. The argument, to some degree, is the same. "We" have been formed by "them" through the process of [economic exploitation and labor alienation/sexual violence]. If we want redress, we must theorize that formation.

Haraway rejects this logic in favor of refusing the formation of "us" in favor of an ontology of our present being as cyborg. Cyborgs are partially connected and interrelated, without fixed boundaries. Their politics depends not on some "original unity" or violation of that unity, but on what they want *now*, and how their connections enable and constrain that. Cyborgs are still victims of injustice through their various relationships, but they should make use of those oppressive relationships—reappropriate them, reconfigure them, using what Chela Sandoval (1995) called the methodology of the oppressed via "technologies of power"—in re-scripting them toward liberation.

I think that Haraway's position in this essay is in fact an extreme version of her own, which she has explicated over the course of her later books. For example, I think that the Cyborg Manifesto Haraway is concerned with history only insofar as it enables or constrains present politics. Compare to her position in the later essay "Situated Knowledges" (1988), in which she claims "My problem, and 'our' problem, is how to have *simultaneously* an account for all knowledge claims and knowing subjects, a critical practice for recognizing our own 'semiotic' technologies for making meanings, *and* a no-nonsense commitment to faithful accounts of a 'real' world." The pragmatism of this statement is familiar to readers of the *Manifesto*, but its insistence on historicity and 'reality' may seem foreign to a reader familiar with a refusal of origin. What unifies the accounts is an underlying set of political goals: toward "finite freedom, adequate material abundance," etc. Similarly, we can compare her position to the positions put forward in her recent books, *When Species Meet* (Haraway 2008) and *Staying With the Trouble* (Haraway 2016), which emphasize interrelationships as a basis for both ontology and politics, while making more accounting of the formation of those relationships.

How does the social model of disability aid or inhibit intersectional analysis? How can disability studies' models of disability be informed by intersectional feminist analysis?

Disability, Society, and Technology Unit 1 Reflection | 2019-02-12

The social model of disability is a commonly used framework for describing the condition of disability, arising from a central claim that *disability is socially produced*. Perhaps, it would be more accurate to discuss the social *models* of disability, considering that the social model has never been a singular representation, but rather a family of representations and theorizations on how disability is socially produced, what disability is, how "social model" understandings differ from other representations of disability, and the relationship between disability and lived experience.

Questions of how social models of disability consider other types of oppression have long been central to discussions of the social model of disability. For example, in one of the first "canonical" articulations of a social model of disability, by the UK's Union of the Physically Impaired Against Segregation (UPIAS), intersections with other types of oppression are alluded to, although analysis of those other types of oppression are not centrally featured:

> "Disability is a situation, caused by social conditions, which requires for its elimination (a) *that no one aspect such as incomes, mobility or institutions is treated in isolation*, (b) that disabled people should, with the advice and help of others, assume control over their own lives, and (c) that professionals, experts and others who seek to help must be committed to promoting such control by disabled people. […] In our view, it is society which disables physically impaired people. Disability is something imposed on top of our impairments, by the way we are unnecessarily isolated and excluded from full participation in society. Disabled people are therefore *an* oppressed group in society. It follows from this analysis that […] *poverty is one symptom of our oppression, but it is not the cause*." (Union of the Physically Impaired Against Segregation and the Disability Alliance 1975, 3–4 [emphasis added]).

In this passage, we both see that UPIAS's social model (at least, as articulated here) is likely concerned with other types of oppression, but analytically and ontologically subordinates them to the general oppression of disabled people. It states that issues are interconnected and cannot be "treated in isolation," but the political question—*what is to be done?*—is left

untouched. Furthermore, UPIAS's model leaves unanalyzed is how "poverty is a symptom" that affects different disabled people in different ways, how "aspects" of the oppression of disabled people are interrelated, and it denies the possibility that other forms of oppression can themselves participate in the production of disability. Of course, UPIAS's use of this social model can and should be thought of in primarily political terms, as an "oppositional device" to position their analysis of disability against the implicit/explicit understandings of disability found in other groups (Beckett and Campbell 2015). Yet the analytical gaps leave a lot to be desired for both analysis of disability in its diverse formations and coalitional political projects.

Tom Shakespeare and Nicholas Watson note the political and analytical difficulties of "unreflexive" social models in their article "The Social Model of Disability: An Outdated Ideology?". They note that the contemporary reality of both disability and identity politics makes it difficult for people to identify as disabled, especially when they are pulled into other, "more salient" identities (20–21).

> "Social model perspectives have not proved very effective in reconciling the dimensions of gender, race and sexuality within or alongside disability. Most people are simultaneously situated in a range of subject positions. To assume that disability will always be the key to their identity is to recapitulate the error made by the medical model perspective who define people by their impairment. […] Identity cannot be straightforwardly read off any more." (Shakespeare and Watson 2001, 21)

Shakespeare and Watson, along with other theorists like Bill Hughes and Kevin Paterson, have in part located these political issues within what they see as a central flaw in the social model itself, its apparent refusal to attend to particular bodies and situations, and more generally to the social nature of *impairment* (Hughes and Paterson 1997). These authors have called for an expanded social model that includes a theorization of impairment as itself socially and historically produced, understood in relationship to disability, not in contrast to it or merely forming the material basis of it.

However, the notion that contemporary politics demands individuals adopt one identity or another adopts a certain *comparative* perspective (*i.e.*, by asking "what are the political implications of identifying as a woman or as disabled?"), or perhaps considers identities as *hierarchical* (*i.e.*, by recognizing that both the categories of woman and disabled experience oppression, but that one is truly the 'source' oppression) or *additive* (*i.e.*, that both the categories of woman and disabled experience oppression, and that these oppressions compound to an even worse subject position). Each of these perspectives is specifically warned against by various critical race feminists (Erevelles and Minear 2013, 355–57), notably Kimberlé Williams Crenshaw, who coined the analytical term *intersectionality* in contrast to them (2008). The notion of intersectionality was generated to analytically and politically respond to a very particular problem common to many types of identity politics: that articulating the experiences of a group tends to ignore variation within that group:

> The need to split one's political energies between two sometimes-opposing groups is a dimension of intersectional disempowerment which men of color and white women seldom confront. Indeed, their specific raced and gendered experiences, although intersectional, often define as well as confine the interests of the entire group. For example, racism as experienced by people of color who are of a particular gender—male—tends to determine the parameters of antiracist strategies, just as sexism as experienced by women who are of a particular race—white—tends to ground the women's movement. The problem is not simply that both discourses fail women of color by not acknowledging the "additional" issue of race or of patriarchy but, rather, that the discourses are often inadequate even to the discrete tasks of articulating the full dimensions of racism and sexism. (Crenshaw 2008, 282)

This problem of eliminating difference within a category because of latent aspects of other forms of oppression at work within a single group are certainly apparent in the case of disability. Claims such as "ableism is an umbrella ism for other isms such as racism, sexism, …" (Wolbring 2008, 253) serves to reduce the ways in which these other "isms" are in fact co-constituted alongside ableism, and the particular ways that they intersect with it. Crenshaw's concern in the above quote indicates a substantially different type of concern from Shakespeare and Watson: while they are concerned that it is difficult for black disabled women to identify as

disabled because of an external political reality that demands singular identifications, Crenshaw instead indicates that it is difficult for the same woman to identify as disabled because of the ways that the class "disabled" is constructed from the experiences of white disabled people, and disabled men—an internal politics with its own complex constructions.

Despite this difficulty, to claim that the developing social model of disability was unaware of the potential homogenizing effect of the identification of a unified analytical category ("disabled") would be to ignore its own past. Indeed, I would argue that attention to the intersection of *class* and *disability* has always been central to various articulations of the social model of disability. For example, Oliver's (1990) articulation of "the cultural production of disability" centers how the emergence of contemporary disability categories happens because of changing modes of production, but also notes that contemporary disability politics are marked by class differences among disabled people (122). This attention to class is almost certainly due to the social model's Marxist roots, but also because of the enduring way that relations of production have figured in producing disability.[40] One must ask why social models like Oliver's have been so adept at analyzing the intra-categorical classed differences within disability, yet have generally failed to adequately account for intersections with gender, race, or sexuality.

Shakespeare and others' theoretical interventions to "expand" the social model of disability certainly aids intersectional analysis. Attention to the social construction of *impairment*, as discussed earlier, can clearly aid intersectional analysis in that it helps attend to

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40. Someone seeking to explain the social model's use of class might say that class is a "difference that makes a difference," to borrow Gregory Bateson's turn of phrase. And it certainly is—but what of these other differences?

the material realities imposed on different people in different conditions. For example, Nirmalla Erevelles in "The Color of Violence" identifies how imperialist wars uniquely produce disabled bodies through the logics of racism, and colonialism, how actual or potential disabilities have unique effects for the lives of third world women, and how all of these different systems can be understood through a lens of "imperialism as the new eugenics" (Erevelles 2011). At every corner of the global imperialist landscape are disabled and nondisabled women and men who are variably racialized; each of these people has new and specific expectations of relationships to ability and disability. The violence is both "material" and "representational"—that is, in the social model idiom, producing both impairment and disability. Though this mapping between Erevelles' analysis and the social model of disability is certainly imperfect, the examples she gives are striking examples of how material-discursive practices of war-making produce the physical realities of disability, race, and gender, as well as the oppression based upon those realities. In other words, her work is a potential example of how a "sociology of impairment" can enhance a "social model of disability" analysis to be attentive to these intersecting oppressions.

