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UNIVERSITY OF CALIFORNIA
RIVERSIDE

Fixing Science: Innovation, Disruption, Maintenance, and Repair at a North American
Open Science Non-Profit

A Dissertation submitted in partial satisfaction
of the requirements for the degree of

Doctor of Philosophy

in

Anthropology

by

Kyle Orion Harp-Rushing

June 2020

Dissertation Committee:

Dr. Juliet McMullin, Chairperson

Dr. Yolanda Moses

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2020

The Dissertation of Kyle Orion Harp-Rushing is approved:

Committee Chairperson

University of California, Riverside

Acknowledgments

As with any creative work, a dissertation reflects bonds of friendship, comradeship, and love. To the extent that some of the seeds sewn throughout this work become generative, it's only because they grew from the soil of friendships too numerous to count. If the seeds wither and dry, I can only blame myself. First, I'd like to thank all the open science workers and advocates at the center. Your generosity of spirit and kindness; your enthusiasm drew me to study with you in your world and continue to ignite in me the hope to return soon. I can only hope this work reflects in some small way the depth of gratitude and respect I will always feel toward you all.

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interested in solidarity as a research question. I love you all. I also submit this dissertation in solidarity with and in recognition of all graduate students and early career researchers, particularly those working tirelessly to dismantle systems of oppression, exploitation, and harassment within the academy. I hope you always know that, while the products of your labor are *of* you, they are not the totality of your worth and value.

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Thank you, Kristina. Thank you for commuting three hours each way for an entire year to be with me that first year. Thank you for always being willing to read my shitty drafts and to give me your constantly brilliant feedback. Thank you for supporting me. Thank you for taking more than a month to move back to Colorado with me when Dad was dying. Thank you for showing him love and kindness; for all of the care you so readily and lovingly gave. Thank you for knowing all the words to say all the times when I was ready to quit the program, but especially that one time. Thank you.

ABSTRACT OF THE DISSERTATION

Fixing Science: Innovation, Disruption, Maintenance, and Repair at a North American
Open Science Non-Profit

by

Kyle Orion Harp-Rushing

Doctor of Philosophy, Graduate Program in Anthropology
University of California, Riverside, June 2020
Dr. Juliet McMullin, Chairperson

In 2015, an article published in the journal *Science* set off what some regarded as a crisis of confidence which quickly swept across several social and natural sciences disciplines. The study suggested that two-thirds of the experiments published in three leading social psychology journals were non-reproducible in other labs. My ethnographic research project is based on several months of fieldwork conducted from 2016 to 2018 at one of the organizations involved with carrying out and publishing this reproducibility study, a relatively small but influential software technology, culture-change, and research non-profit based on the U.S. East Coast. I explore how a small group of dedicated and passionate computer programmers, researchers, and marketers work to expand access and transparency across entire research workflows and lifecycles. While these cognitive laborers work to align support infrastructures and research incentives with ideals of scientific practice, I argue that contemporary capitalist research structures have already made researchers and research products open-ended, modular, and flexible subjects. As a transdisciplinary figure of Scientific research becomes *fixed*, I argue for considering open science as a matter of social reproduction as much as decentralizing research media and workflow infrastructure.

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Introduction

Fixing Science

Threadbare and tattered, the aspirations and promises of ceaseless technological innovation and progress continue to saturate and disappoint contemporary existence. The cultural logics of app-mediated tech-fixes coalesce and group together into what some critical digital scholars have defined as a particular (and particularly depressing) expression of late capitalism; e.g. the “platform capitalism” described by Nick Srnicek (2017), or the “vectoral capitalism” described by Makenzie Wark (2019). Everything seems to be breaking or already broken down. *Everything*, every technosocial gathering of life, is opened to the violent gale of creative destruction (Schumpeter 2005). The mantra of “disruption” has infused into multiple material connections for reproducing social life (infrastructures), significantly reconfiguring the ways in which we’re interpellated as digital subjects, to imagine futures of logistics and shipping, consumption, urban transportation, healthcare, finance... and scientific research.

Advancements in technological fields like artificial intelligence and machine-learning, big data science, and block-chain (the ledger-system underwriting cryptocurrencies) proliferate in wide circulation, sticky with the simultaneously vague and grandiose aspirations of technocratic *control* (Deleuze 1992). Very often, these aspirations frame social and/or political problems (i.e. the agonistic, deliberative sphere, where groups negotiate flows, circulations, distributions) as amenable to technocratic engineering; disembodied and apolitical modes of social and political repair, by technological means. Platforms, user-generated “content” conduits, are simultaneously

disruptive and regulative, rationalizing and normalizing, increasingly constituting the infrastructures through which “societies of control tweak and modulate bodies as matter, not predominately through signification or identity interpellation but rather through affective capacities and tendencies” (Puar 2012, 63).

I locate this ethnographic research project on a particular open science non-profit organization located on the U.S. East Coast, an institution dedicated to “disrupting” scientific research. I focus on the interrelations between digital infrastructures (i.e. digital technologies that function to circulate and distribute digital things, such as data, metadata, and research materials), metascience (“science about science”), and alternative imaginaries of a participatory, decentralized scientific research commons. I frame this ethnographic research project around four interrelated concepts that frame each of my ethnographic research chapters. Each concept underscores the ways in which we relate with and through information infrastructures in the contemporary, late capitalist moment—Innovation, Disruption, Maintenance, and Repair.

Open science discourses often draw upon reference to the “common-sense,” ordinary, or mundane practical *doing* of scientific research. Over the course of two years (a total of three months spent in the field, followed by repeated follow-up conversations over remote video-chat) open science workers¹ would often say “open science is *just* science.” Among particular open science organizations within a loosely defined social movement

¹ I use “open science worker” to refer to employees at the center, as a collective and irrespective of individuals within particular groupings within the organization (i.e. “teams”). Unlike “advocate,” this term has the advantage of not ascribing or assuming a particular position on the open science “movement,” while recognizing their particular mode of participation as a laborer within the organization and the movement.

of open science, interests and strategies vary widely. Yet, most advocates within the diffuse movement are motivated by a shared commitment to a shared ideal of increasing the transparency of research practices, methods, procedures, data, and results. Often comprised of self-described “geeks and nerds,” open science moves and gains steam through a collective desire to tear open “the blackbox” of research, to un-mask research and to strip it bare of its obscure, superficial, and often superfluous trappings. As a result, open science often resembles my own chosen academic field of study—anthropology of science. However, where open science workers often lament the ubiquity of these trappings and their corrosive effects on science, anthropologists of science are prone to see them as belonging to the trove of often mundane, yet deeply significant interstices of research practice. Bruno Latour (1999) defines “blackboxing” as a practice, in the context of social studies of science and technology, rather than a static entity, an act that:

refers to the way scientific and technical work is made invisible by its own success. When a machine runs efficiently, when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity. Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become. (Latour 1999, 304)

Motivated by a desire for researchers to articulate the relationships more clearly between “inputs and outputs” in research, open science workers often insist that the success of research increasingly depends upon openness and transparency, allowing researchers to share and repurpose data and materials. Dubbed “Networked Science” and “Science 2.0,” contemporary digital technologies (e.g. responsive, iterative research

workflow management platforms hosted across multiple servers on “the cloud”) have produced a kind of speculative “frontier,” an open-field of potential through which open science workers imagine re-constructing research communities as made up of decentralized zones of participatory collaboration and reciprocal exchange—a discovery commons (Nielsen 2011).

On the other hand, open science discourse often resorts to the familiar registers of the “common-sense.” Anthropologists have always encountered reference to what Geertz (1975, 7) called the “immediate deliverances of experience,” the “ordinary,” the “mundane,” and the “common-sense(s).” It’s in the becoming foreclosed and settled, congealed into “matters of fact,” that the shared sets of understandings, meanings, values, and practices that we used to clunkily refer to as “Culture” become *anti*-disruptive. At times, such matters stitch together much more complex, dynamic, and contested relationships, departing at times dramatically from their supposed or intended, or otherwise settled and mundane effects. For example, Gregory Bateson’s (1958) *Naven*, situated among members of the Iatmul in New Guinea, is revered as an early demonstration of how ritual becomes a site for disrupting conventional norms and values associated with sexuality. I often found a sense of moving back-and-forth when studying “open science.” While purposely and intentionally distinguished from ritual, open science often elicits contradictions. At times confined, almost nostalgically, to the realm of the ordinary—a future comprised of aspirations mined from the past—open science occasionally becomes *disruptive* to established and conventional social orders regarding

the creation and organization of scientific knowledge production and exchange (Jasanoff 2006). I situate this project within this contradiction.

I don't intend to suggest that the *contradictory*² play of the ordinary and the disruptive in open science is an indication that open science is either poorly thought out or undertheorized. On the contrary, open science workers were often deeply interested in contemplating more abstract components and effects of open science. Rather, I came to focus on the particular relationship between the ordinary and the disruptive in open science as a kind of co-production (Jasanoff 2006), as *informed* by relationships with/through digital communications infrastructures both inside *and* outside of open science. Open science therefore became a way in which to explore the cultural implications surrounding the ways in which we're increasingly enrolled into practices and ideologies of "sharing." The cultural backdrop of my project takes seriously the extent to which we're increasingly enrolled to "share" data and information as mechanisms of exploitation and extraction (Wark 2019). As part of the wider technocultural context, this project considers what it means to become "transparent" and "open."

Chapter Overview

In my first chapter, dedicated to literature review and theory, I focus on drawing a kind of sketch of how this technocultural economic context underwrites contemporary

² My appreciation for contradiction is instead drawn from Marxist, and particularly Marxist feminist scholarship on contradiction as more a space of possibility and potential solidarity than epistemic erosion (see e.g. Jarrett 2015).

academic research practices. Open science workers frequently referred to skewed “incentive structures,” a subject that has been explored in depth by anthropologists simultaneously studying and participating in the open access movement (see e.g. Kelty 2014). These incentive structures are often deliberately connected to the extractive research publishing industry. Open science workers, metascientists in particular, frequently connect issues of experimental irreproducibility (the inability to independently achieve similar results from repeated experimental procedures) to these incentives. In the first chapter I consider the anthropological literatures of knowledge production, design, and infrastructure which (collectively) work to temper the cultural fetish of innovation in favor of theories and values of maintenance and repair. Applied toward research cultures, I argue that such theories attend to practices of what I call *framing work*—what I take to be the conditions for fostering creative solidarity and collaboration. Here, I try to situate the open science and metascience movements in the contexts of recent political and economic trends in the landscapes of contemporary academic research which increasingly constrain the possibilities for creative solidarity.

Despite its purported simplicity, open science social movements articulate into complex assemblages (Tsing 2015), encapsulating and saturating multiple spheres of meaning, practice, power, and materiality. In the second chapter, I articulate the ethnographic methodologies I employed throughout this project. I try to make sense of the multiple, often contradictory interactions among multiple spheres, strategies, and technologies articulated into open science. Ethnographic methods often submerge, becoming the taken-for-granted subtext that roils beneath the surface of post-Writing

Culture ethnographic representation (Clifford and Marcus 2009; Starn 2015; Pandian and McLean 2017). I found that, because much of open science discourse centers around matters of research practice and procedure, ethnographic methodologies employed in the study of open science communities become a productive moment of opportunity for considering the dialectic, mutual transformations of reflexive, feminist STS (Haraway 2006; 1991; 1997; Strathern 2004). In this methods chapter, I come to focus on epistemic uncertainty as a particular demand of ethnographic labor; a mode of surfacing potentiality in encounters with the ostensibly “fixed” and “common-sensical,” and explore the ambivalence surrounding ethnographic uncertainty in the precarious present.

Many of the open science workers I spent time with and befriended were simultaneously concerned with expanding access to research outputs—e.g. asserting a collective, public right over very often publicly-funded, research articles (Harvey 2013)—*and* reducing barriers to cooperation and collaboration in research. Compared with institutional configurations of “interdisciplinarity,” which are often formalized and instrumentalized, open science workers often imagined rich, cross-disciplinary collaborations unfolding “organically,” out of the connections and articulations formed between researchers and research products through open science infrastructures. In my third chapter, I explore how open science becomes articulated through ecological imaginaries and aspirational designs of self-replicating cooperation and reciprocal exchange. I focus on the emergence of a specific research object (the social science

research preprint³) within the context of the flagship research workflow management infrastructure developed at the center. I examine how open science comes to be regarded speculatively, as a matter of innovative infrastructure and as an alternative mode of collaborative objectivity. This chapter explores how nested sets of connections come to configure and articulate participatory, voluntary relationships of solidarity through knowledge production and exchange across channels and conduits engineered along design principles of *modularity*.

Many open science workers came to the open science movement out of their concern with the state of reproducibility⁴ across several research fields, including fields as varied and particular as social psychology and cancer biology. For metascientists in particular, open science was regarded as a mechanism through which to prevent the spread of irreproducibility throughout a field. Contrary to conventional (if unspoken and taboo) norms associated with the competitive, participatory *enclosures* of experimental research procedures and data across labs, these metascientists often insist upon independent, experimental *replication*—“repe[at]ing] what is presumed to matter for obtaining the original result” (Nosek and Errington 2017, 1)—as a vital component of open research. Because of its association with quality assurance standards (Nature 2014), integrating independent replication across multiple labs is regarded as a mechanism, not of

³ *Preprints* are a mode of academic publishing imported to the social sciences from physics in which final or near final drafts of academic research papers are published on preprint servers. Preprint servers adhere to varying degrees of peer-review and/or content moderation.

⁴ Particularly within social science disciplines, the topic of reproducibility is highly controversial and contested (Freese and Peterson 2015; Nosek and Errington 2019). While referring to the relative degree to which independently repeated research methods and procedures should be expected to produce statistically similar effects and effect sizes, whether or not (ir)reproducibility itself is a reliable indication of a finding’s verisimilitude (i.e. correspondence to reality) is widely contested (Collins 1985).

attenuating the tempo of research, but of actually stimulating and “accelerating” scientific discovery and innovation. To this end, *metascience* (“science about science”), in particular “reproducibility studies” are employed to assess, or effectively ‘diagnose’ the average rate of experimental reproducibility across entire research fields (Freese and Peterson 2018). While metascientists take care not to imply methodological error by the original study authors, reproducibility projects nonetheless often *become* disruptive in their socially mediated *after-lives* (Baker 2015).