Though a fairly successful intersectional analysis, we should not allow this example to completely exonerate the social model of disability from its potential problems in masking difference. In another article, Erevelles and Andrea Minear recount a harrowing story of "Cassie," a young black girl labeled with a mental disability, through which they begin to analyze the specific evolving intersections of intellectual disability, race, class, and gender (2013). In this story, it is in fact educators' understanding of *disability as social condition* that plays a key role in Cassie's ongoing oppression; because they understand the instability of disability categories, and the social implications of them, they "fearfully sought the protection of the label 'mental retardation'—a label that would justify her incarceration at the tender age of

five years old and continue to support her social isolation" (365). Part of the function of this

particular intersection (of a social model of disability and race) was in its use to hide the

particular violence that was done to Cassie, through a discourse of 'benevolence.' The case of

how these educators made use of their tacit (social) understandings of disability gives us a sharp

edge to be wary of; not only that our models may *inhibit analysis*, but may themselves enable

harm in unexpected ways.

Approaching Ableism in the Infrastructures of a Polytechnic Institute: Stairs, Professional Histories, Dis/Abilities, and RPI

Or, notes toward a critique of ableism in the history of engineering

Disability, Society, and Technology Final Paper | 2019-04-29

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Making an engineer out of them: bodies in engineering education.

My research into the intersection of ability and engineering education can perhaps be framed in terms of this question—what does it mean to "make an engineer out of" a student? How do universities provide this shaping through certain infrastructural interventions physical, traditional, and curricular? As I intend to express, this story has evolved over time. In the late 19th and early 20th centuries, an engineer was expected to be supremely capable in mental, physical, and technical capacities. As a result, difficulties in education were understood with a 'what doesn't kill you makes you stronger' attitude—either difficulties would help an engineer-in-training progress, or they would prove that he simply wasn't cut out for the profession. There simply wasn't *room* for engineers that somehow proved insufficient, which apparently excluded engineers-to-be with physical or mental disabilities by default.

Over time, as the nature of engineering work changed, engineering became increasingly professionalized, and "abstract" fields became more valued (Hacker 1981), the emphasis on physical capability *seemingly* disappeared. This coincided nicely with the passage of Section 504 in the 1973 and the Americans with Disabilities Act in 1990, both of which substantially encouraged educational institutions to integrate and accommodate disabled students. However, this isn't merely a story of social progress toward total acceptance of disabled persons in

engineering education. This is, in part, because many of the ableist *infrastructures* remained, though perhaps with contemporary tweaks and novel meanings.[41]

In my pursuit of this question—what does it mean to make an engineer out of a student?—I seek to, in the words of Fiona Kumari Campbell and Dan Goodley, "stalk ableism" while "contesting disablism " (Goodley 2014, x). The story of ability, disability, and engineering education is one that's hardly begun to be excavated, but I have here a few starting threads. Through this paper, I look specifically at the Rensselaer's Broadway Approach as a focusing artifact to ground the various pieces, which functions as a multi-faceted manifestation of several, shifting understandings and aspirations of access and ability.

As a point of entry, consider this passage, written by Benjamin Franklin Greene, Director of the Institute, in 1855, describing substantial curricular changes he had instituted:

> In connection with the large amount of technical study which enters into the Curriculum of a Polytechnic Institute, there is associated the feature of nearly continuous daily practice in some kind of sensuous discipline—discipline of the senses. Each student undergoes an almost daily drill in a class of exercises which, besides tending to secure a high degree of muscular training, in all that belongs to facility and precision of manipulation, are of a nature, by their direct appeal to the senses, to contribute to a largely increased command of sensuous power,—in quickness and accuracy of sight,—in delicacy of touch, etc. (Greene 1855, 36)

Greene's attitude reflected and expanded an embodied sensibility that was built into the school from its founding. Although Greene's 1850 reform of the Rensselaer school to a "true" polytechnic institute, […] it did not fundamentally do away with the "exercises" that formed a core part of Rensselaer's curriculum. Consider this passage, written in a Rensselaer promotional pamphlet in the early years of the school (c. 1825–1830):

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41. One such example of it *seemingly* having disappeared is a remark from the first Specialist for the Handicapped, Rita Star, who said "Some impairments do not allow for all courses. A blind student could not become an architect, for example" (Mike Chou, "Office aids handicapped," *The Rensselaer Polytechnic*, Dec. 8, 1982, 5). Certain assumptions about necessary ability continued to be smuggled in.

> Corporal exercise is not only necessary for the health of students, but for qualifying them for the business of life. When such exercises are chosen by students they are not always judiciously selected. Such exercises as running, jumping, climbing, scuffling, and the like are calculated to detract from that dignity of deportment which becomes a man of science. Therefore a system of exercises is adopted at this school which, while it improves the health, also improves the mind and excludes those vulgarisms which are too often rendered habitual among students. Such exercises as land surveying, general engineering, collecting and preserving specimens in botany, mineralogy and zoology, examining workshops and factories, […] etc., are made the duties of students for a stated number of hours on each day. (quoted in Ricketts 1934, 43)

These exercises were clearly conceived of as "exercise" in *multiple* senses of the word—as activities that required physical and mental exertion, as activities to develop skills, and as activities to develop physical and mental fitness. At Rensselaer's founding, these exercises made up the majority of the student's education and lecture-based instruction only occurred when students instructed one another. By 1850, practical exercises had been reduced in favor of direct instruction in different technical areas, but were still clearly present. Over the years, these exercises diminished, but the institute's insistence on a) practical training and b) physical and mental fitness continued. Even into the twentieth century, we see institutional moves toward the physical training of students, for example, the 1912 institution of compulsory athletics for first-year students.[42] However, we see a trend from the school's founding in 1824 to the early twentieth century a gradual *decrease* in the school's formal emphasis on fitness and toward more informal structures. […]

It is clear from how one older alumnus describes his recent climb up the Approach[43] that in his youth, climbing the staircase functioned as a similar kind of physical discipline, which I posit was, intentionally or not, one of the purposes of the Approach. Surely climbing the steps

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42. "Institute Notes," *The Rensselaer Polytechnic*, June 1, 1912, 240.

43. Dan Howley, "At 96 Years, He Approaches the Approach in Tribute," The Times Union, March 28, 2000.

was viewed as physically strenuous, but the disciplining practice would have been taken in a more-or-less positive light by Rensselaer students. Throughout the 20th century, and continuing to today, RPI students took pride in their physical and mental hardships.[44]

Why did this pride in disciplining practices, and the practices themselves, come into the mainstream of engineering education, and why does it persist? Techniques of the body have not been adequately discussed in histories of engineering education, but there are a few starting points. Feminist engineering studies has examined certain processes central to the hegemonic *masculinity* of engineering. For example, Edwin Rap and Maria Teresa Oré identify ten "cultural infrastructure and performative repertoires" that promote and enforce engineering masculinity. Included in these infrastructures are rites of passage like hazing and fieldwork; oral histories and symbolic orders that emphasize 'great men', prestige, and professional mystique; a framing of technology and infrastructure as mastery over nature and a source of "pride, power, and pleasure in engineering"; hierarchical social organization; and physical campuses that promote certain academic activities, are separate from their communities, and are inhabited by an exclusive group (of students, faculty, *etc.*) (Rap and Oré 2017).

As Rap and Oré describe them, these infrastructures of engineering masculinity are all interrelated with another one: "disciplinary and normative pressures to establish and conform to heterosexual identities and gendered hierarchies " (2017, 99). Their framework of interrelated infrastructures of masculinity provides an account of how such disciplinary structures are reproduced. However, their analysis does not explicitly identify how *ability* is constructed within

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44. See, for example, the trans-temporal comraderie at RPI over the "'Tute Screw," the "Meanest Man on Campus" or the "Ugliest Mug" competitions—RPI students seem to take pleasure in being beaten down by their school.

and alongside heterosexuality and masculinity. McRuer's notion of "compulsory able-bodiedness" provides a way to analyze the ways these infrastructures of masculinity as not only sexist and heterosexist, but *ableist* (2006). By reading disciplinary practices as, in part, related to the cultural reproduction of masculinity and able-bodiedness, we can explain part of their persistence as due to engineering's core myths: of mastery over nature, of upward mobility in social hierarchies, and of pleasure in technological use. Identifying the source of these myths, then, is one of the places we can find the source of pride in discipline of the engineer's body/mind.