I was surprised to find how often metascientists are aware of what sociologist of science Harry Collins (1985) termed the “experimenter’s regress” opened up by contemporary replication debates. Collins argued that it was usually impossible to precisely show *why* an experiment either successfully repeats with similar effects and effect sizes or completely unexpected ones. In my fourth chapter, I demonstrate how, for many of these metascientists, open knowledge infrastructures (Edwards 2010; Edwards et al. 2013; Okune et al. 2018), in particular free and open source research workflow management and hosting platforms, become dense with the aspirations and promises of techno-utopia. Despite the indeterminacy of irreproducibility, these decentralized, participatory communication and data-sharing networks become saturated with the hope of “fixing” irreproducible, fetishized, novelty-seeking scientific research cultures. Despite these aspirations however, reproducibility also came to be treated as a *matter of care* (Puig de la Bellacasa 2017)—a configuration of research questions, materials, and procedures that seriously considers and attends to questions of research stewardship and

the futures of scientific research. I argue that metascience asks us to consider how *disruptive* practices become entangled within otherwise *care-ful* technocultural projects.

In my fifth chapter, I continue along this thread to explore how open science workers spoke about futurity and maintenance to examine uncertainties that came to surround preprint hosting services around the time of my follow-up fieldwork. Where the value of free and open source project workflow management infrastructures was more easily translatable to funders, I argue that preprints appeared as a kind of *queer object*—an indeterminate, potentially disruptive and transgressive entity. A relatively recent expression of technoscientific *accelerationism* (Shaviro 2015), I argue that preprints inhabit a zone of liminality, conjuring along the way anxieties regarding the authenticity of particular research findings.

In my sixth chapter, I follow these anxieties further to critically examine a specific preprints use-case. Here, I examine how social science preprint servers—designed to “lower the barriers” to research publishing and consumption by circumventing extractive, for-profit publishing infrastructures—also come to infrastructurally underwrite the reactionary work of evolutionary psychologists who are able to use open knowledge infrastructures to appropriate the imprimaturs of Science. I argue that, while such appropriations are seemingly fringe and obscure in the present, their situation within the context of a global, viral surge in white supremacist nativism, and an erosion of the cultural efficacy of categories between “authentic” and “pseudo” sciences (Hartigan 2008; Panofsky and Donovan 2019), demand that we consider the long-term, ambivalent implications of open science infrastructures. Rather than argue for the social reproduction

and replication of existing, exploitative publishing infrastructures, I consider how *creative solidarity*—a recognition of the shared material circumstances experienced amongst marginalized creative workers in solidarity for the future (Gramsci 1972)—might come to underwrite alternative, reparative open knowledge technocultures.

Positionality

My personal interest in relatively small-scale, but deeply influential web applications didn't grow out of a pre-existing interest in computers and software. I've never been much of a geek, and I have no claim to being one now. In that sense, my entry to the topic can, at times, bear an unsettling resemblance to anthropology's more troubling roots... narrating exoticized encounters with Others and Otherness (Gusterson 1997). Feminist STS scholarship has typically gone ahead in the other direction. These projects often unfold out of technical interests (e.g. in computers, infrastructures, or other technical devices), which become reflexively turned "inward" on themselves and their position within technocultural systems, toward the cultural construction of ostensibly "purely" technical interests and expertise, and toward the dense and messy ontological interweaving of technologies with bodies.

In this project, I ask how complex, intentional, and design(ed) communities like those constructed around ideas and practices of good, reproducible, and open science are constructed, contested, maintained, and repaired. One of the side-effects of *platformization* (the simultaneously technical and ideological proliferation of software platforms in contemporary capitalism, embodied for example in the now defunct ad campaign "there's an app for that"), is a tendency toward technocentric scholarship.

When we focus too much attention on technical configurations, we run the risk of losing the threads that bind together relationships of creative and intellectual solidarity, what Maria de la Bellacasa (2012, 212) describes as those “affective aspects of knowledge politics” that stitch together opportunities for *thinking-with*. The goal of this chapter is to understand how technical configurations, knowledge infrastructures like OSF and application programming interfaces take part in reproducing narratives about reconfiguring scientific practice and circulations.

The story of open sciences with which I’m most interested has to do with the idea of a shift in the nature of the researching and experimenting subject, accommodated by alternative gift economies in scientific data, materials, and procedures. Yet, early on I began to find out that this story can’t really be told without engaging seriously with the design and agency of software platforms as such. What does it mean to apply ethnographic methodologies to relatively mundane workflow platforms and web applications which are less overtly dialogic and communicative (than say, social media) in flavor? How do we approach something more like a responsive and living archive, an open network through which to circulate supposedly more “serious stuff,” like data artifacts and experimental protocols? What does it mean to draw together a messy set of narratives that is, in part, about my own clumsy attempts to become familiar with what I continue to find elusive, strange, and often incomprehensible infrastructures?

Applying an ethnographic approach toward workflow management platforms informs a deeper understanding of a specific technocultural becoming-with (Puig de la Bellacasa 2017), an entwinement of software and subjectivity that is in some ways particular to this

historical moment, and yet deeply reminiscent of much older narratives about the doing and circulation of science and technology. Ethnography of unfamiliar platforms delineates the subtle attunements and modulations enfolded in contemporary, often breathless calls to be “innovative,” to enthusiastically undertake an entrepreneurial self-craft and open subjectivity. Here, I’m interested in the technocultural components deployed in re-configuring the researching self into an open-ended, experiment(al/ing) subject, in this case as a precursor toward creating knowledge-sharing (and knowledge producing) collectives.

Tracing stories of specific platforms and their features helps to understand how enticing imaginaries of maximizing research efficiency become materialized into features which are designed to be subtle and invisible, in the hope that they might flow seamlessly into the routine, unseen subconscious of a research or laboratory workflow.

Anthropology feels most potent and lively in the moments when it breathes life, animating previously unseen or invisibilized possibilities and potentialities for world-building solidarity and communality. As someone increasingly pessimistic about the declining state of neoliberalized knowledge production, depressed by the melting into thin air of prospects for meaningful employment opportunities within academic research, I’m deeply interested in the possibilities and potentialities for world-building that might exist in alternative knowledge production communities. While I’m interested in the kinds of political foreclosures which take shape in particular instances of open science infrastructures, I’m also deeply interested in the kinds of strategies and opportunities which persist nonetheless in the messy and indeterminate re-construction of the

experiment(al/ing) subject and experimental ontologies. What opportunities for example, for epistemic and creative solidarity get stitched together by alternative science media, and how might those opportunities help us to craft potentially less extractive and less exploitative research ecologies?

As a result, being reflexive in this project has meant trying to be attentive and responsive to the ways in which my own imaginative horizons have withered under the pervasive reproduction of extraction and exploitation in contemporary research cultures. While I try to explore how “open” knowledge platforms and infrastructures potentially facilitate continued processes of colonial knowledge extraction, as well as the formation of reactionary communities, I also try to consider how open science infrastructures also materially reconfigure grounds of knowledge production toward potentially generative ends. In the following chapter, I configure a theoretical and historical framework for interpreting contemporary movements and infrastructures to dramatically alter the ways in which we produce and circulate knowledge and information.

Chapter One

A Specter is Haunting Science, The Specter of Reproducibility

Common Breaks, Broken Commons: Theory as Reparative Framing-Work

As an active intervention into the world, literature review reminds us of the always already partial performance of boundary-work (Star and Griesemer 1989), of drawing categories around nebulous and partial ethnographic research objects. Throughout this project, I've often felt myself twisted into conceptual knots, often losing the thread in common-sense questions. 'What is "open science"? Is there a "closed" science? What is "open science" not?' In ethnography, a project is always much larger, more interconnected, and more complex than encompassed in our partial representations ("partial" here, building on the work of Donna Haraway refers to both, the state of being limited in scope and *for* particular modes of being-in-the-world and in opposition to others) (Haraway 1988; Strathern 2004). Particularly since postcolonial anthropologist Michel-Rolph Trouillot's (2003) critique of anthropologists' and our persistent taxonomic tendencies, anthropologists and ethnographers have wrestled more openly with where we decide to draw boundaries. How do we decide where to *cut* the domains of our study (Barad 2007)? How do we decide what is or isn't relevant?

In this moment, forces of wreckage have pressed to the conscious fore in Euro-American political milieus. As we're confronted with the material, infrastructural, and ideological breakdowns wrought by neoliberal capital (Harvey 2009), epistemic crisis *feels* more widespread and common (Roitman 2014), as domains of sociopolitical commons continue to hollow-out, wither away, or implode. Open science imaginaries in

particular are underwritten by narratives of repair, of restoring a collapsed research commons crumbled by the contamination of misaligned incentive structures (Nosek and Bar-Anan 2012; Nosek, Spies, and Motyl 2012).

As a research practice, ethnography is an experimental, often playful mode of reassembly. In her magnificent homage to the forms of life that bloom around the matsutake mushroom, Anna Tsing (2015) reminds us that practices of reassembly amidst wreckage illuminate reparative aims and practices, while also undermining Western ideologies of inevitable technological and political progress. How might we think with literature review in this moment as a kind of reassembly, as a way of building alternative worlds while also keeping in check our tendency to hold out for inevitable historical progress?

In literature review, the boundaries of our sensibility, the sensory envelopes that surround ourselves, become stretched and iteratively reconfigured, yet never out of whole cloth (Hartsock 1983; Harding 1994). Subjected to boundary-work, our bodies are reshaped into research instruments, curiously searching cyborgs (Haraway 1991). An attunement to the minutiae of relationships both inchoate and long-established, sacred and profane, normative and transgressive, feminist lit review carefully, thoughtfully, critically, and queerly communes with intellectual ancestors and kin. Queer feminist lit review has been particularly influential in my thinking with social theory as intervention, potentially as a kind of social-political repair that nurtures enchantment, imaginaries, and counter-hegemonies of alternative future worlds (Sedgwick 2003; Simmons 2016).

As with any intervention, reparative social theory is neither innocent nor pure. It's a messy commitment, "staying with the trouble" (Haraway 2016), and agitating for some worlds at the expense of others. This chapter works with the idea that critical theory is laborious and potentially reparative. Does *repair* imply an interest in reinvigorating dead, nostalgic technocultural political formations? As someone feeling more and more pressed out of academic research (even from within a position of relative privilege, as a cis-gendered, heteronormative-passing white man), I hope instead for social theory that builds more livable, less extractive and less exploitative, more imaginative and *experimental* research worlds.

In the first section of this chapter on literature review and theory, I construct a story of historical formations. Stories of historical and technological progress figure prominently in narratives of open science. As a "recursive public" (Kelty 2008), open science advocates often reflect on their positionality and their mission. Often self-identified as "open" individuals, open science workers and advocates are typically excited to talk about their experiences within the movement to free data and knowledge by helping to build and maintain free and open knowledge infrastructures. Following the spirit of *recursion* (in computer science terms, this concept describes a function which solves a larger problem by iteratively solving smaller instances of the same), Kelty (2008) described how they often express an expansive and anticipatory hope, an imagination that the alternative knowledge infrastructures they build will also help new collectives to do the same.

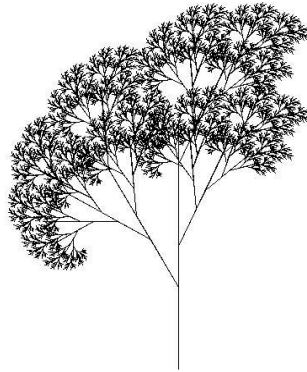


Figure 4.1. Tree created out of the accumulation of multiple instances of the same; an example of a recursive function created in the LOGO programming language (Wikimedia Commons 2008).

My section on historical formations traces a part of this recursive process, exploring how an insurgent and inchoate field of research appears, at first seemingly unrelated to knowledge infrastructures. A kind of neo-constructivism, the field of metascience (“the scientific study of science”) emerges through a coupling of epistemic uncertainty with infrastructure. This part of the literature will help to supply essential context for understanding the “doing” of metascience.

In the second section, I sketch the systemic, historic, and structural components of academic precarity in the social abandonment of the public university. Open science discourses often configure reproducibility and scientific integrity as problems remediated through mechanisms of “soft-power.” That is, primarily through technological design and intervention. I’m not at all opposed to the development of open science tools as such. On the contrary, I support efforts to circumvent the extractive corporate platforms sold by conventional publishers. I argue, however that the techno-utopianism embedded in ideas of large-scale behavior change emanating from incremental design, particularly when

coupled with normative configurations of reproducibility, elide systemic dimensions of academic precarity.

Envisaging individual researchers as sites of behavior modification risks further naturalizing the hegemony of the public university as a “social factory,” an affective zone of production that encompasses and exploits all aspects of social life toward the accumulation of capital (Jarrett 2015). Abolishing systems that reproduce conditions of academic precarity along axes of race, class, gender, ability, and sexuality is an all-too-often overlooked, and yet deeply crucial component in open science imaginaries and infrastructures (Alejandra 2018; Okune et al. 2018). We can’t engineer our way back to an imagined, timeless, utopian commons (partly because such a thing never existed in the first place). This section asks what it might mean to think and build open knowledge infrastructures alongside and with radical social and political imaginaries.

In the concluding section of this chapter, I work toward queer theoretical frameworks of open sciences. I attempt to depart from the image of scientific practice and reproducibility proceeding like a (social) factory: a site for scaling-up data’s selfsame reproduction across multiple labs and disciplines. Drawing on queer feminist science and technology studies (STS) of relationality and repair, along with ethnographies of design and infrastructure attuned to contextual practices of maintenance, I try to contribute toward creating spaces in which performative practices of open sciences can find their footing. Communities of practice organized around knowledge production and creativity bear a closer resemblance to reenactments amongst actors on a stage, mobilizing context-

specific repertoires of technical skill (Ankeny and Leonelli 2016) and social reproduction within intra-active entanglements in complex experimental apparatuses (Barad 2007).