Yet this explanation does not seriously interrogate the *source* of these disciplining practices, or why Greene viewed the embodied aspects of technical training with such importance. To understand this, it is (perhaps unexpectedly) helpful to compare Greene's vision of technical training with more current accounts. ABET's "EC 2000" accreditation criteria was in many ways a turning point in American engineering education, and provides one articulation of what engineering educators of 1996 considered important and what they considered missing from engineering education at that time. EC 2000 shifted focus from particular educational structures to educational outcomes and assessment, and demanded that graduates of engineering programs have certain *abilities*: among others, to apply scientific knowledge, to conduct experiments and analyze data, to design systems and components, and work on teams (Lattuca, Terenzini, and Volkwein 2006). The emphasis on professional skill-building was notably a shift away from, but in conversation with, 20th-century emphasis on fundamental scientific and mathematical knowledge (Akera 2017).

Why were engineering educators in 1996 seemingly calling for similar changes in technical education as Benjamin Franklin Greene championed in 1855, albeit for skills

articulated in relation to the engineering *profession* in general, and not the *body*? The history of engineering in the interceding years is informative for this question. There were two important trends that I will emphasize here: first, the development of increasingly abstract technical fields, and second, the expansion of hierarchies in the technical workplace that saw engineers distance themselves from "manual" workers.

Greene's curricular reform of 1850 saw a refocusing of technical education at Rensselaer from a focus on disseminating scientific knowledge for farmers and mechanics toward the education of engineers and architects. Although the course in Civil Engineering had been established by 1835, it was not until Greene's reforms that a "modern" Civil Engineering program was implemented. Following Greene's vision of a "true" polytechnic teaching "many techniques," the years afterward saw experimentation with new degree programs including topographical engineering, land surveying, mechanical engineering, and mining engineering, all of which were discontinued at various points before 1907, when the rapid expansion of the engineering field demanded that technical courses be specialized (lest the catch-all Civil Engineering degree last nine years). This specialization split the course in engineering and science, added new areas, and provided opportunities for post-graduate specialization. […] This specialization also saw an increase in the "core" classes students would take, establishing more or less the canonical emphasis on basic science instruction before "practical" specialized courses. This responded to the demands of industry (sometimes, actively following or actively eschewing them), as ever-complex technical projects required specialized knowledge that apparently could not be gained on the job (Noble 1977).

This proliferation of specialized knowledges went hand-in-hand with the huge growth of the number of engineers and the professionalization of the field of engineering, with the core

professional societies being formed from 1852–1908 (Noble 1977, 35–36). The early years of

professionalization were marked by a split between "shop culture" and "school culture." This

split initially mirrored an internal division among practicing engineers of those who (for

example) were trained mechanics elevated to the status of "mechanical engineer," and those who

received a degree in "mechanical engineering" from a school like Rensselaer. This division

lasted well into the twentieth century, but slowly came to exist more as an internalized conflict

for practicing engineers striving to distinguish themselves from "manual" laborers on the shop

floor while also maintaining practical skills and a sense of "real" know-how. Robert Zussman

describes this split, in part, as class conflict playing out with engineers in the middle. As

individual engineers' work increasingly involved planning single parts of larger systems

manufactured in outside shops, engineers came to be neither squarely managers nor laborers, but

occupied a space in-between. This was driven by trends toward articulating a professional

identity, engineering narratives of upward class mobility, and the increasingly precise nature of

engineering work (Zussman 1985).

These two changes meant that by the end of the twentieth century, engineers could safely

proliferate the myth that engineering was primarily a *mental* task, unencumbered by bodies. Yet

the myth was always unsettled, due to professional histories of times when 'engineers did

things,' recruitment from practical fields and of young people with hands-on technical

experiences, and a latent narrative of engineers as the apotheosis of *homo faber*.[45] It was *this*

conflict that we can understand EC 2000 as attempting to resolve: between narratives of

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45. Of course, this belief was occasionally made more explicit. See, *e.g.*, (Florman 1994).

specialized, scientific work of the mind and latent individual and cultural desires of engineers to be more hands-on.[46] We should take note but not be surprised that the body of the engineer was only brought back into discourse by virtue of their *ability*; indeed, ability was always a salient organizing concept in engineering.

Despite the increasing prevalence of "mental labor" in engineering in the 20th century, there is another way in which bodies demanded to be seen; primarily when they led to a breakdown of normal working conditions. The "primarily mental" work of an office engineer still occurs through a body in ways that support the possibility of "mental" labor. There are daily tasks that go unmentioned but are nonetheless crucial to typical engineering work: shifting in one's chair, going to the bathroom, typing on a computer, reading a memo, speaking to a co-worker, and participating in meetings are all typical activities that depend on bodies. It is only through one's inability to perform these tasks as prescribed that the essentiality of the body for "mental" work comes into focus. Therefore, the bodies of engineers often only become visible when there is a breakdown in normal relations, what John Law and Ingunn Moser have called "bad passages" (Law and Moser 1999). It is in the lack of women's restrooms in an office, or black engineers' coming up against the racialized ruling relations of a space (Bix 2004; Pawley 2019; Wharton 1992; Slaton 2010), that non-normative bodies are materialized in the engineering workplace. The *disabled* engineer, unlike the able-bodied engineer, is *always* visibly embodied, through their regular transgression of "species-typical boundaries" (Wolbring 2008) (though in this case, we might even say "*profession*-typical boundaries") which substantially

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46. Whether or not EC 2000 *adequately* responded to this crisis of the missing body is a discussion for another time.

modifies their daily experiences. It is in this way that both physical and mental disabilities come to matter in the 'mental' occupations which promise equal opportunity for all.

This is not to say that the increasingly "mental" nature of engineering work has not enabled more disabled persons to become engineers. Rather, it is that a simple narrative of progress toward "accessible workplaces" must be abandoned in favor of a more nuanced understanding of access and disabled bodies.

We have now seen one of the ways in which bodies came to matter on Rensselaer's campus and engineering more broadly. As a lasting artifact from the early days of engineering specialization, the Approach certainly played into and was differentially constructed by these shifting professional identities and the latent belief that a physically capable body was important for practicing engineering. How else was ability articulated in engineering?

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Queer(y)-ing Technical Practice: Queer Experiences in Student Theater Productions at a Technical University

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Abstract: This pilot study presents a potentially novel way to consider gender and sexual diversity in STEM by attempting to identify sociotechnical practices which might be considered "queer" in a broad sense—by being of, by, for, or regarding queer people—and by seeking to understand how these practices might challenge and complement other technical practice and education. To explore these questions, I conducted participant-observation fieldwork at a student-run theater organization at a mid-sized technical university, identified by students as "outstandingly queer" for both its increased proportion of LGBTQ+ students and its notably welcoming attitude toward them. From examining student-run practices across technical theater, acting, directing, and organizational management, I find that the practices of *identity negotiation*, *performance*, and *flexible democratic decision-making*, situated in an alternative technical-social space, are sociotechnical practices with a queer inflection important to the site. These can help engineering educators in three ways: 1) by simply providing a description of some meaningful sociotechnical experiences of queer students; 2) by beginning to bridge the "diversity-oriented" and "technically oriented" streams in engineering education research through considering how queer STEM students are innovative technologists in their own right; and 3) by contributing to the body of useful cases for potential changes to the sociotechnical environment of engineering education. This paper presents these practices, as well as the role of *in/authenticity*, as some salient aspects of queer student experience as I observed it.

Introduction

In recent years, some attention has been given to diversifying STEM institutions, workplaces, and cultures in respect to sexual and gender minorities (NOGLSTP n.d.). In practice, this is often considered as a matter of increasing the number of lesbian, gay, bisexual, transgender, and queer (LGBTQ+) individuals—hereafter, queer persons[47]—in these contexts, and improving support for them. Though these goals remain important, the associated approaches to diversification run the risk of tokenizing the participation of already-marginalized queer persons. To avoid tokenization, research has tried to describe the lived experiences of queer STEM students and practitioners so that harm can be systematically identified and responded to. That work has identified a decidedly "chilly climate" toward queer people in STEM fields, and a need to explore how STEM fields might demonstrate increased understanding of and respect for queer persons and their experiences (Brinkworth 2016; Cech, Waidzunas, and Farrell 2016). This present study presents yet another way to consider diversity in STEM, by attempting to identify technical practice that might be considered "queer" in a broad sense—by being of, by, for, or regarding queer persons—and by understanding how these practices might challenge, recapitulate, and complement "non-queer" technical practices and education.

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47. Although no students identified this concern at my site, I would like to briefly acknowledge some heterosexual trans persons' objections to being labelled "queer." Beyond major qualitative differences in experiences, the grouping of LGB and trans persons can be problematic especially for certain histories of trans exclusion and transmisogyny in the LGB community and a widespread misconception that trans identities are rooted in 'deviant' sexualities. Despite these problems, queer studies and transgender studies have historically been related, if non-parallel, traditions within the academy. To reflect this tension, I have chosen in this paper to critically employ "queer" as a term to include trans individuals in a broad heterogeneous grouping, in part because the terms "*queer* and *transgender* are linked in their activist investments, their dissident methodologies, and their critical interrogation of and resistance to gender and sexual norms" (Love 2014, 172). Future work must seek to better understand specifically the experiences of trans students, both to attend to their specific difficulties and to broaden and nuance research on gender and engineering education (Haverkamp 2018).

In this paper, *queer* is employed to simultaneously and variably be understood as an umbrella term for LGBTQ+ people; as a descriptor for their experiences or cultures; as an adjective meaning 'odd' or 'unknown'; as a reference to queer theory/queer commentary, a theoretical tradition about breaking binaries and boundaries (Berlant and Warner 1995); and as an often-used verb in that tradition, "to queer": to make like or become one of these meanings. The term is historically a slur against LGBTQ+ people, but through its engagements in activism and the academy, has undergone a sort of reclamation toward its more critical usage employed here. *Queer*, as I use it, refers to people, experiences, and processes, and is intended as an empowering term for bringing together these disparate parts under a common heading.

To explore these questions, I conducted participant-observation fieldwork at the University Dramatic Society, a student-run theater organization of about 100 students in a mid-size technical university over the course of multiple productions and several months. This site was selected for its significantly increased proportion of queer students over the university as a whole, its situation within a university of primarily engineering and science students, and the diversity of technical, social, and artistic practices involved in theatrical production. Dissatisfied by the content of "standard" technical practice[48] and its tendency to reproduce old systems of social control and inequality (Riley 2008; Blue, Levine, and Nieusma 2014), I approached my site asking thematically, **"What might a *queer* technical practice be?"** a question I hoped both

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48. I recognize that my usage of a "standard" technical practice throughout this paper is itself distinctly binary and perhaps uncritical. Indeed, the content of "standard" technical practice, its instability, and its internal and external contestations are central to the question of "queer" technical practice. Nevertheless, I make use of it as shorthand indicating technique characterized by "hard science," technical rationality, rigor, and a strictly enforced division between social and technical domains—recognizing that no actual site fully embodies such a characterization.

novel and potentially liberatory for queer engineering students. I broke this into two questions that focused my fieldwork: **1) how do STEM students practice and learn technique at the site,** and **2) how does queerness, in the broadest sense, intersect with these practices of technique?** Although this paper does not analyze or discuss most of the diverse technical learning practices I observed (that is, fully respond to the first question), engaging with the complete diversity of technique at the site was of vital importance to the analysis presented.

Of course, this work builds from an assumption that there might indeed be "queer" technical practices that are worth identifying and learning about. Far from using this hypothetical category to essentialize "queer" as a personal or organizational identity that reliably modulates "non-queer" technical practice into a genre of technique that educators can systematically describe and reverse-engineer into "improved" technical education, I envision the category as a provocation to the positionality of queer engineering students as outside-insiders, and to the notion that "queerness" and "technicity" have nothing to do with one another, either because they are opposed or because they operate in totally separate spheres. To assume that queer technical practices exist is to claim simultaneously that queer technicians have unique positionality in technical spaces, that they have experiences of oppression and joy that are at least partially unknown to non-queer technicians, that those experiences may result in changes to how they approach sociotechnical work, and that those differences of experience and approach are not only acceptable in but could *belong* in technical work—claims that I wholeheartedly adopt.

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Methods

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Literature Review

The traditions of queer theory, especially in its intersection with disability studies and manifestation as "crip theory," have demonstrated the prevalence of compulsory efficiency, heterosexuality, cissexuality, and ability in society at large (McRuer 2006). Queer theory has further indicated that these imperatives construct binaries, and are constructed as a response from powerful actors to perceived threats based on naturally occurring difference, a reactionary political move intended to maintain power relations or revert them to a more hierarchical past (Sedgwick 1990). Looking to engineering studies, Donna Riley and other members of the Liberal Education/Engineering and Society division of ASEE have demonstrated that similar imperatives are created in the mainstream of engineering, likely as a result of the militaristic origin and continuing reality of engineering employment, though they promisingly note that it does not have to be so (Riley 2008; Blue, Levine, and Nieusma 2014; Lucena 2013).

A useful theoretical distinction that I make use of in this analysis is the one between *performance* and *performativity*. An analytical focus on *performance* foregrounds the actions of artists and other actors in the limelight (*e.g.*, a professor lecturing or a doctor *performing* a diagnosis). The notion of *performativity*, on the other hand, interrogates where performances stop being "showings" and become "becomings"—*e.g.*, the utterance "I do" at a wedding—acts that both describe and enact a situation (Salter, Burri, and Dumit 2017). In the social life of the Dramatic Society, Dramatists certainly *perform* queerness, but in so doing, they work out what queerness *means* and bring about that meaning.

This present study is positioned in conversation with engineering education research, which, in my view, has two major areas: studying how best to teach/learn engineering, and studying how to increase diversity in engineering institutions. Other researchers have attempted to bring together these two areas, for example, by identifying technical problems likely to be

relevant to a broad group of people (Klotz et al. 2014), or by describing particular

epistemological barriers dominant technical education presents to some groups (Cech et al.

2017). By focusing on "queer" technical practice, this paper seeks to provide another vector of

connection between the two areas, by explicitly considering how practices originating from

gender and sexual diversity may have implications for more "technical" engineering education.

Within engineering education, this work builds upon the insights generated by previous

scholars analyzing the experiences of queer students and faculty in engineering educational

contexts. For example, Leyva, Massa, and Battey's 2016 literature review (Leyva, Massa, and

Battey 2016) demonstrated how the social/technical divide and its resulting division of labor that

Wendy Faulkner had previously identified as influential in structuring womens' experiences

(Faulkner 2000b) similarly affects the experiences of LGBTQ+ engineers. The work of Erin

Cech, Tom Waidzunas, and Stephanie Farrell has also been informative in locating the sources of

queer engineers' oppression: from an association of homosexuality with technical incompetence

and the additional labor queer students must do to fit into a heterosexual environment (Cech and

Waidzunas 2009); to the depoliticization of engineering education (Cech 2013); to the more

structural aspects of institutional (non)support for queer students (Cech, Waidzunas, and Farrell

2016). These sources of oppression and their results have been documented widely across

institutional contexts, revealing that they are deeply a part of engineering culture (Cech,

Waidzunas, and Farrell 2017).

This present work is also similar in site and scope to a 2018 paper by David DiBiasio,

Kristin Boudreau, and Paula Quinn (DiBiasio, Boudreau, and Quinn 2018). These authors

examined theatrical experiences as Worcester Polytechnic Institute (WPI) as a part of the

school's humanities capstone program, especially including experiences around a recent

showcase of LGBTQ+-themed plays at the university. Their paper began from and substantiated the same starting point as this present study: that theater experiences at a technical university provide a space that supports a "culture of inclusivity." However, their study focused primarily on showing how WPI's theater program contributes to such a culture and focuses on implications for liberal education, while this present one is more provocative in stance, asking how the University Dramatic Society that I study could inform sociotechnical practice more broadly. Furthermore, the papers diverge in methodology: while DiBiasio and colleagues began from survey results and developed interview questions to explore themes more in-depth, this present study begins from an ethnographic account of student theater experiences, supplementing with interviews as necessary. Finally, while the context DiBiasio and colleagues describe is seemingly structured primarily by student-faculty interactions, my site is entirely student-run. Despite these differences, their work provides important background for contextualizing my own.

Setting the Stage: The Barn Theatre as a "Queer Space"

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At the physical boundary between students' technical and social lives, the Barn is a liminal space that exists simultaneously as a place to relax and work, a place to be technical and artistic. Borrowing from Pola Bousiou (Bousiou 2008), I find it useful to describe the Barn as a "queer place" on three levels. On campus, it is associated with queerness (as a category for sexual and gender identity and behavior); it is distinctly atypical (that is, "queer") at the University as a student-controlled place, let alone as a place that is artistic and technical, technical and social, work and play; and it is a place with performance and performativity actively woven into the sociotechnical fabric, lending itself to a queer theoretical analysis. To summarize these levels, the Barn is *queer as in gay*, *queer as in strange*, and *queer as in*

theory.[49] In contrast to the towering academic centers that surround it, the Barn Theatre functions as a different sort of center—a *subversive* one—*sub-* for its place beneath the others, and *-verse* for its turn from the way things are.