Throughout this chapter, I attempt to draw on literature and theory which captures the “doing” (Puig de la Bellacasa 2017) of social theory. “Doings” gesture toward messy practices of re-assembly and coproduction (Jasanoff 2006; TallBear 2013), of salvaging and piecing together, repurposing what remains from wreckages into collaborative assemblages built around care and solidarity (Tsing 2015). In part, this is because I came to see developers, community relations members, and metascientists at the Center for Open Science as active, *recursive* participants in building not just infrastructures, but also alternative social theory through an ethics of repair and maintenance. Their commitment, vision, and practices are much too complex and multiple to be distilled into artifacts of neoliberal false-consciousness and non-profit do-gooderism. While building, using, and maintaining "frameworks" for open science, they also cared deeply about many of the more ambiguous aspects and potentially unanticipated dimensions and side-effects of their work. Many came to be motivated by an ethics of care I call *framing-work*, an ethics of repair and maintenance which builds imagination and desire for alternative research worlds around collaboration.

Metascience as Neo-constructivism for the Social Media Age?

On August 28, 2015 a team of two-hundred and seventy researchers published a damning report on the state of reproducibility in the field of experimental and social psychology (Open Science Collaboration 2015). As a “metascience” study what came to be known as “RP:P” was meant to be a “snapshot,” or an estimation of the ability to

reproduce data and findings across the field of experimental psychology. Researchers (including students and professors) replicated a sampling of experiments chosen at random from three of the “most influential” journals in the field. In 100 attempts to reproduce experiments chosen from three “high-impact” journals in the field, the researchers were only able to reliably reproduce about a third of the effects and effect sizes that had been originally reported.

In the conclusion of the article, the Open Science Collaboration struck a predictably metered tone. The group insisted, for example that the irreproducibility of individual experiments merely demonstrates a need for further investigation. The replicators’ findings should be regarded simply as additional data points in an open-ended experiment. A year later, during several conversations with metascientists involved in the project, they would often say just as much: *other researchers and members of the public should think of the replications as just another N... Just another data point in the wider context of the experiment*⁵. At times, they were frustrated with what had become an unintended controversy. Some had come to see the importance of minimizing interpretation in the published project, of cutting “narrative” from the report (*fieldnotes*, 2016).

The project should not be taken as a sign that the field of experimental psychology, or scientific research in general were “broken,” the authors of RP:P recommended. On the contrary they argued, the reproducibility project was itself a testament to the certainty and

⁵ Throughout this ethnographic research, direct quotes are demarcated by quotation marks, while indirect quotes are demarcated by italics without quotation marks. All participants’ names have been replaced with pseudonyms, except when participants were speaking or writing in a public forum.

inevitability of scientific progress through self-correction; while exposing several key areas in need of improvement (e.g. increasing data transparency and reducing publication bias in favor of positive results), the collaboration wrote that the project, “demonstrates science behaving as it should” (Open Science Collaboration 2015, aac4716-7), by exposing inadequacy and inefficiencies in design and practice. But whether the inefficiencies lay in the design of several dozen experimental apparatuses continuing to hum along in individual labs, or in the means of disseminating methods and procedures, the authors could not definitively say.

Press coverage was notably (and perhaps no less predictably) interested in the spectacle of what one article had a year earlier provocatively dubbed “psychology’s food fight” (Meyer and Chabris 2014). Headlines spread quickly across social media interfaces. Many participants in new media began to frame and categorize the project in the contemporary register of socially mediated scandal, circulating the hashtag “#repligate,” alongside articles peppered with click-bait titles, like “Is Science Broken?” (Cara 2019). RP:P represented, for many, a crisis of faith that had been virally mediated through the increasingly participatory media of our time. Susan Fiske, former president of the American Psychological Association was reported to have written a controversial open letter in the APS newsletter, suggesting (in a portion of a statement which was later retracted) that the crisis resembled something more akin to a “distributed denial of service (DDOS) attack,” orchestrated by a marauding band of adversarial “methodological terrorists” and “self-appointed data police” (Doctorow 2016). In the final published version of the statement, Fiske (2016) took issue less with RP:P directly,

and more with the effect of social media in decentralizing and publicizing what should have been an internal debate. Others in the field made controversial accusations that secondary data analysis (e.g. “reproducibility”) studies might amount to little more than “data parasitism” (c.f. Longo and Drazen 2016).

In a long-form blog post on the reproducibility crisis written in response to Fiske’s open letter, Columbia statistician Andrew Gelman argues that Fiske’s concerns reflect a “discomfort with the modern world” attempting to prop-up a “dead paradigm” that stigmatizes secondary data analysis as a viable component of peer review (Gelman 2016). The post gathered over 289 comments. In it, Gelman argued that until recently, the reproducibility crisis was but a faint “cloud on the horizon.”

When debates about experimental psychology findings have surfaced in the recent past, with the advent of new media they’ve typically resembled an affect of exposure, what Wendy Chun (2016) describes as an “epistemology of outing.” Accusations of researcher (mis)conduct circulate through new media infrastructures *designed* to amplify a spectacular feedback loop of consumption and production (Dominus 2017; Debord 1994). As experimental psychology spectacles circulate throughout new media conduits, they do so usually *without* disrupting the presuppositions underlying the supposed universality of psychological research findings, without unsettling their supposed correspondence onto a theorized, meta-cognitive human condition.

In *The Authoritarian Personality* (Adorno et al. 2019), Theodor Adorno undertook a critique of such presuppositions at the heart of the field of personality research in the late 1940s. What Adorno saw as indicative of a “fascistic character,” the propensity to “type,”

to concoct different categories of personhood, reflected not internal mechanisms of achieving selfhood, but rather a “symptom” of industrial modernity’s attempt to inculcate a state of compliance. In her examination of the rise in popularity of the Myers-Briggs personality test, historian of science Merve Emre (2018) points out that,

The rise of industrial capitalism and the division of people into classes — owners versus workers, white collar versus blue collar — had left an indelible imprint on the souls of men and women, stamping certain predictable ways of thinking and feeling onto their psyches. Those who believed in the sanctity of the individual had been conditioned to do so by their class positions (2018, 126).

At the same time that mid-twentieth century subjects were being conditioned through the logic of “type” to think of their *selves* as confined to inherent and immutable personality categories, Emre (2018) demonstrates how they were also conditioned to respect the universality of psychological findings. Yet, these findings have faced criticism from outside of the field. Anthropologists have often drawn from cross-cultural evidence to critique the controversial subfield of evolutionary psychology (which is widely regarded with skepticism and at times, disdain even among psychologists). They’ve argued that sociobiology and its recent offspring, evolutionary psychology, are little more than a projection onto our evolutionary past, of the systems of domination and oppression at work under patriarchal, imperial capitalism (Sahlins 2003).

Science historian Jill Morawski (2005) has documented how in the course of these debates—with the exception of three relatively obscure psychologists—“experimental psychology virtually escaped reflexive regard, even evading the reflexive paradox of claiming rational authority about the irrationality of human nature” (2005, 78).

Throughout the 20th century, reproducibility in experimental psychology typically confined itself to questions of the technical, to domains considered “external” to the observer. Questions that were typically considered legitimate, at least to the extent that they successfully coalesced into an atmosphere of deliberation, were those regarding technical configurations of particular apparatuses in the lab, and/or the methods of communication outside of the lab.

An erosion of faith in scientific findings over the last two decades and rooted in the epistemic uncertainty surfaced through (ir)reproducibility extends across disciplinary boundaries, encompassing for example biology (Ioannidis 2005). Yet, the issue of reproducibility typically remains confined to “matters of concern” (Latour 2005) that are deemed *external*, to those material conditions that ignite concern, are reproduced and that ostensibly operate *outside* of and beyond what Morawski (2005, 98) terms the “subject-less” experimenter. Reproducibility and replicability are primarily treated as questions of data-sharing infrastructures and “incentive structures.” In the context of metascience, experiments are treated collectively, subjected to meta-analytic procedures of assessment, what sociologists Jeremy Freese and David Peterson (2018) call an emergent orientation toward *forensic objectivity* that treats metascience as the “ultimate arbiter of objectivity.”

Where experiments *fail* to reproduce, openness seems to emerge as a technology of the self (Foucault 1988), a quasi-voluntary means of normalization, reconfiguring human behavior through subtle attunements of practice and toward a more rational and objective ideal. The goal is a realignment with “common-sense” principles of scientific reproducibility, replicability, and open communication considered precursors to scientific falsification (Merton 1974; Popper 2008). In this project, I ask how infrastructures (such as the ones created by COS that I explore in more depth in the “Innovation” chapter) become material iterations of an aspirational technology of the (open) self. I ask how platforms are imagined to enculturate and embody open subjects, not through force, but rather through a quasi-voluntary, self-replicating sense of “flow” articulated through deliberate and iterative (re)design (Schüll 2014).

Amidst the technocentricity of metascience publications, questions of *social* reproducibility most often become bracketed and foreclosed. As a field, is metascience able to systematically apprehend the connection between knowledge infrastructures and the ways in which we sustain ourselves in increasingly precarious research worlds? Does metascience enable us to ask how knowledge infrastructures take shape in hollowed-out fields of late capitalist research practice? Is metascience able to consider how a proliferation of existential uncertainties might influence data quality and reproducibility, regardless of infrastructural fixes? Do the published products of metascience resemble social-constructivism (a sort of neo-constructivism), perhaps where *the social* seems not so much disassembled (Latour 2005), as absent entirely?

Despite orbiting around the same types of questions, the boundaries between metascience and STS seem to be erected and maintained by the gap created by the “horror of reflexivity” (Woolgar 1993). However, I demonstrate in my chapter exploring disruption and metascience that, as I spent more time with metascientists, I found that they were often deeply reflexive about “downstream” consequences. They increasingly came to express uncertainty, not only about whether projects would reproduce, but also about what it *meant* to replicate experiments (opening up a loop of uncertainty, similar to what Collins (1985) labeled the “experimenter’s regress”). They also came to reflect on how replications and uncertainty might reflect specific, situated technoscientific positionalities and situations.

On Studying-Up

The domains in which open science discourses and infrastructures are created and maintained are multiple. Individual projects and institutions orbit around an indeterminate figure of “open science,” influencing and shaping its contours with unique (and at times conflicting) outcomes. These contours and outcomes nonetheless share a certain *family resemblance* (Wittgenstein 2003), a set of loosely-shared understandings rooted in a wide-spread discontent with the state of contemporary research communities and practices. My attempt to ethnographically study a relatively influential open science institution works alongside the spirit of “studying-up” (Nader 1969; Gusterson 1997). Studying-up attempts to better grasp how discursive and material power are reproduced by studying influential institutions at work and in real-time. Questions concern how things are built and reproduced: concepts and terms, ideas and ideologies, political stakes

and stakeholders, as well as material infrastructures. Studying-up places aside assumptions regarding power relations, instead attending to the subtle relationships that construct and maintain moral economies (Daston 1995) regimes of value (Appadurai 1986), and (alternative) social relations. My approach to “studying-up” considers relationality *queerly*, through its contradictions; institutional relationality is emergent and porous, often unfolding iteratively and recursively (Kelty 2008), in counter-intuitive ways, even as social orders are ossified and reified (Gershon 2019).

As a technology and policy think-tank situated in the global North, with an annual non-profit budget of several million dollars U.S., the Center for Open Science is a relatively small but influential site in the crowded and breathless cacophony of public, academic, private, governmental and non-governmental entities that have sprung up around open science in the last two decades (Delfanti 2013; Mirowski 2018). However, I don’t argue for treating COS as the most significant or *valuable* site for open science (a statement with which I’m sure most at COS would agree).

As other ethnographers of open science have brilliantly demonstrated, open technoscience takes on multiple forms with the potential to disrupt preconceived power relations. Particularly in decolonizing contexts, “open science” is a contested and negotiated signifier for deeply potent projects by which oppressed communities make powerful claims to rights that are systemically denied by states and corporations (Alejandra 2018; Chan et al. 2019). Often developing their own, and/or using existing, decentralized and participatory experimentation frameworks, local researchers in these contexts use data to construct knowledges as counter-narratives, “patching into” a global

information conduit through which to circulate data and knowledges in opposition to narratives recognized and replicated by the state (e.g. in terms of environmental exposure).

Particularly in response to credible threats of surveillance, control, and reprisal, scientists in many of these contexts have been hesitant to adopt what they consider overly utilitarian and often totalizing open data standards and protocols developed and circulated in the U.S. (Alejandra 2018). While many researchers in these contexts self-identify as being engaged in open science, these ethnographies have demonstrated that they don't passively adopt technocultural forms reproduced in the global North. Open science is instead situated within a long history of reassembly, repurposing, remixing, and other forms of alternative re-production recently accelerated and intensified in the contemporary global condition (Boellstorff 2005; 2008; Appadurai 2013).

I found COS to be a particularly generative site for ethnographically engaging questions of open science, particularly as visions of alternative research commons become tightly coupled to infrastructure. At times, these attachments and couplings took on a familiar, techno-utopian resonance. A spirit of connectivity and relationality underwritten by the familiar logic that "if we build it, they will come," knowledge infrastructures stitch together forms of community and commons. At other times, the fate of the commons in contemporary research cultures seemed much larger and much more complex than able to be imagined through technological fixes. While questions of *social* reproducibility rarely entered the formal deliberative atmospheres of open science at COS (e.g. meetings), informal conversations often touched on how science and

experimentation is configured by conditions of social reproduction, opening onto questions of how conditions of social reproduction are reconfigured by experimentation.

Throughout this project, openness often feels beyond reproach, like a moral absolute. As a technique of self-craft, openness implies a reflexive tendency, a movement toward an alternative sociality with an inherent capability to meet the contemporary needs for scalability demanded by the generalization and proliferation of wreckage under late capitalism (Beck 1992; Tsing 2015). In the next section, I begin to examine how epistemic openness also comes with its horrors.