"Oh, You're a Gay Woman with a Boyfriend Too?" Negotiating Queer Identities

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To an extent, the gendering of the groups is related to a ritual in which the director introduces new Dramatists to the two awards before curtain on opening night. The director calls out "do we have any Hams here tonight?" and all cast members who have previously been named Canned Ham step forward to perform boisterous, obnoxious one-upmanship, while the director says "if you know anybody who's like one of these people, nominate them for Canned Ham." The same happens for Blondes, only current Blondes perform stupidity and capriciousness. The self-referential structure of the groups reinforces certain cultural stereotypes. However, performing exaggerated versions of those stereotypes, along with the occasional award given "cross-gender," willfully plays with the gendering aspects of the groups. In this way, the Hams, Blondes, and the way they're selected/performed, function something like prototypical drag performances. In a "true" drag context, performers neither comfortably fit as "gender radicals" or "gender conservatives," but allow complex new gender formations to occur (Taylor

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49. Here, I am drawn to read in the infamous queer activist slogan "Queer as in fuck you!" This phrase invokes a queer politics that stands in opposition to the "homonormative" politics that focus on fitting certain sexualities into existing institutions (Sbicca 2012, 39). I am unsure how I would consider the Dramatists in relation to such political arenas, or to a radically queer ethics of the sort advocated by Edelman (2004). However, I recognize in the Dramatists an angry activist contingent, mostly evident in some Dramatists' attitudes toward University administration. This oppositional tendency is certainly an aspect of the Barn's identity as a queer space, but here I will allow it to be grouped with the atypicalities and performativities of the Barn (*queer as in strange*, *queer as in theory*) rather than give it a distinct category.

and Rupp 2004). Something like this is going on in the conferral of these awards, as their ritual includes hyper-performative versions of the kinds of masculinities and femininities common to the Dramatists, centering gender performance as a way of poking fun at them; but the process rarely explicitly engages queer gender formations, making it far less radical. Even so, as with many social processes in the Dramatic Society, the performative aspects of this practice make it an active part of cultural construction, while its negotiative aspects leave it more open to interrogation and change than it might otherwise be.

It is hard not to interpret the nomination and voting processes for these "honors societies" as institutionalized popularity contests and sites of a kind of gendered violence: in many ways, each show votes for its own prom king and queen, and deviations from gender norms are done for laughs. This perspective shows that these negotiative processes are not innocent, and in fact do particular work towards the exclusion of persons who fall too far outside of the explicitly identified in-groups. They also surely force some students to conform to structures originating outside of the Dramatists, including those based ultimately in problematic gender and sexual relations that Judith Butler refers to as the "heterosexual matrix" (Butler 2011). Furthermore, this activity depended on specific sexual relations coded as *white*, contributing to the entanglement of sexuality, gender, and race more broadly in this space.[50]

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50. This paper's failure to attend much to race regrettably mirrors the site's tendency to do the same; in part, this is because of race's absence in my research questions and my fieldwork's general inattention to the specifically racialized aspects of interaction. Hegemonic whiteness figured heavily in the constitution of the site as well as at the University more generally, but I did not have space in this work to provide this substantial discussion. My inattention to this issue is a *substantial* shortcoming of this analysis. Readers wishing to make use of this work, or otherwise explore the intersections of engineering, theater, queerness, and art, are encouraged to expand upon this direction in particular. A good starting point would be to analyze the racialized ruling relations of the space (Pawley 2019), particularly attending to how race, gender, and sexual identity intersect (Crenshaw 2008). Crucially, discussion of "the negotiation of identities" must be re-visited with an understanding of how racial

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"I'm Happy I Made it Gay": Queering Identities for the Stage and Democratic Decision-Making

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Discussion: In/Authenticity and Technical Practice

The Barn Theatre is certainly a "queer" site at the levels of its association with non-heteronormative sexualities, its multiple oddities as a student organization's building in the middle of campus, and its several ways that practices within it are amenable to a queer theoretical analysis, especially its subversion of hegemonic technical practices through an orientation to performance, its performative practices, and the value of negotiation at the limena of the Dramatists' collective defined experience (to recapitulate, *queer as in gay*, *queer as in strange*, and *queer as in theory*). However, through examining the queerness of the organization, I consistently encountered a figure, sometimes hidden, sometimes visible, of *in/authenticity* in actions, performances, and identities.

In/authenticity is a semantic figure that challenges the reader and the analyst not to consider what is or is not authentic, but rather to treat is as a political category that emerges from the field-site. When things are claimed to be authentic, inauthentic, or troubles the boundary between them, when something's authenticity is questioned, and when these categories, or the categorization itself, are mobilized for political ends, the figure of in/authenticity is present. The notion of in/authenticity is borrowed from Wendy Faulkner (Faulkner 2009b). For Faulkner, the

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identities are not allowed the same kind of flexibility, yet play a role in those identities which *are* more negotiable.

notion of *gender* in/authenticity is useful to describe the actions of women engineers and their affective relationship to their work and workplace. Her use of it is intentionally not to name what makes an action "gender authentic" or "gender inauthentic," but to better understand how authenticity is both understood by her participants and can be used to explain their experiences. As a binary, in/authenticity is a useful analytic tool to think through in a queer theoretical analysis of a case, because even when it is not present for our participants, we can ask why it is *not* as a way of understanding how to trouble or subvert the binary when it *is* present. In other words, thinking through binaries can be a mode of developing anti-essentialist theory (Haraway 1985).

At this site, the figure of in/authenticity maps onto the ways in which we can consider the Barn Theatre as a queer space and the Dramatists as a queer community. First is the question raised by the building: when one is a Dramatist, how are they being in/authentically a University student? Existing at the boundary between social and technical student spheres, the Barn is firmly a place for students to relax and prepare for the difficulties of academic life. Yet it is also a distinctly queer (*as in strange*) space: it is closed off from the general student body, its small wooden frame is dominated by giant concrete and brick buildings around it, and it functions as a technical and artistic space for both work and pleasure. Identifying the Barn as a queer space that fits uncomfortably within the social/technical binary, physically and culturally, mirrors the feelings some queer STEM students may feel when in the "chilly climate" of STEM education towards difference (Brinkworth 2016).

Second, in/authenticity is a salient figure in understanding the negotiations of identity discussed earlier. In fact, the negotiations of identity I observed can be understood as desirable ways of grappling with in/authenticity, in contrast to the pervasive heteronormativity of STEM

cultures, its historical inertia, and the physical infrastructure of the University which produce stricter notions of "correct" sexuality. In the areas of both professional and sexual identity, I suspect that in/authenticity has a similar ordering effect for queer students at the University as it can have for women in engineering. Students may ask, "how can I be both authentically queer and authentically technical?" or, "does authenticity in one area indicate inauthenticity in the other?" However, as in Faulkner's analysis (Faulkner 2009b), the recognition of in/authenticity as a salient figure in the experiences of queer students need not inscribe a new essentialism— *e.g.*, that feeling "inauthentic" is bad and feeling "authentic" is good. Rather, it becomes apparent that the strict categorization of experiences into either authentic or inauthentic ones is an ordering system that contributes to women and queer engineers' disidentifications with engineering as an identity or community.

Last, the discussion I had with Jacob and Austin about "right" and "wrong" technical/artistic practice maps onto in/authentic as well, through the questions, "is an artistic engineer being professionally in/authentic?" and "what constitutes in/authenticity in a performance?" The first of these points to the processes of professional identity-building and asks that researchers attend to the technical enculturation. The latter fits more comfortably with earlier studies of queer performance, especially an interest in "camp." Camp is celebrated inauthenticity; the notion of "camp" pulls us to recognize inauthenticity as a value in itself, or perhaps as a mark of unalienated labor value. Tinkcom suggested that camp has a potential to mark commodities as the product of queer labor, and therefore could hint at alternative values within a hegemonic, capitalist productive system (2002). However, one must wonder if to call camp production within an existing system would simply aid those already empowered, or at least be easily reconfigured by them. McRuer raises these questions in a field of increasingly

normative queerness: if queerness becomes normal, then what pleasure can remain in claiming queerness? Can queerness ever truly be normalized (2006)? *In/authenticity* re-emerges in these questions. Does the positioning of the queer as anti-essential re-inscribe a new essentialism? If the Barn Theatre is an increasingly queer (*as in gay*) space, won't at some point it cease to be queer (*as in strange*)? What does this mean for student negotiation of identities? What does it mean for positioning this "queer technical practice" as a meaningful alternative to the dominant practice?

Conclusion: Challenges and Potentials for Engineering Education

Within the above questions are important issues for scholars interested in the intersection of queerness and engineering education/engineering culture. The ways in which the Dramatists' are *queer* represent important potentials for engineering education, from their ability to trouble comfortable cultural categories, to their interrogations of gender and sexuality, to their pursuit of technical practice that subverts technical rationality (Feenberg 2017a), to their alternative democratic practice. However, the question of in/authenticity threatens to turn their unalienated labor and artistic expression to bitter alienation of the sort many students feel toward their coursework.

This paper has summarized several months of participant observation in the "queer space" of a student performance group, the University Dramatic Society. I noticed that Dramatists engaged in several activities that are meaningfully different from "standard" engineering practice. This investigation highlights the need for future research that continues to provide ethnographic accounting of queer students' lived experiences at engineering universities. It also serves as a challenge for changing engineering education: what were the structural conditions that have led to the University Dramatic Society as such a unique technical-artistic

space? What would a *queer(er) engineering education* look like (*queer as in gay*, *queer as in strange*, and *queer as in theory*)? Finally, I hope that the account has resonated with queer engineering students, who may see elements of themselves and their circles in the Dramatists' experiences.

What then, are the implications for engineering educators? As with most performances, the practices of the Dramatists are more provocative than didactic. I would hope that the relevance of the space to engineering educators would be self-evident—the fact that engineering students engage in the practices I have identified is reason enough for them to be studied and read. Yet, the Dramatists show specific considerations that engineering educators should take seriously.

First, the subversive and comfortable space of the Barn Theatre and its encouragement in the negotiation of queer identities meaningfully provided a basis for practical technique; in this case, it provided guidance on how to interpretively translate guiding texts into material reality responsive to the concerns of diverse stakeholders. Second, the critique of technical rationality that stems first from the facts of an artistic site and second from the lived experiences of queer students, *co-existing* with the production of technically successful performances, indicates that explicitly critical and/or personal analysis of technique need not compromise technical education. Third, the use of a particular democratic decision-making practice that diverges from "standard" engineering corporate hierarchies exemplifies at least one mode of social interaction conducive to technical work that does not require command-and-control relationships. And finally, the presence of the figure of in/authenticity affirms that this site, and others like it, do not have perfectly straightforward relationships to either "standard" technical practice or the teaching and learning aspects common in traditional engineering education. Doubtless that this

site, and the practices of queer engineering students more generally, have countless additional lessons for engineering educators.

My search for a queer technical practice led me first to a queer sense of place: the Barn is not so much a queer place full of queer people doing queer technique as it is a space in-between, subversive of the dominant structures around it, yet firmly embedded at the base of them. The Barn is a place to rest before the arduous journey, the petcock on the pressure cooker. Yet in each of these descriptions is a sense of situatedness: beliefs about a difficult and uncertain future reflect past experiences and narratives, so the present moment of rest contains and is defined in relation to them all (*the petcock is attached to the pressure cooker; it's there because someone knew that steam would be there and would need to be released*). We need not look far to see self-awareness as technologists in the Barn, nor to find people working on their problem sets, nor to find them avoiding their problem sets. The technical practice among the Dramatists is at the same time rest from the remainder of a student's technical practices, and a version of them in their contestations and imperfections. *How queer.*

The ethics of the new materialisms

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Abstract: Within engineering, "ethics" is often individuated and "microethical," focusing on "decisions" and "engineering practice" as the central site of intervention. Codes of ethics provide engineers with scant resources for addressing *macroethical* problems in the structures that microethical decisions are made. I propose a potential "cultural fix" for addressing macroethical problems arising from present engineering culture: the incorporation of certain insights from the new materialist philosophical tradition into re-figuring conceptions of 'engineering practice' in a useful way, challenging notions of epistemology, ontology, and ethics via a re-figuring of relationality. The new materialisms, particularly as articulated by theorist Karen Barad, provide several contributions that could both be compatible with present engineering practice and hold a possibility for de-centering the dominant epistemological, discursive, and ontological practices that presently constrain microethical decision-making. The essay proceeds with an overview of new materialist ontology and epistemology, thought to include five core principles for our purposes: (1) *matter* and *meaning* are inseparable, as are *ontology*, *epistemology*, and *ethics*; (2) the fundamental unit of the world is the *phenomenon*, occurring within heterogeneous structures/apparatuses/assemblages; (3) 'objects' and 'subjects' (perhaps, 'bodies') are produced within these phenomena, that is, *relata do not pre-exist relations*; (4) that causality, and therefore *agency*, in the sense often invoked by ethical theories, is *distributed* and *intra-active*; (5) that the nature of 'knowledge' is not *representational*, but *performative*. The essay concludes with a set of questions for considering the macro-ethical implications of a new materialist onto-epistemology.

Keywords: Engineering ethics, macroethics, new materialisms, Karen Barad

Introduction: Framing the Intervention in Engineering Ethics

Within engineering, there are some differences of opinion on what constitutes

engineering ethics. The two main texts on engineering ethics, Martin and Schinziner's *Ethics in*

Engineering and Harris, Pritchard, and Rabins's *Engineering Ethics* (respectively) define

"engineering ethics" as

> "The study of the moral issues and decisions confronting individuals and organizations engaged in
> engineering and the study of related questions about the moral ideals […] of people and corporations
> involved in technological activity." (Martin and Schinzinger 1996, 2)

> and

> "The question of what the standards in engineering ethics should be and how to apply these standards to
> particular situations. […] [It can help] to promote responsible engineering practice." (Harris, Pritchard,
> and Rabins 2000, 26)

Both of these definitions of engineering ethics vary in their site (individual, corporate,

societal) and their scope ("moral decisions," "standards," or "responsible practice"). However,

they have in common a) an underlying notion of the engineering profession and its general

relationship to the public and b) an emphasis on identifying *engineering practice* as a site of

intervention.

Engineering ethicist Joe Herkert has pointed out that this focus on *practice*

overwhelmingly focuses engineering ethics upon the "microethics," that is, a concern with the

decision-making of individuals, instead of an engagement with "macroethics," or the structural

contexts in which those decisions are made meaningful (Herkert 2005). This concern can maybe

be seen in nearly any "code of ethics" for engineers. Consider the National Society of

Professional Engineer's code, which lays out particular commandments for each engineer:

> "Engineers […] shall:
> 1) hold paramount the safety, health, and welfare of the public;
> 2) perform services only in areas of their competence;
> 3) issue public statements only in an objective and truthful manner;
> 4) act for each employer or client as faithful agents or trustees;
> 5) avoid deceptive acts; [and]

6) conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession."[51]

Viewing these canons as individuated microethical dictums, even (or especially) when they touch upon macroethical problems, helps us see the distinction Herkert draws and understand the particular content of the unquestioned macroethical structure that engineering operates within. Qualities like 'competence,' 'objectivity,' and 'deception' are left to each individual's interpretation of the norms of educational and practical cultures. Meanwhile, the structure for these norms are explicated: 'holding paramount the welfare of the public' may indeed be listed first, but the proper way to respond to concerns is defined in order to *primarily* benefit the client. In short, the problems facing the code are: (1) its interest in class reproduction in favor of the capitalist class (via epistemically privileging the knowledge of engineers and enrolling them to the interests of their employers);[52] (2) its uncritical reliance on a positivist epistemology, assumptions about the discursive practices of engineering, and implicit ontology that cleanly distinguishes stakeholder groups like 'the public' 'users', 'employers', and 'engineers'; and (3) its individuation that prevents engineers from addressing these questions in a meaningful way (that is, from attending to macroethics).

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51. "Code of Ethics for Engineers." Alexandria, Virginia: National Society of Professional Engineers, July 2018.

52. My colleague Atsushi Akera has pointed out in personal exchanges that the NSPE's code of ethics is actually *less* interested in enrolling engineers into the interests of employers than other codes (*e.g.*, the 1974 IEEE code of ethics), due to the former's interest in promoting an 'autonomous profession' modeled on the likes of doctors or lawyers. Of course, engineering codes of ethics vary in the degree to which they weigh the interests of 'the public' and 'the client.' However, I contend that we still ought to read even ethics statements promoting a vision of an 'autonomous profession' as fundamentally interested in class reproduction (Tang and Nieusma 2017; Althusser 1971). In this way, I propose reading "act[ing] for each employer or client as faithful agents or trustees" as "acting for the capitalist class interest" as an "oppositional code" in Stuart Hall's sense (Hall 2008).

Nothing short of a radical re-framing, not just re-writing, of codes of engineering ethics writ large would enable the address of these problems from the seat of power. However, I doubt the efficacy of such an approach, seeing it akin to "technological fixes" that engineers often poffer in the face of such challenges. Some would instead propose a "social fix" of refiguring the working conditions and relations of engineers. Both of these are bound to have some effect. But instead, I propose that a 'cultural fix' is to an extent necessary, expanding the cultural resources that engineers have to respond to ethical crises that arise as the result of macroethical problems unaddressable from within the current structure.[53] I hope that this essay, as well as future work, begins to provide the outlines for such a fix, in the form of drawing upon literature in the 'new materialisms.' This philosophical tradition has a potential to respond to problem (2) above, and in doing so, may hold potentials for long-term change on (1) and (3).