Horrors of the Open: Social Abandonment in the Academy

Whoever fights monsters should see to it that in the process he does not become a monster. And if you gaze long enough into an abyss, the abyss will gaze back into you. (Nietzsche 2008, 68)

In their groundbreaking essay on *professionalization* in the university, Stefano Harney and Fred Moten (2013) insist that the only viable orientation toward the academy today is one rooted in transgression and fugitivity. Hollowed out under the force of neoliberal capitalism, the academic subject is today an ossified creature whose reproduction is assured in the repetitive crucibles formed by forces of modulating in a society of (digital) control (Deleuze 1992). Contemporary sites of knowledge production are inundated with strategies and tools for transforming and reproducing researching bodies into branded commodities. Professional social networking sites like LinkedIn.com and Academia.edu function by enticing us to meticulously curate our “public-facing” personae. As open-ended, entrepreneurial subjects, we’re drawn to a mirage of a

professorial commons, always with automated suggestions of other researchers to follow (and emulate). We're even tasked with participating in a system of symbolic reciprocity; to exchange what are often essentially baseless and infantile "badges" and "endorsements" of one another's "skillset." With the open-ended extension of contemporary adolescence (Harris 2017), meaningful prospects for life-sustaining research have evaporated, replaced with gold star stickers.

In a cruel twist of irony, those who stand to benefit most from the "premium" features proffered by these platforms (e.g. wider exposure to more profiles) are also the exhausted members of the academic precariat who are least likely to be able to afford them. Furthermore, there is little substance to the promise that ostensibly "decentralized" networking infrastructure platforms like LinkedIn will be able to "automate" away racial bias and systemic harms. Research on algorithmically-driven platforms suggest that such tools more often replicate, amplify, and further reify existing hierarchies constructed along such social axes as race, class, gender, sexuality, and ability (Amoore 2011; Eubanks 2018; Dave 2019).

A pernicious dimension of the reputational landscape we're forced to navigate as researchers in the twenty-first century, these platforms stand-in (both literally and figuratively) for what many of us find lacking: institutional support for relational solidarity and realistic, life-sustaining prospects for employment. Recent evidence gathered from surveys taken among early and middle career researchers (EMCRs) indicate a mental health crisis in the academy (Plos Student Blog 2018). Evans et al. (2018) recently found, for example that rates of severe anxiety (41%) and depression

(39%) amongst doctoral researchers are often times up to six times higher than in the general population.

Configuring mental illness as a symptom of the larger evaporation of the future under *capitalist realism*, Mark Fisher (2009, 35) has argued that, “with post-Fordism, the ‘invisible plague’ of psychiatric and affective disorders that has spread, silently and stealthily, since around 1750 (i.e. the very onset of industrial capitalism) has reached a new level of acuteness.” Fisher credits Marxist economist Christian Marazzi (1998) and Richard Sennett (1999) with recognizing that the new conditions of deregulated, flexibilized, Capital and labor emerged from “an increased cyberneticization of the working environment” that we now see articulated in the social mediatization of academia (2009, 33), and in the proliferation of techno-utopian fixes. Drawn in part from her own experiences navigating bipolar disorder as an academic, anthropologist Emily Martin (2007) similarly traces how mental disorder becomes both a symptom and an asset of creative labor in the cultural contexts of contemporary, flexible finance capital. An influential and well-intended cottage industry has begun to blossom in these flexibilized, hollowed-out wastelands of late capitalist academia, where PhDs offer advice on how to acclimate and accommodate yourself to a “freelance” worker in academia by “pivoting” your humanities and humanities-adjacent PhD into “industry” (e.g. Pryal 2019). It’s difficult to imagine how we go about dismantling systems of oppression when we can’t see beyond the imaginative limits of our own (Fisher 2009).

Tenure-track academic positions continue to evaporate, as profit-maximizing university administrators continue cutting permanent appointments in favor of low-wage,

“flexible” adjunct, or “gig” positions (The Chronicle of Higher Education 2018). As a result, alienating and often violent *pathologies of power* (Farmer 2005) and patterns of abuse take root and are reproduced in the affective voids created when academic labor is devalued, deskilled, and disempowered, a process which disproportionately targets early and middle career women scholars of color (Palmer 2019). The recent example of an extensive pattern of abuse and sexual harassment toward precarious employees at the (formerly) open access anthropology journal *HAU* articulates in particular how such patterns emerge even amidst the apparent progressivism of “open” institutions (West 2018).

Demonstrating how these horrors work in the present shouldn’t be regarded as a nostalgic yearning for the past. Instead, it should be read as further evidence that we can no longer hitch ourselves to the Liberal myth of inevitable historical progress (Tsing 2015). As a *professionalized* institution (Harney and Moten 2013), the North American university increasingly exists to prop up an emergent, audit-driven managerial class primarily charged with sustaining an anxiety-inducing feedback loop of “assessment” (Strathern 2000; Hacker and Dreifus 2010; Fisher 2009). Furthermore, the “adjunctification” of the academy has been coupled to a ballooning debt crisis fueled by rising tuition rates and wage stagnation, thus ensuring that first-generation, working-class college students who once saw graduate school as a means of economic mobility, will be forever trapped in an abyss of debt which ensure that patterns of harassment and abuse will be allowed to reproduce (Zaloom 2018). Public university administrators also continue to disavow and devalue the crucial work of the university’s army of maintainers,

the classified staff who actually contribute to the production of value by cooking meals and maintaining and repairing the physical infrastructure and facilities upon which research and teaching depend (C. Anderson 2019).

The unsettling characteristics of subjective openness, of an entrepreneurial orientation toward the academic worker as an experimental and open subject, resemble those of contemporary subjects under the digital societies of control articulated through participatory, “social” media (Han 2015). Within anthropology, participatory media also often represent opportunities for engaging in public anthropology; for extending ourselves to precipitate an emergent, public sphere of rational deliberation around the insights that ethnographic representation offers into the human condition (Habermas 1999). One might speculate for example how Ruth Benedict might have considered how Twitter, with its accelerated and expansive reach, in the hands of anthropologists, might figure into the noble project of “helping to make the world safe for human differences” (Shannon 1995).

In the autonomist Marxist theoretical tradition, the figure of the “social factory” builds upon Marx’s (1973) identification of the process of the real subsumption of labor, the increasing tendency of automation not to bring about the liberation of the worker, but instead to penetrate and reach into previously “nonproductive” social spaces, to encompass, enclose, and exploit each aspect of life. Under the forces of post-Fordism “the whole society becomes an articulation of production. In short, all of society lives as a function of the factory and the factory extends its exclusive domination over all of society” (Tronti 1962, *cited in* Thoburn 2003, 78).

In her critical exploration of digital labor, Kylie Jarrett (2015) notes that, contrary to the claims of organic intellectuals in *Operaismo*, the social factory is in fact, not all that new. The reproduction of capital has always depended on systems of extraction designed to exploit uncompensated work socially deemed “nonproductive,” in particular, the often-feminized work of *social reproduction*. Anna Tsing (2015) similarly traces the historical trajectory of uncompensated labor in the plantation system as an integral force in the scalability of global capital. Jarrett’s figure of the “digital housewife” draws attention toward the gendered divisions of labor that sustain contemporary capital through digital platforms, while paying tribute also to radical political movements to have that labor valued and compensated (e.g. the “wages for housework” movement led by Italian housewives in the 1970s). Applied toward multispecies communities of doing and knowledge production (e.g. in permaculture sustainability communities), Maria de la Bellacasa’s (2017) work figures and blooms in the same radical histories and critical approaches toward care practices and ethics. Her critical elaboration upon Bruno Latour’s (2004) call for studying *matters of concern*, which she reframes as *matters of care* that are more attentive to the messiness and partiality of care obligations, figures prominently into how I tried to theoretically approach the simultaneously deconstructive and repair-centered practices at the center⁶.

While Jarrett’s (2015) work focuses on the structures by which digital media consumers come to regard themselves as volunteers who nonetheless create an enormous

⁶ For reasons I discuss later, I hesitate to describe the ontology of open science as “reparative,” although it was very often motivated by a kind of “spirit” or ethos of repair (Simmons 2016).

amount of value for large corporations like Facebook, I suggest that this figure of the “digital housewife” is also helpful for anticipating how open research ecologies (even when *nominally* positioned in relations “outside” of the machinations of capitalism, as a “non-profit”) might similarly come to sustain and reproduce mechanisms of capitalist extraction and exploitation. As researchers come to regard not just their research data, but also their entire *selves* as open-ended subjects, to be meticulously curated in the “open” social factory of research, how are corporations reconfiguring the means of knowledge production to capture new frontiers of extraction? Most importantly, who are the researchers that “openness” places in the most precarious positions?

Open science discourses rarely touch on the use of existing “participatory” platforms for exchanging and interpreting scientific knowledges, although they often rely on such platforms as Twitter and Reddit to recruit and organize communities of open science advocates, as well as to guide open science discourses. However, in the context of public participation in how scientific findings are interpreted and their meanings negotiated, science has (in many ways) never been as “open” as it is in the contemporary moment. In his discussion of *biohackers*, Alessandro Delfanti (2013) argues that participatory, open science directly appropriates cultural strategies of “hacking,” applying a DIY approach toward questions of scientific discovery and biological modification. Sophia Roosth (2017) similarly documents open-ended, do-it-yourself approaches to “creating life” with the rise of the field of *synthetic biology*.

Anthropologist Jenny Reardon (2017, 7) has documented how *genomic liberalism*, the collection of “efforts to secure the meaning and value of human genome sequence

data through creating a participatory, inclusive, and open genomics,” has largely failed to materialize some of the sweeping promises of the human genome project (e.g. major biomedical advances, and the establishment of a post-racial polis). In their extensive qualitative analysis of the online white supremacist forum *Stormfront*, scholars Aaron Panofsky and Joan Donovan (2019) similarly argue that white supremacist commentators who visit the site upon receiving direct to consumer genetic ancestry test (GAT) results from companies like 23andMe and Ancestry, participate in a form of collective negotiation similar to citizen science. While they may initially express personal frustration over findings that indicate Jewish and/or African ancestry for example, they will often engage in collaborative boundary-work (Star and Griesemer 1989), including contradictory practices of what they call “racist bricolage” (Lévi-Strauss 1966), strategies that that collectively shore-up and ossify, rather than *disrupt* their confidence in race “science” and the idea of bounded/pure races (Panofsky and Donovan 2019, 675).

The liberal ideal of information transparency often draws upon a progressivist axiom which treats data as fungible, stable commodities (Leonelli, Rappert, and Davies 2017). Information exchange is best left to its own devices, to swirl around in a rationally ordered, disembodied and freely circulating “marketplace of ideas.” The metaphor resurfaces frequently throughout “open science/science 2.0” representations (M. A. Nielsen 2012). *Like bugs in code, many hands make light work. The only cure for bad information is more information.*

I discuss in my chapter on *Repair* how the enduring figure of a free marketplace of ideas, coupled with a hands-off, “hacky” spirit of anti-moderation (Tkacz 2016) has

contributed to a tendency among open science advocates to treat academic content moderation and peer review as *prima facie* sources of (implicit) bias and inefficiency, rather than imperfect systems for quality assurance. While one can hardly argue with the inadequacy of conventional peer review coordinated through extractive, parasitic journal publishers, I demonstrate how open science is nonetheless left with few mechanisms of *epistemic* repair, of guarding against the recuperation of open science to reanimate, amplify, and grant appearances and imprimaturs of legitimacy to deeply reactionary pseudoscience that many open science advocates and workers find personally reprehensible.

Laboratories and Social Factories: Reproducing Objectivity

The task is to win over the intellectuals to the working class by making them aware of the identity of their spiritual enterprises and of their conditions as producers. (Ramon Fernandez, cited in Benjamin 1999)

From my standpoint in queer feminist science and technology studies, the recent emergence of metascience—“the emerging field of research on the scientific process” (Metascience Symposium 2019)—conjures an image of the field as simulacrum (Baudrillard 1995), a chain of echoes reverberating without a clear origin. As I demonstrated in the historical formations section of this chapter, the philosophical questions and propositions raised by metascientists are reminiscent of those raised in science studies scholarship. While both fields formed out of turbulent moments of collective disenchantment with the narratives of progress—particularly regarding the idea of objectivity’s persuasive inexorability—the points where their paths explicitly cross are

virtually non-existent. Despite a long history of queer feminist and postcolonial scholars attending closely to the material and epistemic contexts, relationships, and systems upon which experiments depend and through which alienating practices become normalized and ossified, metascientists rarely cite their work.

A “recombinant” genealogy of STS and anthropology (Fischer 2007) draws a direct connection to the reflexive turn that took shape in feminist anthropology the 1980’s. A theoretical and methodological accounting for one’s own standpoint, an appreciation for the ways in which standpoint infuses into our research, feminist ethnographers made groundbreaking contributions to the systematic cultural study of science and technology (Haraway 2006; Traweek 1988; Martin 1994). Animating the concept of research reflexivity in light of science and technology, they focused primarily on questions of epistemology, demonstrating dense material-semiotic connections embedded in cultural systems of knowledge through meticulous, ethnographic “implosion” (Dumit 2014).

Far from a technologically mediated and purified, subject-less “view from nowhere” (Latour 1986; Daston and Galison 2010), objectivity in these studies emerges as rather a “complex gathering” (Latour 2004), neither timeless, taken for granted, nor innocent. Rather, objectivity comes carrying material-semiotic baggage, like so much of technoculture, “with its worlds” (Haraway 1997). What we come to regard as “objectivity” is far from pure, but deeply laden with naturalized, normative categories and presumptions (Harding 1994; Hartsock 1983; Haraway 2006).

Situated knowledges reflect a potential for participation in more-than-human collaborations (Haraway 1988). Feminist ethnographers of science borrow from the

sociological concept of *standpoint theory* (Hartsock 1983), which built upon the Marxist argument of a collective ontological and epistemic agency immanent in the recognition of shared subject positions and knowledges (Marx 2007; Gramsci 1972). In standpoint theory, the strategy of “strong objectivity” reconfigures experience and sensation as sources of insight, rather than bias; liabilities to be *bracketed* out of experimentation.