The new materialisms are a philosophical tradition arising from post-humanist, materialist, and feminist accounts of the world, especially informed by science studies and their accounts of knowledge production, as well as investigations of 'discourse' and phenomenology. In this way, the movement can be considered a synthesis of much philosophical, critical, social, and cultural theory of the 19th and 20th centuries. Especially prominent in the new materialisms are feminist philosopher-physicist Karen Barad, whose 2007 work *Meeting the Universe Halfway* (2007) is an especially instructive text; also important is philosopher Jane Bennett, whose book *Vibrant Matter* (2010) provides a more phenomenological account of materiality. For the purposes of this essay, Barad and the work she draws upon will serve as the foundational

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53. This distinction is drawn from (Layne 2000).

actor, while Bennett will play an occasional supporting role, especially in explicating some ethical implications.[54]

Principles of (Baradian) New Materialisms

I. Inseparability of *matter* and *meaning*, of *ontology*, *epistemology*, and *ethics*

> "Matter and meaning are not separate elements. They are inextricably fused together, and no event, no matter how energetic, can tear them asunder. … Mattering is simultaneously a matter of substance and significance…"(Barad 2007, 1)

So begins Karen Barad's landmark work, *Meeting the Universe Halfway*. As we will see, this understanding is not just the claim on which her work rests, but rather the central achievement of it. This view has bi-directional significance, simultaneously claiming that the proper study of meaning depends upon the study of matter, and that matter *comes to matter* in its particular meaning, that is, in its relationships with other matter. For Barad, this achievement is the result of reading works in physics, science studies, and social theory through one another, especially informed by Niels Bohr's philosophy-physics. And though many people critique her work for drawing primarily on quantum physics—and therefore, apparently, irrelevant to larger processes. But Barad operates irrespective of scale: she isn't interested in drawing an *analogy* between anything, much less the small and the large,[55] and she recognizes that, in the entanglement of matter and meaning, small things often come to matter most as a result of their particular placement.

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54. There are other important figures as well; for the purposes of this essay I have omitted them. Still, interested readers should consult (Pickering 1995; TallBear 2017; Arboleda 2017)

55. Indeed, methodologically speaking, Barad is wary of analogies and believes that it has led to misunderstandings and misapplications of crucial insights. See her discussion in the introduction to the book, especially pages 23–25.

In Barad's explanation, the persistent belief that matter and meaning are separate rather than combined has led to serious ontological-epistemological errors. This error can be summed up as 'representationalism,' the belief that science is "above all, an activity that seeks to represent nature, to produce knowledge that maps, mirrors, or corresponds to how the world really is" (Pickering 1995, 5). This belief produces several effects, among them the human subject (knower), who alone is capable of mediating between the domains of knowledge and "the known." Instead, the new materialist account of knowledge-making practices is *performative* (see later section), denying the possibility of separation between, on the one hand, "knowledge," and on the other hand "practices of knowing," or even "action." Without this distinction, the boundary between ontology (one's theory of what is) and epistemology (one's theory of knowledge) becomes incredibly leaky. Indeed, this leakiness leads Barad to claim that the two were always joined at the hip, and that the common belief that they were separable is historically and culturally contingent to Western philosophy's particular formation (Barad 2007, 46–50).

Barad goes a step further: it's not just ontology and epistemology that are admixed, it's ontology, epistemology, and ethics (or, in her figuration, "ethico-onto-epistem-ology"). The claim that ontology and epistemology are joined is perhaps uncontroversial, but what about this introduction of ethics? This, I'll admit is perhaps the central question motivating this essay, as the claim, while appealing, seems unclearly fleshed out. How is it that *ethics* arise from one's beliefs about the world? And if the new materialisms are a re-working of ontology and epistemology, what are their ethical commitments? I take the following two quotes as suggestive of what constitutes "new materialist ethics" at first blush. First Barad:

> "Particular possibilities for (intra-)acting exist at every moment, and these changing possibilities entail an ethical obligation to intra-act responsibly in the world's becoming, to contest and rework what matters and what is excluded from mattering."(Barad 2007, 235)

And Bennett:

> "It is, I think, the 'responsibility' of humans to pay attention to the effects of the assemblages in which we find ourselves participating, and then to work experimentally to alter the machine so as to minimize or compensate for the suffering it manufactures."(Khan 2009, 93)

Both statements radically center their respective theorist's onto-epistemological frame;[56] yet both show concern for the particular boundaries and actions that an actor finds themselves to be a part of. This is, I think, a good place to start.

II. _Phenomena_ as ontological basis, making use of _apparatus_ and _assemblage_ in our accounts of them

Barad's account of new materialist ontology centers the _phenomenon_ as the "ontologically primitive relation"—before object[57] and before subject. Barad's use of the term comes from Niels Bohr, whose ontology regarding _phenomena_ she tries to excavate in the chapter "Niels Bohr's Philosophy-Physics."(Barad 2007, 97–131) For Bohr studying quantum physics, he had initially considered "phenomenon" in the sense offered classical physics, that is, a bounded event with limited actors, definitely causing some observation of the phenomenon. However, Bohr's development of the quantum principle of _complementarity_ (that is, that certain properties of matter cannot be simultaneously observed, _e.g._, position and momentum) indicated instead that "the nature of the observed phenomenon changes with the corresponding changes in

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56. Barad is more concerned with 'intra-acting', while Bennett is more concerned with 'the effects of assemblages'; I hold that these are entirely compatible concerns and viewpoints.

57. This is the core of the tension between the new materialisms I am here discussing and the "object oriented ontologies" (OOO) that are often thrown in the same basket. Both make use of 'phenomenology' as a source of ontological claims, yet while the OOO advocates are left trying to explain how it is that 'phenomena' emanate from 'objects' (and how it is that objects have different phenomena at different moments, some 'sensuous,' what we experience, and some 'real,' what makes the object _itself_ and not _something else_), new materialists do not take such 'things' for granted (Cf. Harman 2018, 150–61).

the apparatus" (*i.e.*, that observation of position and momentum require different experimental apparatuses), and therefore that "the unambiguous account of proper quantum phenomena must, in principle, include a description of all relevant features of the experimental arrangement" (Barad 2007, 106; Bohr 1963, 4; as quoted in Barad 2007, 119). Barad's explication of *phenomenon* in the new materialist sense relies on this entangled relationship between the "observed" objects and the "observing" apparatus, or, in other words, an "*intra-action*"—Barad introduces the term (in contrast to *interaction*) to refer to the "ontological inseparability of objects and apparatuses" (2007, 128). This notion of phenomena is in stark contrast to Kant's notion of the distinction between noumena and phenomena, or between "the thing-in-itself" and our perception of it.[58] Barad's account of an 'apparatus' with unclear boundaries (within/alongside which phenomena occur) similarly questions the existence of such "things."

Bennett's place for phenomena is also useful here: her account of the "distributive agency" of any action makes use of Spinoza's "modes of *Deus sive Natura* (God of Nature)" and Deleuze and Guattari's "assemblage" (Bennett 2010, 21–24), within which such Baradian phenomena occur.[59] Within these assemblages are, no doubt, people and experiences. The figure

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58. And, by extension, Husserl and Heidegger's use of "the thing": (Cf. Husserl 1994; Heidegger 1971; Harman 2011)

59. It's important to note that Bennett does *not* use Barad's terminology of "the phenomenon," rather, I find Bennett's discussion of distributed agency to be resonant with Barad's. Additionally, Bennett seems primarily interested in discussing bodies as *composing* assemblages rather than assemblages *producing* bodies; this is a fundamental distinction between Bennett and Barad's accounts, though not irreconcilable. In contrast, Spinoza's use of "modes of God" is almost identical to Barad's notion of agencies making themselves apparent through intra-action, though curiously, Barad does not attribute any part of her ontology to him. Indirectly, a genealogy might be made, perhaps through Latour (who takes Spinoza as central inspiration in the second half of *The Pasteurization of France* (1993)), or Althusser (who Barad squarely pans but was nonetheless influential for Foucault—himself influential for Barad), or Deleuze (who wrote his doctoral thesis on Spinoza, calling him 'prince of philosophers,' but who Barad is clearly familiar with yet ignores for the purposes of her book). Of these, the Spinoza→ Althusser→ Foucault→ Barad connection seems most likely, as Foucault's conception of

whose account of *experience* best comports with both Barad and Bennett's conception of such experiences, *within* these entanglements, is phenomenologist Maurice Merleau-Ponty. To demonstrate her notion of what being-in-the-world looks like with such *apparatuses*, with which phenomena occur, she draws upon Merleau-Ponty's example of a blind person's "incorporation" of a white cane, which becomes a part of their sensing-apparatus and interactions with the world (Barad 2007, 157). Merleau-Ponty's attempt to de-center the human subject while maintaining an account of *phenomena* is similarly useful for Bennett's account of experience-within-assemblage (Bennett 2010, 29–30).

Barad leaves us with a (fairly challenging) definition of the *apparatus*, which I suggest is analogous with the 'modes' of Spinoza and 'assemblages' of Deleuze and Guattari: *phenomena* are "dynamic topological reconfigurings/entanglements/relationalities/(re)articulations of the world" (Barad 2007, 141). As with Bennett's notion of the *assemblage*, the idea is clearly intended to be wide-ranging, describing *any analytically useful collection of objects/agencies through which phenomena occur*.