Instead of reinforcing subject/object differences, “strong objectivity requires that the subject of knowledge be placed on the same critical, causal plane as the objects of knowledge. Thus, strong objectivity requires what we can think of as a strong reflexivity” (Harding 2004, 136). However, in ethnographic representation, there exists a tension with the ways in which standpoints can become fetishized, producing the appearance that subjectivities are static, timeless, and mutually-exclusive (Haraway 1997). How do we instead account for *movement* across multiple, intersecting, and often contradictory boundaries across disparate subject positions and social orders (Gershon 2019)? Furthermore, how do we account for the labor required of these movements, particularly when assemblages become predicated on becoming-open (Deleuze and Guattari 1987)? These questions become particularly relevant when considering the relationship between objectivity and reproducibility in the contexts of open sciences, where practices of designing alternative ecologies for research are underwritten by imaginaries of collaboration and relationality that span disciplines and fields.

Open Science as Frontier

While offered ultimately in defense of logical positivism, Thomas Kuhn’s (1994) well-known contribution to science studies was a recognition that objectivity takes a form

resembling less of a reflection of an inherent superiority of a particular experimental apparatus, and more of an index of an experiments' persuasive communicability. Science historians Steven Shapin and Simon Schaffer (2011, 60) similarly defined "virtual witnessing" as a fundamentally literary technology, developed in the West during the 17th century, which established matters of fact through "production in a *reader's* mind of such an image of an experimental scene as obviates the necessity for either direct witness or replication" (*italics original*). The ability to convince a reader that an experiment was performed *as described* hinged, at least in part, on ones' ability to draw a compelling mental image through prose. By the middle of the 19th century, Lorraine Daston and Peter Galison (2010, 195) note, the ethos of "mechanical objectivity," particularly regarding scientific images, had begun to supersede the preceding reliance on the prosaic; fidelity to the instrumental outputs of experiments as the benchmark of reliable and objective reflections of nature had begun ascending to a matter of moral duty.

In the early twentieth century, Daston and Galison (2010) go on to argue, scientific images have come to be dominated by a movement away from representation as an act of ensuring "fidelity to nature," in favor of *presentation*. The figure of an "image-as-tool," they argue is coupled to "a new kind of scientific self – a hybrid figure, who very often works toward scientific goals, but with an attitude to the work that borrows a great deal from engineering, industrial application, and even artistic-aesthetic ambition" (2010, 413). Anthropologist Orit Halpern (2014) has similarly argued that the arrival of the figure of "beautiful data" in the midst of Cold War urban planning, a hybrid of cybernetics and pedagogy in engineering and the arts, signals the emergence of an

inchoate form of governmentality. In this emerging feature of governmentality, subjects are fashioned, made representable and malleable through an increasingly amorphous, open-ended ecology of information. Consequently, interest in data's fidelity begins to take on an *ad hoc* quality. In the fantasies of accelerated feedback loops of big data enfolded in an infinite, open-data ecology, practitioners "agglomerate information and retroactively discover patterns. This "communicative" objectivity was data driven, nonstructural, and relational" (2014, 95).

In her ethnographic study of synthetic biology, Sophia Roosth (2017) draws upon queer theory to demonstrate how the business of "creating life" similarly signals a shift toward retroactive, just-in-time, and "supply-side" laboratory practices. She argues that "they [synthetic biologists] do not make living things in the service of discovery science or experimental research alone. Rather, making is also an *end* in itself. Newly built biotic things [...] are tools with which synthetic biologists theorize what life is" (2014, 3 *italics original*). Drawing inspiration from Marxist and queer theory, Roosth (2014) simultaneously offers an ethnographically-informed critique of mechanisms of exploitation and extraction often obfuscated in the fetishized global supply chain of corporate biotech (Hayden 2003; Sunder Rajan 2006), while also offering an appreciation for the ways in which the materiality of synthetic biology disrupts naturalized taxonomic categories of descent and relationality by creating unruly, transgressive, lively artifacts.

In the post-genomic condition of ready-to-hand genetic insight (Reardon 2017), as synthetic life is transformed and packaged into data, commodities, and property following the 1980's passage of several pieces of legislation legalizing the patenting of

DNA, notions of propriety frequently reassert themselves in alignment with capital accumulation. Yet, synthetic biology at times renders such relations unstable in debates over whether or not to make such data free and “open” under copyleft licenses (Kelty 2012). Within free and open source software communities, questions of value and propriety have long been the subject of intense debate (Kelty 2008). On the one hand, communities that began creating and maintaining free and open source software in the twilight of the 20th century were thought by some to herald an intoxicating post-capitalist ethos resisting the brutal hegemony of the profit motive at the supposed heart of creativity and innovation (Negri and Hardt 2014, 301). The world of free and open source software seemed at first a reaffirmation of the hope that humans (like much of the natural world) are naturally predisposed toward collaboration over conflict and competition (Kropotkin 2017).

Over the course of about a decade however, corporate software entities have come to be built upon (and profit from) much of what was originally intended to be open. Proprietary “platforms” didn’t appear from whole cloth. Instead, they extract surplus value from the uncompensated labor of free and open source programmers and content moderators (Terranova 2000). This is a relation of intellectual production not unlike that which currently reproduces the academic publishing industry, in which researchers are recruited to supply mostly uncompensated peer review labor and to pay fees for access to the article that they helped to produce.

Open science I argue emerges as a new frontier—a zone of uncertainty and potential, open to primitive accumulation as emergent forms of exploitation seek to privatize

increasingly diffuse means of knowledge production (Marx 1981; Tsing 2015). Corporate publishers are in a mad rush to define, analyze, enclose, and accumulate open science and open data. Hardening and ossifying categories is a vital component of making extraction and exploitation scalable (Tsing 2015). In this process, a familiar specter of exploitation emerges, this time regarding the potential exchange value able to be extracted from creating categories and patterns in scientific data and metadata (e.g. data and “insights” gleaned from research workflow and life-cycles by large, extractive, rent-seeking publishers such as Wiley-Blackwell and Elsevier) (Kelty 2016b; Posada and Chen 2018; Caduff 2017). In my chapter on innovation and ecologizing research, I discuss how open science advocates often express personal opposition to for-profit, corporate interests in treating scholarly workflow data with a spirit of “communicative objectivity” (Halpern 2014), highlighting how interconnectivity across multiple platforms emerges as both, an emergent objectivity and a prophylactic against corporate parasitism via “locking down” research workflows.

Queer Feminist STS and Experimental Reproducibility

How might metascience and reproducibility figure into transgressive and fugitive orientations toward the university? Quantum physicist and STS scholar Karen Barad (2007) draws inspiration both from the work from Judith Butler (2006) on performativity, and quantum physicist Niels Bohr (1998), to develop a theory of reproducibility that focuses on entanglements amongst “experimental apparatuses.” Animating Barad’s (2007) and playful mode of attending to the material-semiotic circumstances of objectivity (what she calls “meeting the universe halfway”) as an act of salvage in the

context of the ever-expanding wreckage of the Anthropocene, media theorist McKenzie Wark notes that material-semiotic objectivity is far from a “mirror of nature” reproduced by either “the moral probity of the gentleman scientist, or because of the rote work of the lab assistant.” Intimately entwined with reproducibility in the means of knowledge production, objectivity involves

being accountable to a materialization of which the scientific worker is a part. Objectivity means producing a certain kind of *cut* in the world, over and over again, and getting comparable results. But the results are always the product of a particular apparatus, which makes this cut in a particular way. [...] The advance of Bohr and Barad is to insist that what objectivity really comes down to is repeating the situation of the experiment and communicating the result. [...] There is a realism of the means of production of knowledge. It might even be a realist *media theory*, where the media in question are scientific ones (2015, 157-158).

A “realist media theory of knowledge production” echoes empirical insights derived from ethnographic laboratory studies. The extents to which devices, apparatuses, reagents, and sensors *come to matter* in experimental conditions and institutions is often in tension with tacit knowledge and skill (Collins 1974; Traweek 1988; Knorr-Cetina 1999). This issue surfaces repeatedly in metascience, as researchers debate the importance of situated knowledges and having ‘a feel for the experiment’ when replicating psychology and biology experiments outside of a lab. As vagaries are woven

deep into the “thickly populated worlds” of technoscientific practice (de la Bellacasa, 2017), prescriptive generalities as a result lose their stability, not just for the meanings surrounding “good science” (Thompson 2013), but also for emergent frontiers of what constitutes “open science” (Levin and Leonelli 2017). For Wark (2015), who also engages deeply with the speculative fiction of Soviet author Alexander Bogdanov, labor is embedded deeply within knowledge production. In response to a “shift toward the right” (2015, 179) in science studies, which “undermin[es] confidence in the methods of climate science and the consensus reached on climate change,” Wark (2015, 180) instead advocates a movement away from constructivism and toward the study of the reproduction of an “*infrastructural unconscious*,” attending to the multiplicity of the relations of labor that produce, and mediate knowledge and information.

However, where social constructivism has been implicated in reactionary critiques of climate science, I argue that this has likely been the case because social constructivism has itself been cynically misappropriated. In a critical response to the emergence of *new materialisms* which are predicated on the charge that feminist STS has disregarded materiality in a spirit of anti-biologism, Sara Ahmed (2008, 33) makes an argument that the poststructural turn in the study of technoscience has always been steeped in materiality; she argues that, “if anything, given the concern with the social reproduction of hierarchies, much feminist work might point to the complexity of the relationship between materiality and culture, rather than reducing one to the other.”

“Thinking-with” Haraway (Haraway and Goodeve 2000, 101-8) and Barad (2007, 71-94), Maria Puig de la Bellacasa (2017) also seeks to understand processes of *mattering*,

particularly as they foster multiplicity by creating conditions for *diffraction* rather than repetitions of ethico-political forms. She argues that, “*feminism does not preexist its relatings*. Ontologies and identities are affected by collective politics and positionalities that constantly have to confront and put into question the boundaries and cuts given in existing worlds” (Puig de la Bellacasa 2017, 72). Rather than boxing us in as passive observers, queer feminist STS attends to the diffractive and multiple at work and at play in seemingly naturalized, common-sense communities of practice (e.g. those that reproduce the dichotomy between “open” and “closed” science). Furthermore, thinking with knowledge production as labor and of labor as knowledge production in the ethnographic encounter queers the linkages between embodiment (i.e. the reproduction of the self) and experimentation (i.e. the reproduction of interactions amongst variables). Uncertainty requires labor.

Building upon this performative framework for understanding relationships in collaborative research projects, Rachel Ankeny and Sabina Leonelli (2016) find the pragmatic category of *repertoires* particularly generative for navigating the often-diffractive, diffuse and deliberative encounters and circumstances in technoscience. Research repertoires mark the multiple ways in which researchers reflexively “wield and align specific skills and behaviors with appropriate methods, epistemic components, materials, resources, participants, and infrastructures” (Ankeny and Leonelli 2016, 19). The figure of repertoires in various states of (mis)alignment is particularly helpful for understanding how collaborative groups of metascientists reflect on the ways in which

they form identities, distribute credit and prestige, perform discipline-specific boundary-work (Susan Leigh Star and Griesemer 1989), and disseminate research outputs.

Because COS acted as a central hub through which much of the replication labor for the metascience projects was coordinated with outside agencies during the reproducibility studies, my decision to spend most of my time with metascientists at the Center meant that I was unable to follow the replicators, to fully witness replication “in action,” as it were (Latour 1987). In that sense, my chapter exploring the question of disruption in metascience is perhaps less of a traditional laboratory study and more of an exploration of networks of deliberation, coordination, and exchange across space and time (Malinowski 2014; Povinelli 2011). How do these networks influence the ways in which a group of metascientists, trained in molecular biology, psychology, and statistics come to see themselves as open-ended subjects, constantly re-aligning and shifting their repertoires in real-time, in order to cope with epistemic uncertainties and unanticipated “road-blocks”? It’s in this chapter that I extend the figure of research repertoires toward a view of reproducibility as a kind of performative reenactment, one in which metascientists’ own opinions on reproducibility become disrupted, upended, and complicated.

Anthropology of/as Maintenance and Repair

Vulnerability is woven into the fiber of reflexivity (Behar 1996). Ethnographic reflexivity is at least partially about recognizing personal embarrassments and foibles, bearing resemblance to the cathartic release of a confessional. My interest in the open science movement began with what I later realized were the naive expectations of my own pre-field imaginaries. I’d initially wanted to study the movement of open science out

of a critical curiosity in “disruptive” start-ups. I had become increasingly critical of the wave of “disruption” surging through service economies and increasingly mediated through digital platforms. “Disruption” always appears cynical, recuperating and sanitizing anti-capitalist aesthetics toward exploitative and oppressive projects in hybrid digital-analog worlds. I wondered how this process extended to science. I had initially set out to immerse myself on the ground-floor of disruptive innovation, uncovering the practices at work in ambitious projects to first theorize, then *shift* a notion of the collective behavior of scientists.

But ethnographic encounters often bloom out of the uncertainties of personal disappointment. I’m ashamed to think of how often I feigned enthusiasm when handed tasks that were much more mundane than the tasks of creative innovation I’d been imagining for months. Instead of taking part in conversations about the design of new software features for the flagship platform OSF, I often found myself editing mundane surveys and emails. I couldn’t comprehend in the moment how significant these maintenance labors could be in the organization.

As our late industrial worlds continue to succumb to the ravages of deferred maintenance under restructuring and privatization (Fortun 2014), social scientists have called for a turn (see e.g. Russell and Vinsel 2018) toward what Steven J. Jackson (2014) has described as “broken world thinking.” In worlds constantly pulled between states of (dis)repair, Jackson (2014, 222) suggests *repair* is perhaps best defined broadly, as “the subtle acts of care by which order and meaning in complex sociotechnical systems are maintained and transformed, human value is preserved and extended, and the

complicated work of fitting to the varied circumstances of organizations, systems, and lives is accomplished.”