III. The production of bodies via material-discursive practices

In what is perhaps Barad's most challenging section, she looks to how *bodies* are produced within the interconnected world of *phenomena* that her ontology supposes. Bodies are not separate (spatially, ontologically, or epistemologically) in her account, but neither is perceived separateness "mere illusion" (Barad 2007, 136). Rather, it is through material-

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power is in my opinion analogous to both Spinoza's account of "modes of God" and Barad's account of "agencies" (see Foucault 1990, 92–94). Still, the connection is tenuous at best.

discursive practices that bodies are produced. To understand this, we must first understand what "discourse," in the Baradian-Foucaultian sense, implies:

> "Discourse is not what is said; it is that which constrains and enables what can be said. Discursive practices define what counts as meaningful statements. Statements are not the mere utterances of the originating consciousness of a unified subject; rather, statements and subjects emerge from a field of possibilities. This field of possibilities is not static or singular but rather is a dynamic and contingent multiplicity." (Barad 2007, 146–47)

The Baradian-Foucaultian *discourse* is thus analogous to Bohr's account of the *apparatus* which produces meaning and participates in the *phenomenon*. Barad's crucial move for bringing these together is her insistence that Bohr's *apparatus* is, in fact, a discursive practice. Furthermore, the specific configuration of the apparatus is produced by other material-discursive practices, and on and on forever (Barad's ontology is a theory of *everything*, after all). Discursive practices resolve semantic and ontic indeterminacy; they enact causal structures with cause and effect fall out of either side of the phenomenon (Barad 2007, 148–49). They are not human practices, they produce both the notions of "human" and "human practices."

Barad's relates her account of how discursive practices produce matter to fellow queer theorist Judith Butler, whose text *Bodies That Matter* attempts to show that the production of (sexed, human) bodies is "fully sedimented with discourses on sex and sexuality," and that we best understand the ways that sex discourses 'sediment' into bodies is through a process of *materialization*: "[Matter is a] process of materialization that that stabilizes over time to produce the effect of a boundary, fixity, and surface we call matter," by the processes of discursive regulatory practices Foucault describes (Butler 1993, 29, 9; as quoted in Barad 2007, 150). Barad critiques Butler (and by extension, Foucault) for allowing these discursive practices to belong to the realm of agential humans while not allowing the non-human agencies their due. Yet, as

Barad successfully does, Butler and Foucault's account can be salvaged with the proper moves

toward including humans and nonhumans in accounts of "bodies" and their "agencies."

IV. Distributed *agency/ies* and *causality*

      With a performative (that is, produced by material-discursive practices) understanding of

bodies, we can now return to the question of *agency*. Barad usefully elaborates on notions of

material agency which have been so productive in new materialist accounts. Consider

Pickering's introduction to the topic:

> "The world is filled not, in the first instance, with facts and observations but with *agency*. The world, I
> want to say, is continually *doing things*, things that bear upojn us not as observation statements upon
> disembodied intellects but as forces upon material beings. Thing of the weather… Much of everyday life, I
> would say, has this character of *coping with material agency*, agency that comes at us from outside the
> human realm and cannot be reduced to anything within that realm." (Pickering 1995, 6; cf. Ingold 2013)

      Pickering's definition here is a useful starting point, however, Barad rightfully critiques

Pickering's accounting of "performativity" in action as re-inscribing the division between human

and non-human agencies (not to mention his failure to account for the queer origins of the term,

which, in Barad's view, are important for understanding what a 'performative' account of action

ought to mean) (Barad 2007, 410-411n18). Pickering's account of science (indeed, of human

activity generally) is as a 'dance of agencies' between the human and non-human realms.

However, there are some strengths of his approach: Pickering recognizes the need to disentangle

the notion of *intentionality* from *agency*, something he does with moderate success. However,

Barad gives us more robust tools for doing the same thing.

      Barad's account of *agency*—or rather, *agencies*—*phenomena* (previously discussed) are

viewed as "the ontological inseparability/entanglement of intra-acting agencies" (Barad 2007,

139). In other words, the specific entanglements of agencies, infinitely entangled, made

separable through their mutual entanglements and differential matterings, make up *phenomena*

when considered in a dynamic sense.[60] In this field of entangled agencies are all of the previously-discussed ontological relations: matter, meaning, phenomena, apparatus/assemblage, bodies, and material-discursive practices. What's important here is that as the phenomena produce bodies, they also produce causal structures, in which some bodies are marked as the "cause" (effector), and others as the "effect" (affected).[61]

Both Barad and Bennett see an understanding of the radical connectivity of the world as cause for re-thinking causality; as I alluded to before, Bennett's notion of *assemblage* gives rise to a sense of *distributed agency*, in which responsibility is not figured as an absolute problem of 'blame,' but rather as a mutual recognition of the ways interacting agencies produced particular effects (Bennett 2010, 36–38). What is crucial to recognize about this distributed agency (or, if you prefer, field of intra-acting agencies) is that it *does not preclude political action*. Instead, it promotes a vision of responsibility as 'response-ability' (Haraway 2008), the urgency to recognize problems in our differential entanglements and act with the agencies 'we' are afforded to reconfigure—to be an active part of the world in its becoming.

V. Performative account of knowledge-practices

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60. I find it *very* useful for a metaphor here: if the world "is" infinite, entangled agencies with differential and mutual entanglements, we can think of it as a large, 3-dimensional space of several strings interconnected and entangled to make 'string figures' (in Haraway's (2016) sense). The figures *are there*, but they also are *an effect of the differential entanglements*. Furthermore, the "agencies" are *not* the strings in this metaphor, but the *figures themselves*, entangled, with unclear boundaries, brought into existence and meaning in relation with one another.

61. It is crucial to recognize that while Barad considers these phenomena to be *dynamic*, they do not unfold neatly in time. Instead, not only is *matter* produced by this dynamicity, but the entire *spacetimematter manifold* (Barad 2007, 246), that is, time, space, and matter are all configured by the world in its becoming.

As alluded to in the first sub-section on Baradian ontologies, there is a persistent belief, stemming from a strict separation between knowing subject and known object, that the practice of crafting knowledge is a practice of *representing the world*. Much work of science studies (especially in the actor-network and post-actor-network traditions, e.g., Pickering 1995; Law and Hassard 1999) has been to question this perspective. But what, then, of notions of 'objectivity' in knowledge, if all the world is always intra-acting? What can be salvaged of 'critical distance'? As Haraway suggests, such ideologies of objectivity are illusory effects of a hegemonic discourse that attempts to "see everything from nowhere" (Haraway 1988, 581).

Instead, Haraway suggests that objectivity ought to be thought of as *situated knowledges*, that is, "an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognizing our own 'semiotic technologies' for making meanings, and a no-nonsense commitment to faithful accounts of a 'real' world" (Haraway 1988, 579). I contend that Barad's account has done just that, situating simultaneously histories, knowing subjects, semiotic technologies, and an account of the 'real' that allows for practical, experiential, knowledge-making practices intended to achieve knowledge. However, an important condition for such knowledge, in Barad's view, is that "*the referent is [considered] a phenomenon* (and not an observation-independent object)" (Barad 2007, 120). With these tools in hand, we can fully commit to a 'performative' account of knowledge-making practices instead of a 'representational' account, giving ourselves the necessary conceptual tools to claim that our knowledge is indeed 'objective.' Indeed, *all knowledge-making practices are performative*, but they must account for their contingencies in order to be considered anything approaching the objectivity of before.

Possibilities for Micro- and Macroethical Insights

Here I have outlined what a new materialist onto-epistemology looks like, but what of the ethical concerns that we began with? In the introduction to this essay, I outlined three problems that current engineering ethics practices face, as macroethical problems a part of the structure of the engineering profession and its culture, and have proposed the new materialist account of the world and our knowledge practices for responding to at least one of them: engineering codes of ethics' "uncritical reliance on a positivist epistemology, assumptions about the discursive practices of engineering, and implicit ontology that cleanly distinguishes stakeholder groups like 'the public,' 'users', 'employers', and 'engineers'. I end with a few questions for future investigation of new materialist possibilities in engineering ethics:

1. Might the new materialist epistemological account of *performativity over representationality* appeal to engineers' practical sensibilities? Does it hold potential for promoting a post-positivist account of the engineer's active role in producing knowledge?

2. Might the new materialist account of *material-discursive practices* provide new insight into what 'counts' as engineering, and what sorts of the world's macro-structural *apparatuses* produce engineering, and what sorts of apparatuses engineering practice itself is a part of?

3. Might the new materialist ontology of uncertain boundaries and ever-present entanglements promote reconsideration of such subjects/objects of engineering practices as 'the public,' 'users,' 'employers,' and 'engineers'? What of other subjects/objects, like 'bridges,' 'silicon,' 'the internet,' or 'the environment?' What new notions of responsibility/response-ability are promoted by a vision of the world

as intensively and extensively interconnected? How do we avoid the potential for a

de-centering of the responsibility of engineers, once we've spread the agency around?

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