In his ethnographically informed theory of “*people as infrastructure*,” Abdoumalig Simone (2010) draws attention to the subtle, mundane, daily acts by which urban residents in Kinshasa shore-up and repair, not only physical connections that circulate technical things, but also crucial bonds of sociality and solidarity. Antina Von-Schnitzler (2013) similarly demonstrates how water meters in Soweto, South Africa were introduced to inculcate a particular, “modern” subjectivity under Victorian English colonization, later coming to be the subject of “rent boycotts” as women-led protest groups circulated knowledges about how to divert the meters in order to provide water to one another’s neighbors.

Anthropologists Christina Schwenkel (2015) and Jessica Barnes (2017) both explore what happens when the maintenance and upkeep of water and irrigation networks get passed on to residents in post-socialist Vietnam and Egypt, respectively. As repair becomes re-configured as an ethics of solidarity and care, Barnes (2017) notes how its performance at the hands of residents comes to threaten the legitimacy of the state, who seize upon repair to shore-up an image of legitimacy. Also based in Cairo, Julia Elyachar’s (2010) ethnographic work underscores the ways in which women’s practices of sociality expressed and maintained through what she calls “phatic labor,” came to be recognized by finance “empowerment” NGO projects as networks of infrastructure just as crucial to the Egyptian economy as roads, bridges, and telephone lines. These formerly “semiotic commons” (Kockelman 2005) came to be recognized, and enclosed, as sources

of alternative value. Situated within these “informal economies” (Elyachar 2010; Hart n.d.), she argues that systems of enclosure become predicated not on directly economic motivations, but rather on the idea of the *eventual* and *potential* value of continuing to keep lines of communication open. This sort of speculative, theoretical interest surrounding indeterminate communications infrastructures is, I will argue, not unlike the vagaries surrounding corporate interest in open science.

Queer feminist scholars studying repair have been particularly interested in the question of critical theory as a reparative intervention, a mode of resisting the kind of imaginative foreclosures we often find in otherwise “paranoid” and “deconstructive” readings (Sedgwick 2003; Puig de la Bellacasa 2017). In a reparative reading of “imposter syndrome,” historian Dana Simmons (2016) thinks-with queer feminist STS and anti-racist scholarship to arrive at reparative reading as:

A non-innocent accounting for the past and a making of amends. A reassembly, refiguring and reconfiguring objects to make them more livable. A generous, generative process, testing, cutting and employing old tools in different ways. I am interested less in deconstruction than in serious tinkering (Simmons 2016, 123).

Since completing fieldwork, I’ve come to notice how often open science discourses become saturated with references to maintenance and repair. In conversation, open science advocates would often compare scientific knowledge to the structure of a building that had begun to crumble under the weight of deferred maintenance. Ethics of care have long been recognized as an integral component of the stewardship of

experimental design, the contingent generalizability of findings, and the stability of the scientific process itself (Shapin and Schaffer 2011; M. Fortun 2005; Thompson 2013). In that sense, there was nothing all that novel about the use of the architectural metaphor to describe the stability of experimental research processes.

However, open science advocates extend the analogy in interesting ways. They are mindful that this is a moment in which researchers increasingly describe symptoms of depression and anxiety related to the pressure to publish novel and innovative findings in an increasingly oversaturated and competitive job market. They often express hope that their work will create space and mechanisms for valuing what often escape recognition, overlooked as invisible labors (e.g. the subtle and often mundane work required to ensure data quality and adherence to research standards, which are crucial in research).

In the wake of a surge of generalized epistemic uncertainty and anxieties—from the "reproducibility crisis" in psychology and cancer biology, to climate change denial and vaccine refusal—open science poses a paradox. On the one hand, some critics regard open metascience an emergent neo-constructivism, a corrosive and deconstructive force undermining public confidence in scientific findings. On the other hand, a potent anticipatory logic of repair underwrites visions of open sciences mediated through social connection and community-building. Propelled by an intoxicating spirit of tinkering, open science attempts to give social form to research as a gift economy (Mauss 1967), a system of exchange based upon a spirit of reciprocity and creative solidarity, rather than novelty and competition. In the final two chapters, where I focus on issues of maintenance and repair, I explore this paradox in greater depth. Following a bit of the

social life of preprints, what I describe as a *queer object*—an indeterminate and transgressive infrastructure of scientific communication—open science I argue has in recent years become less an expression of self-sustaining collective effervescence and more a matter of maintaining and “merging” imaginaries.

Examining the unintended, “downstream” effects of accelerated, decentralized modes of experimental communication underwrites the theme of the concluding chapter, where I explore questions surrounding content moderation and peer review in open science, specifically with the appearance of preprints. There, I argue that the utilitarian framing of open science and the fetish of a “free marketplace of ideas” facilitates both the acceleration and obfuscation of reactionary pseudosciences and misinformation. As a result, the cultural efficacy of categories of research authenticity (e.g. the epistemic work we hope to be performed by labeling reactionary pseudoscience as *pseudoscience*) is increasingly undermined by accelerationist narratives of open science.

Epistemic and ontological repair, creating spaces and infrastructures for *reparative*, creative solidarity, I argue demands neither a return to parasitic, for-profit publishers nor a breathless embrace of seamless and accelerated interconnection. I tried to demonstrate throughout this theoretical framing and literature review how contemporary research cultures and subjects are, in some ways more “open-ended” and “transparent” than ever. The results are mixed. Infrastructures of knowledge are constructed and reproduced through quasi-voluntary mechanisms of extraction and exploitation which include the imperative that we each transform ourselves into open-ended, participatory subjects. Open science is alluring because it conjures a promise of community and connection,

intellectual solidarity and collaboration through shared products and resources, while at the same time, potentially (if even unintentionally) streamlining and accelerating data-extraction. In the next chapter, on ethnographic methodology, I attempt to seriously contemplate what creative and intellectual solidarity and co-constructed knowledges can look like in ethnographic practice.

Chapter Two

Stories of Design: Ethnographic Methods and Data Analysis

Openness and the Labor of Uncertainty

Late one evening in the summer of 2016, we walk out a “hidden” door. The nostalgic pastiche of the retro “speakeasy” became even more ironic by the deafening noise inside. Along with about ten open science advocates, we begin to walk down a well-lit alley off the idyllic downtown mall. We cross the small, one-lane side street that would just months later become the site of anti-racist activist Heather Heyer’s brutal murder during the white supremacist “Unite the Right” rally of August eleventh and twelfth. In this moment, as many of the students at the nearby campus of the University of Virginia have returned home for the summer, the small urban core lined with bars and restaurants is quiet.

The stifling mid-summer heat had begun to subside for the night. Our group, including developers, community team members, and metascience researchers from the center, peel-off periodically as we walk down the bright red brick footpath, moving aimlessly but in the general direction of the office. I’ve only been in town less than a week. Because I couldn’t secure funding, I can only afford to spend two months at the center. Anxious to begin the rapport-building process, I’m glad I’m already receiving invites for after-work drinks.

Rounding the corner out of the alley and onto the mall, Bridgette, an open science “evangelist” on the community team and I are talking about research methods. She’d tried to ask what my research entailed inside the bar, but our conversation kept getting

drowned out. Bridgette had received her master's in biology and worked as a lab researcher in several labs both in and out of academia before coming to work at the center. She'd heard about the center and decided to apply after speaking with a community team member at one of the booths at an open source software conference. Though she'd been there a few months, she's still a bit uneasy about the religious connotation that surrounds her official title of "open science evangelist." Still, she's deeply committed and enthusiastic about the mission, she tells me.

She'd recounted how she'd quickly grown frustrated as a lab researcher. There were several times she'd try to replicate an experimental procedure from another lab, with only to the methods in the published article as reference. She'd felt like she'd had little success. Over time, she began to experience imposter syndrome, doubting whether she was a good researcher. Maybe it was a problem with her skillset, she thought. She began to feel like maybe she wasn't cut out to be a researcher. When she discovered open science, it felt like a way of helping early career researchers to become more confident in their skills. By shifting science toward more open practices, she was teaching research teams how to use tools to help expose not just the published end-products of scientific research, but also more of the data, procedures, methods, and materials. Open science, she said, was about creating an atmosphere where researchers could feel more comfortable telling a more complete "story" of an experiment. She'd hoped that, by helping to create a culture that would allow for more complete storytelling, other early-career researchers might be less inclined to doubt their own expertise and skills.

As we continue to walk, I tell her I've been facing similar experiences in my own project. As a grad student, I frequently doubt my skills. I'm constantly unsure of my grasp on ethnographic methods. To cope with uncertainty, I'm often retreating to what feels like a more comfortable ambiguity in theory. While there are plenty of books on ethnographic methodology, we're often told that some aspects of ethnography simply don't translate. To *do* ethnography, we have to work issues out "on the ground," in the course of fieldwork. Ethnographers have to be *flexible*, open and sensible to the indeterminacy of complex interactions, in ways we often don't anticipate and can only begin to apprehend long after we've left "the field" (Stoller 2009).

"I'm not that familiar with anthropology," she replies. "What is it that you do?" As far as she could remember from her undergraduate course, she explained, anthropologists studied cultures and subjects that were "far from home." In the moment, I stumble my way through the formulaic response I'd crafted months ago, describing how, in a way the work of open science advocates was, at least for me, "really far from home." As we'd long ago paused in the walkway, I proceeded with an almost disembodied and canned response, weaving in well-worn concepts of interpretive approaches critical of objectivity, writing with thick description (Geertz 1973), and the inductive orientation of grounded theory as systematic attempts to elicit some level of "authenticity" in our interactions.

Our approach to temporality, our commitment to spending large stretches of time observing and participating *locally*, in relatively small groups, I elaborated, differentiates anthropology from seemingly similar methods used by, for example journalists or

psychologists. “What about statistical power, or reproducibility?” she asked. Different anthropologists would supply different answers, I responded, but ethnographic methods are, for the most part, held to completely different standards of methodological rigor. Personally, I’m more interested in why those issues are of interest to open science advocates. Anthropologists are known to be stubborn when it comes to exploring the genealogies and histories behind “common-sense” concepts.

As she nods, I wonder if I see a trace of skepticism flash across her face before she responds that it sounds interesting, and to let her know if she can help with the project in any way. I reply that I’d love the opportunity to follow-up with the process behind “evangelizing” open science. Chuckling slightly, she responds immediately, “Sure! Send me a calendar invite!”

Anthropology and the Labor of Uncertainty

Though it was short, my conversation with Bridgette was one of the first times I can recall open science configured as a kind of cure for imposter syndrome. Her personal experience of existential and experiential doubt that followed failed replications affirms the epistemological grounding of imposter syndrome, a controversial, gendered, and racialized pop-psychological diagnosis reflecting “anxiety around partial, situated knowledges” .

Anthropologists tend to look upon uncertainty with a certain fondness. Experiential openness, a certain comfort with uncertainty, underwrites a sensibility toward and perception of nascent cultural forms, of otherwise all-too-often overlooked and invisibilized *forms of life* (Fischer 2003), means of participating in the reproduction of

shared and contradictory modes of sense-making (Fortun and Fortun 2005). As forms of life iteratively take shape in real-time, our methods, our always *partial* modes of perceiving and representing relatively small, local doings (Strathern 2004; Puig de la Bellacasa 2017), as well as the larger systems and structures that either impinge on and/or facilitate forms of life, are correspondingly and iteratively re-shaped in real-time, continually “improvised” (Cerwonka and Malkki 2007).

And yet, uncertainty seems particularly ambivalent in this moment. As with finance cultures (Ho 2009; Tett 2009; Miyazaki 2013), openness to experiential uncertainty in the ethnographic field often underwrites stories about the entrepreneurial, “self-made” celebrity anthropologist. Such a subject is layered with mystification (Marx 1981), ostensibly (self-)crafted through (and correspondingly valued for) a quirky, eclectic, cool, and “sexy” amalgamation of DIY or “can-do” ingenuity, always propelled along through an unwavering comfort with the *uncomfortable*. Should they successfully navigate the waters of existential uncertainty, apprehending just the right kinds of vignettes and reconfiguring them into literary curios, they’ll be firmly ensconced within the professional academic *avant garde*. Working in the margins of fuzzy and indeterminate experiential borders and boundaries carved by the New Left (Keucheyan 2013), anthropological hegemony is shaped by the twinned fetishes of innovation and disruption, an anthropology always in pursuit of “the limit” (Fortun and Fortun 2005; Cornell 2016).

As an anthropologist coming of age in increasingly precarious academic forms of life, institutions increasingly hollowed out by restructuring and privatization pursued under neoliberal capital (Mirowski 2011), I felt haunted by injunctions of

experiential/methodological “openness.” Openness felt like a peculiar symptom of cruel optimism (Berlant 2004), an always contingent orientation toward the future of academia. This cruel sense of haunting (e.g. an ever-present anxiety that I’d miss out or be unable to capture the “right” moments, that I wouldn’t fully understand the infrastructures), of course, cuts across ethnographic field sites and projects. The anxiety of uncertainty is endemic, and in some sense inevitable, as we attempt to capture and represent what are only ever partial slivers and flashes of immensely complex forms of life (Strathern 2004). However, it seemed to take on a particularly looming, spectral (and therefore interesting) resonance when working with open science workers, a group for whom issues of the relationships between methodology and uncertainty are ever-present in the foreground. Navigating methodological uncertainty, I came to find, is a particular form of labor unto its own.

My abiding interest throughout this project is in the relationship between experimental infrastructures and cultural anxieties surrounding (ir)reproducibility, uncertainty, and methodological overdetermination. I ask how particular technocultural forms of life emerge through aspirations of repair in technoscience imagined broadly, and how these projects come to feel *fixed*, overly rigid and inflexible. How do formerly or ostensibly *open* infrastructural forms come to create conditions of enclosure, to say nothing of extraction, and exploitation? As anthropologists are expected to navigate increasingly precarious and uncertain futures, we risk succumbing to the pervasive demands of *scalability* (Tsing 2015), folding to demands that we participate in utilitarian,

reductionist (i.e. functionalist) fictions of technocultural simplicity at the expense of spontaneous uncertainty.

Anthropologies “at the limit” reproduce by fetishizing anthropology’s primary praxis; that is, by obfuscating the methods that exist at the heart of ethnographic knowledge production. Navigating the paradoxical pull along a continuum of fetishization/reductionism that configures contemporary ethnographic methods, I attempt to think ethnographic methodology alongside Danilyn Rutherford’s (2012, 106) insightful call for anthropology to embrace a kind of *kinky empiricism*, a queer orientation toward ethnography as a method of comprehending realities which are “always slightly off-kilter, always aware of the slipperiness of its grounds and of the difficulty of adequately responding to the ethical demands spawned by its methods.” *Being off-kilter*, Rutherford maintains (2012, 106), “is a strength, not a weakness.” In the following section, I think with participant observation as a mode of being continually off-kilter, facilitating uncertain sociality and relationships toward uncertain, aspirational futures able to unfold out of shared senses of creative solidarity.

Participant Observation: Creative Solidarity in Mundane Places

Participant observation configures around a commitment to closely *follow* our interlocutors, taking part and observing in the multiple domains, activities, rituals, ceremonies, and aspects that make up and that matter in their daily lives. Following open science design workers and advocates and metascientists meant journeying through places both central to open science work, and *interstitial* (i.e. adjacent to the typical or formal places where one might expect open science to be reproduced). A primary locus

where open science is often imagined and materialized is the modern, open plan office where formal work was conducted. Illuminated by fluorescent lighting and aerated by industrial ventilation ducts, offices are mundane and easily taken-for-granted. However, the office was prominent in the lives and work of open science advocates who often express feelings of compulsion, of being driven toward a larger mission.

The centrality of the office articulates for example in the fact that employees were rarely hired to work remotely. While the advance of video-chat and the portability of the Github workflow management system meant that, in theory, the work of open science could be conducted entirely remotely, it was still regarded as significant and essential that open science advocates work in physical proximity to one another in the office. For this reason, I felt it was essential that I ground, in some sense what is a very diffuse field site (i.e. the trans-local and Internetworked field of open science) at this particular institution.

Particularly since the literary influence of the “writing culture” period in anthropology (Clifford and Marcus 2009; Strathern 2004; Rutherford 2012; Starn 2015), the idea of participant observation is rarely motivated by the promise of finding an authoritative and authentic or truthful representation embedded beneath the surface of a pre-defined cultural “other.” Through simultaneously participating, observing, and documenting, I instead sought to understand how alternative sociality takes shape, how infrastructures and gift economies around scientific data become constructed through relational systems of design, development, and research. I focused on trying to understand how complex alternative data ecologies (including software infrastructures, as well as cultural and political adjustments) materialize in the moment, becoming common-

sense or otherwise taken-for-granted forms. Working through multiple domains of labor, which were compartmentalized into three teams (i.e. “infrastructure, metascience, and community”), I tried to capture as much as possible about the labor of technosocial research and design.

My particular ethnographic *orientation* (Ahmed 2006), always an embodied point of view and particular standpoint (Hartsock 1983), stems in part from my position that objectivity is a situated affair, a circuitous happening, an aspiration of a collaborative, intra-active “apparatus” that always queers the supposed boundaries between observation/subjectivity (Barad 2007). I recognize participant observation is a real-time, embodied reconfiguration of attention, a re-attuning toward the subtle stories and moments narrated and performed in seemingly taken-for-granted, and/or totalizing narratives and/or technologies (Haraway 1997; Squier 2004). Drawing inspiration from Marx’s (1981) attention to the relations of labor infused into commodity forms and subsequently erased from view in the reproduction of industrial capitalism, the stories which constellate around and through technical apparatuses are meaningful and significant in feminist science and technology studies (STS) *because of* (rather than in spite of) their subtlety and slipperiness. In a sense, it is often that which is *least* reproducible that is most deserving of preservation.

In her “riot of stories” Anna Tsing (2015) brilliantly demonstrates how collaborative relationships in human and non-human assemblages, even amongst seemingly “lowly” mushrooms that bloom in the rotting wreckage of late capitalism, conjure a *latent commons*, an emergent relationality in unassuming places where we encounter world-

building, reconstructive potentiality. Animated through a *reparative* (Sedgwick 2003) spirit of critique, my project attempts to imagine how research cultures—including my own—can become less horrendously alienating and egoistic⁷. Against hegemonic, institutionally-overdetermined configurations of *interdisciplinarity*, I’m interested in possibilities for research cultures to nurture conditions of creative solidarity (Gramsci 1972). I use participant observation as a mode of attending to and surfacing subtle figures and stories as they’re infused into (open) science technocultures. Against *fixed*, inflexible replications of interdisciplinarity, what instead are the possibilities for articulating conditions and circumstances for meaningful and collaborative researching relationships? How might ethnography help to figure these kinds of relationships?

In more practical terms, attending to (open) science technocultures meant immersing myself in the physical settings (e.g. lab meetings, paired code-review sessions, experimental apparatuses undergoing assembly/maintenance, and design team meetings) and spaces in which design labors were performed. My initial descriptive notes (about setting, people in attendance, activities) often started out as shorter, *staccato* style notes. I rapidly scribbled these small “jottings” (e.g. key details such as participants and conversation topics and quotes) into a small, relatively unobtrusive paper notebook (Emerson, Fretz, and Shaw 2011). I subsequently “wrote-up” these short pieces, layering

⁷ As I worked through my research, several former employees at the formerly open access journal *Hau* spoke out about horrific patterns of abuse and harassment (see e.g. West 2018), through which several anthropologists have called for a “decolonial (re)turn in anthropology” (Todd 2018), including a pursuit of “new forms of anthropological practice and life that can be produced at this juncture, as well as the regenerative potential that such anthropologies hold for the genealogical work carried out by those envisioning Indigenous futurities” (Tengan 2018).

more richly detailed descriptions (Geertz 1973). I compiled these longer-form notes into an Evernote folder. In these longer field notes, I would try to include as much detail about the activity, its setting and (anonymized) participants as possible. I tried to bracket interpretations and analysis of the events into a separate part of the same note. I concluded each note with a section on emergent questions that the event had opened as a result, including any future or follow-up action or questions that I'd planned to pursue.

Regardless of whether I was participant-observing in the activities in research labs, or at the center, during these interactions, I tried to capture the ways in which relationships take shape around experimental and infrastructural design. How are relationships reproduced and maintained around what are often deeply aspirational, future-oriented, and therefore often indeterminate design projects? This was often achieved through what Bronislaw Malinowski ([1936] 2014) long ago termed *phatic communication*: those often overlooked moments of communication (e.g. small-talk), in which the reciprocal act of communication itself shores-up and maintains sociality, rather than to merely transmitting information. Anthropologist Julia Elyachar (2010) has closely documented for example how modes of what she generatively calls “phatic labor” are performed among groups of Egyptian women. Relatively “small” talk becomes integral to the construction and maintenance of communicative infrastructures, which are subsequently appropriated in the interests of global capital accumulation, she argues. Paying close attention to, for example, the beginnings of team meetings, where light-hearted banter, joking, and repartee often preceded heavily technical discussion about software, experimental design, or data analysis provided deep insight into how *friendliness* became

absolutely integral to the reproduction of cognitive labor required of (experimental/infrastructural) design (Fortun and Fortun 2005).

I also attempted to capture how seemingly mundane and relatively trivial details of design were hashed out and argued over during long sessions of what was called “bikeshedding.”⁸ While these more technical details were far from inconsequential, open science advocates would often describe them as “trivial” compared to the larger goal of a specific project. Bikeshedding often seemed to facilitate a deliberative atmosphere, a collective mood, an atmosphere or an affect in which the relational act of argument and debate was as much phatic as informative. In these moments, I often felt as if the act of deliberation was at least as important as achieving resolution on an individual, miniscule element of software/experimental design. To try to capture more of the tempo and cadence through which technical details enfolded in these more complex impromptu meetings, I had to contend with shared tacit understandings built-up over hundreds of meetings that had taken place in the years before I arrived. To contend with this implied or tacit knowledge left unsaid, I occasionally audio-recorded meetings (only if each individual researcher or open science worker had given verbal consent prior to the meeting, and always reaffirming I had permission from each team member *before* each meeting).

⁸ Also referred to as “Parkinson’s Law,” or the axiom that “work expands so as to fill the time available for its completion,” bikeshedding referred to the perceived tendency of groups of cognitive workers to spend an inordinate amount of time on relatively trivial matters of design, slowing the pace of overall progress on an individual project (Parkinson 1955).

While listening to and coding audio from these meetings, I often found these details interesting in themselves. However, I was most interested in how they figured into the ideological warp and weft of open science as a “social infrastructure” (Simone 2010), simultaneously configuring and reproducing *local* social order, while creating a technosocial system designed to facilitate the emergence of social order, communities, and collectives designed to accelerate and diffuse the flow of experimental data and materials. My own (usually off-kilter and clumsy) participation in these meetings—which I document and interpret in my fieldnotes—is about more than simply “writing myself into the narrative.” Reflexivity attends to the real-time experience of witnessing and stitching together a small piece of a social infrastructure’s “fabric,” apprehended from a situated (Haraway 1988) and partial (Strathern 2004) point of view and participation. As a graduate student in anthropology of science, I always tried to be mindful of how my own configuration was simultaneously interior (as a researcher) and exterior (as a humanities-adjacent researcher with minimal programming knowledge) to that of many of my interlocutors. Recognizing this position of being in-between often creates ethnographically generative moments of experiential and symbolic slippage, confusion, and friction (Stoller 2009).

Participant Observation Across the Interstitial and Adjacent

In my theoretical framing chapter, I discussed in how scholars of post-Fordism often point to a particular moment in time (i.e. the dissolution of factory labor and the rise of flexible accumulation (D. Harvey 2009), particularly since the 1970s and the rise of cognitive labor with software development and the Internet) wherein which capital

accumulation began to subsume previously “unproductive” zones of life, to colonize even spaces of leisure and play under what some have called “ludocapitalism” (Jungwon 2018). Recent scholarship however, informed by Marxist feminism in the domain of social reproduction theory (Bhattacharya and Vogel 2017), demonstrates how the “real”⁹ subsumption of labor, the process extending capital to each domain of life, of exploiting “invisible labor” while simultaneously rendering it “unproductive,” has always been endogenous to capital accumulation and capitalist reproduction, relying for instance on the feminized, uncompensated labor of housewives (Jarrett 2015).

Participant observation is more than a familiarization with a specific way of *doing* (or, in the parlance of this moment, of “building a value-added skillset”). Participant observation is instead a mode of attending to, appreciating, and participating in the invisible, interstitial, and seemingly “unproductive” processes through which groups sustain themselves. Participant observation attends to configurations of place, lively and often overlooked zones where cultural life is reproduced or replicated, where life is, for instance reproduced with alterity and differences (Taussig 1993).

In a mission-driven, non-profit “culture change” organization, labor extends to less visibly “productive” spaces, zones that are interstitial to and adjacent to the lab/design center, to the spaces where conditions of social life are reproduced. Researchers and programmers, often driven initially by a playful, ludic orientation toward their respective crafts, think and argue with one another often, even outside of work hours. They’re

⁹ Marx’s (1981) delineation between the “formal” and “real” subsumption of labor, as articulated in his sketch of primitive accumulation, refers to the re-articulation of both formal (e.g. legal) institutions and lived experiences relationships (respectively) in the reproduction of capital.

encouraged to maintain vibrant relationships with one another, relationships which often unfold *recursively* into the ways they perform and disseminate their creative work (Kelty 2008).

While often stereotyped as individualist, hobbyist pursuits, the cognitive design labor of metascientists and developers was deeply social, relying on shared strategies of social care and maintenance. Recognizing the reproduction of sociality to be integral, yet often understudied components to producing good science and good design (Fortun 2005), participant observation necessarily extended to places wherein which friendships were maintained. For example, I would often attend afterwork drinks at one of several bars near the center, or dinner at a friend's house. In these places, topics of discussion often turned organically to open science and software development, usually without provocation.

Of course, I don't interpret these interactions as serving some kind of *functional* purpose in the context of reproducing or replicating a larger, internally consistent meta-cultural institution of open science (c.f. Malinowski [1936] 2014). On the contrary, following stories, infrastructures, and conversations about open (techno)sciences in the contexts of multiple, intersecting and often conflicting systems and relations of meaning and power, *complicates* ideas of open science as a singular, monolithic technosocial movement. Following the thread of conflicting narratives, I consider the cultural significance of ethnographic conversations in the contemporary, hypermediated cultural and political moment.

*Ethnographic Conversation in an
Anxious Age of 'Conversation Simulation'*

Our collective, contemporary pop culture moment is dominated by an insatiable appetite for dystopia, particularly one materialized through pathological relationships with/through media technologies. For example, Netflix's ever popular anthology series *Black Mirror* continues to entice audiences with tales steeped in cultural anxiety surrounding the often violent, exploitative, and (un)intended consequences of contemporary digital communications technologies. The methodologies I employ in this project are, to a large extent, a reflection of my particular situated theoretical journey through the field of anthropology of science and science and technology studies (STS). STS invites a critical attention to the social lives of stories (Appadurai 1986; Squier 2004), following how and where they move, particularly as they become embedded in speculative technologies (Haraway 2013). While I'd originally imagined uncovering a slow-moving scientific *dystopia*, facilitated in part by our collective enchantment with technocratic, marginal solutions to political problems (Marcuse 1966), stories around these technologies (in both their production and use) are often much more ambivalent and indeterminate, often unfolding through conversation.

Postcolonial and anti-racist speculative fiction inspires us to consider how meaningful relationships formed through collaborative, creative solidarity are built and maintained through narrating and performing shared stories of times and technologies as being always slightly off-kilter, out-of-joint (Vizenor 1996; Fisher 2013; R. Anderson and Jennings 2014). To echo Anna Tsing's (2015) beautiful images of post-apocalyptic renewal, stories underwrite the relational hope in emergent solidarity and aspirations for

alternative circulations, a future-oriented vision of relationality and potentiality which she calls a “latent commons.” It’s perhaps this latent hope that draws anthropologists toward speculative fiction, to think through social theory alongside more ambivalent, less monochromatic dystopian stories about binary relationships between technology and society. More than an eschatological certainty for inevitable collapse, stories *with* technology are infrastructures for “fabulation,” for “staying with the trouble” and re-imagining imperfect futures (Haraway 2013, 2016; Pandian and McLean 2017; Wolf-Meyer 2019). Stories need not resort to ready-to-hand narrative forms, such as the reactionary conservatism of nostalgia (Jameson 2009), the breathless accelerationism of *urfascist* eugenicist transhumanism (Kurzweil 2005), or the collective affect of political impotence engendered in dystopian narratives and structures of feeling (Fisher 2009; Williams 2009).

In the immediate aftermath of Trump's election in 2016, Internet hot takes began to circulate widely. Many left-leaning articles tried to shore-up the crumbling ideological edifices underlying neoliberal capitalism by invoking a familiar, technodeterminist narrative. For many among the garden variety left-leaning commentariat, the proliferation of social media—not the devastating contradictions of neoliberal capitalism (see Holmes 2000 on the role of "fast capitalism" in the rise of neofascism in Europe)—was at the root of Trump's rise to power. An article in Slate suggested, for instance slipped easily into the metaphor of the mind as computer, arguing that while the election was indeed "hacked," it was voters' *minds*, not voting machines themselves, that had been manipulated as a result of a massive Russian state-sanctioned disinformation campaign

employing an army of inauthentic, automated accounts (or, "bots"), cleverly engineered to replicate living human (Johnson 2016).

Regardless of the specific contribution of external, Russian disinformation and internal online radicalization campaigns in stoking a surge in misogynist and white supremacist sentiment coupled with class conflict, the specter of "bots" is a particularly interesting object with which to think the contemporary moment. "Bots" (i.e. automated social media accounts that, for example retweet tweets from other, predefined Twitter accounts) are a ghostly signifier for the cultural anxieties and aspirations that haunt a collective panic over (in)authentic communication and conversation.

"Bots" are simultaneously mundane and horrifying. In an online "botifesto" published on Vice (Woolley et al. 2016), several Internet scholars, including danah boyd insist that the automated agency of recursive social media functions is context-specific, neither intrinsically negative nor positive. Bots instead pose an agential blur, glitch, or crackle (Fisher 2013), a contemporary manifestation of aestheto-capitalist infrastructural *sublime*—an entity whose presence simultaneously entrances, and horrifies (Larkin 2008).

Particularly haunting is the potential for "bots" to convincingly mimic disembodied, conversational and dialogic subjects, concurrent with the emergent anxieties surrounding AI-generated, so-called "deepfake" videos (O'Sullivan n.d.). At the same time as contemporary "conversation" infrastructures are simplistically vilified for single-handedly degrading both the material and *social* infrastructures of communication, recreating conditions for "authentic" conversation often reverts to a naive re-animation of

nostalgic theories of “rational” discourse mediated through an heretofore unachieved partition or compartmentalization, a modularization between thought and emotion (Habermas 1999). “Conversation” is thus a kind of floating semiotic container, often charged with holding vague aspirations for collectivity and understanding, as in the vapid and inconsequential calls for a “broader conversation” issued in bad faith by every politician in the wake of avoidable tragedy or scandal.

In the following sections, I use the ambivalent aspirations and anxieties surrounding “bots” and crises of communicative authenticity as objects through which to re-center the significance of *ethnographic* conversation. Conversation—as opposed to “interview”—attempts to position ethnographers and interlocutors within relationships of “co-creating” knowledge (Campbell and Lassiter 2015). Ethnographic conversation potentially creates spaces and opportunities for realizing creative solidarity, a shared sense of aspiration for imagining and building a better future. As simultaneously ethnographic method *and* political praxis, ethnographic conversation works toward creative solidarity by re-imagining, designing, and co-creating stories toward a better future. Conversation, often circuitous and looping practices of spoken dialogue, is a mode of surfacing stories, of thinking outside of the forms of speech enforced by institutions (Harney and Moten 2013).

Semi-Structured Conversations

Much of the creative labor performed at COS is carried out “just-in time,” following cycles of temporal compression and expansion around deadlines (e.g. submitting applications for funding grants and committing software features to the code base operate

around deadlines organized into “sprints”). As a result, I was initially worried that metascientists, developers, and marketers would simply be too busy to speak with me. Thankfully, this wasn’t the case. Many were overwhelmingly generous with their time. Our conversations were often co-constructive and deeply reflexive. As a “recursive public” (Kelty 2008), open science workers and advocates are simultaneously passionate about the things they build, and about discussing their significance. Many workers at COS thus saw our conversations as opportunities to critically reflect on the meanings and political agencies of the software platforms and/or experiments they were involved in designing and running. Particularly for those with a background in free and open source software, articulating ones’ opinions and values on the political and cultural significance of creative work is a valued component of the spirit of openness and transparency. When I first arrived, a member of the “community team” pointed out that “it would be ironic” if they had, as an organization, refused to talk to a researcher while simultaneously espousing the value of open research practices (Personal communication, 2016).

When I would thank researchers and open science designers for their time, they often replied that they appreciated the opportunity to think beyond the technical aspects of an experimental apparatus, to step outside of “the tech” for a moment and remind themselves of the “importance and value of the mission” of open science, to reflect on what it means to each of them personally. However, the constant anxiety of impending deadlines meant that many researchers and open science designers preferred that we schedule our time together (e.g. to send a calendar invite via instant message).

Particularly at COS, ethnographic interviews were seen as an opportunity not only to reflect on the mission of open science, but also as a setting in which to internalize a particular mode of (open) subjectivity, to enact a particular “care of the self,” developing conversational modes of *askesis* in crafting the self into a particular kind of subject (Foucault 1988, 74). Conversations were an opportunity to develop ones' expertise and ability in articulating open science practices and principles through conversation. I was surprised, for example when a senior staff member encouraged early in my fieldwork to make appointments with employees for interviews during working hours. To facilitate conversations, I was also given permission to use any of the conference rooms that were available.

As a result, I was encouraged that open science workers would be compensated for their time (even if I couldn't compensate them myself). I would come to find that these accommodations would eventually raise several ethical and methodological considerations, however. Though workers at the center were indirectly compensated for the time they were willing to spend with me (i.e. they weren't expected to “clock out”), they were still expected to meet their project deadlines. During this phase, I began to ask how the setting of our conversations may have influenced both their tempo and content. Did the time they spent in conversation with me during work hours increase the level of stress and anxiety they would later feel to meet their deadlines? Did this sense of time compression potentially affect our conversations and interactions? Could they have assumed, for example that because they were essentially “on the clock” during these interviews, that they might as a result be expected to respond to my questions in a

particular way, to replicate particular feelings and values toward (open) science, even if they didn't hold such views personally?

While I still can't answer these questions with certainty, they appear in my analysis strategies. Like a reflexive hinge, they turn my attention toward the significance of ethnographic context and to the ways in which conversations become shaped by settings. To minimize the anxiety of these scheduled interactions, I decided in some cases to employ a *semi-structured* conversation approach (Bernard 2006, 209-210; Campbell and Lassiter 2015, 97-98). While practically everyone at the center had familiarity with interview strategies (some had even been interviewed by journalists, particularly after the publication of the reproducibility papers), I often explicitly differentiated our conversations from interviews, in order to highlight my hope of stimulating creative spontaneity. Because we have a shared interest in reconfiguring research cultures to be less alienating and exploitative, I often prefaced our conversations with the hope of collaboration. Introducing our discussions, I often explicitly invoked the following criteria:

Openness: While I am particularly interested in certain themes (e.g. creativity, design, communication, and labor), and may occasionally employ conversational “probes” to elicit elaboration on a particular topic (Bernard 2006), I'm *not* seeking to confirm an existing interpretative frame. Drawing from the methodological orientation of "grounded theory" (Clarke 2005), I am instead applying an *inductive* approach. I'm interested in wherever our conversation happens to go, in understanding the categories, topics, and themes that surround

open science and experimentation, and (most importantly) as they are significant and meaningful to you, as a member of self-defined group (i.e. open science designers and metascience researchers). I'm interested in how these concepts surface and unfold in real-time, and I'm completely aware that they might have different meanings for different members of the group.

Reciprocity and Reflexivity: The group member primarily guides ethnographic conversations, in the hope that meaningful and significant categories and themes will emerge in the course of our conversation (rather than reflecting primarily my personal biases and interests as a researcher). At the same time, I believe these conversations represent a potent opportunity for *thinking-with* one another, for crafting and maintaining relationships of solidarity through interdependent approaches to knowledge and knowing (de la Bellacasa 2012). I'm interested in how these relationships form at COS and in the labs, while I'm also mindful of my personal obligation for reciprocating in the construction of relationships of solidarity around mutual interests (in this case, helping to craft research cultures that are less extractive and exploitative).

Although I refer to "semi-structured" above to refer to the temporal and spatial setting of many scheduled (i.e. somewhat "structured") conversations, this category also refers in ethnographic methodologies to the content and structure of the conversation itself (LeCompte and Schensul 1999; Bernard 2006; Campbell and Lassiter 2015). Because time in these instances was somewhat structured, so too were our conversations. In some

ways, this was brought about by the setting of these conversations. Particularly in the compression of time in contemporary creative knowledge and design work, one of the ways I tried to reciprocate in the moment for the time that people would generously give, was to work from a list of themes surrounding design, creativity, data, and experimentation. That is, these "semi-structured" conversations were guided partially by a loosely structured list of open-ended themes and topics (more than the occasional, specific question) that I hoped to address (Schensul and LeCompte 2012, 172).

In many of these conversations, I'm seated across a table from an open science designer or a researcher. My laptop sits in front of me, open. The screen is displaying an Evernote document, a dynamic and iterative conversation guide I'd often stayed up late editing the night before based on themes which had surfaced earlier that day, as I listened to earlier conversations and read over fieldnotes. In this way, these lists draw upon themes that had already begun to surface in earlier conversations, either with the particular respondent, or another member of the center. Depending on how close we were as friends, I'm anxious that a completely unstructured conversation in such a scheduled setting might signal a lack of respect for their time. I am also concerned that with a laptop in view, these conversations might feel somewhat fixed or constricted, that stories about the anxieties and aspirations for (open) science design and research won't be allowed to breathe (Frank 2010), to pursue creative and insightful "lines of flight" toward critical perspectives and possibilities. However, communities of contemporary design and knowledge work are deeply *polymediated*— that is, modes of inter- and intra-office communication were

instantiated across a panoply of analog and digital platforms (Madianou and Miller 2013), such that conversations never felt impeded by devices.

In these semi-structured conversations, I often took advantage of the relative lack of ambient distraction to ask the kinds of questions found in the ethnographic approach toward "human-machine interactions" (Suchman 2007). These conversations focused primarily on the ways in which relationships become mediated across technical interfaces and platforms in indeterminate, context-specific ways; *potentially* supporting the types of conditions conducive to alternative forms of sociality in research cultures. Some of these conversations centered around a specific software feature or a bug, a line of code, or an otherwise seemingly small manipulation in experimental design. Throughout these conversations, I attempted to craft a systematic attunement to the ways in which seemingly minuscule and inconsequential objects and things tended to radiate outward, forming reciprocal relationships that come to appear exceedingly complex and nuanced (Malinowski 2014; Mauss 1967; Povinelli 2011). While many of these conversations about human-machine "configurations" started off regarding the significance surrounding "the tech" or "the data," they rarely fixated on purely technical components for long. Instead, open science workers and researchers were deeply interested in the radiant effects of their work, speculating on how these technical components were anticipated to act "in the world," and in some cases, how they helped to configure alternative worlds (e.g. more vibrant, responsive, and transparent data ecologies).

Dérive: Unstructuring Conversations

The “open” architecture that circumscribes many contemporary labor relations under post-Fordist production aren’t all that uniquely extractive or new. Such configurations represent a several decades-long aestheticization and materialization of the metaphor of flexibility, as labor grew increasingly unmoored from top-down, Taylorist modes of modular “scientific management” (Leffingwell 1917). A proliferation of temporary desks and the dismantling of cubicle walls function like incantations, conjuring a “new spirit” of frictionless and seamless context-independence, serendipitous relationality in an illusion of “solidarity” and collaboration through efficient affective self-management (Chiapello and Boltanski 2007). I expected this to translate to my experience as an ethnographer. I had expected worksites to be places of primary significance in the creative and reproductive maintenance of sociality.

However, I came to find that many open science workers and researchers at COS often preferred to take our conversations outside. Even in the sweltering and humid heat of an East Coast summer, many preferred to talk while walking along the mall, or to sit under the shade of a coffee shop. Many of our conversations would continue late into the evening, over drinks at one of the many upscale bars situated along the mall.

While they presented challenges in terms of note-taking, I came to think on these mobile, relatively “deterritorialized” conversations in their radiating and immanent effects, appearing like small-scale instances of building and maintaining social solidarity in motion (Deleuze and Guattari 1987). Open science workers were allowed, and in some ways actively encouraged to venture beyond the office as part of their affective self-

management, to write code or analyze data on the downtown mall, for example. While unstructured conversations among self-described “geeks” were often opportunities for me to follow up on technical themes and topics that had surfaced around issues of human-computer interactions, my focus in these interactions oriented toward understanding how groups create and understand the technical aspects involved in their work in the context of building alternative sociality and infrastructures of knowledge.

I also became interested in how these interactions came to embody interdependent modes of maintaining relationships of solidarity, friendship, and affection. I was initially drawn to the labs and the center not out of an interest in software development (this came after spending time with developers), or because of an interest in the kinds of research being pursued (though metascience research often proved deeply fascinating. I was first captivated with the ways in which a small, multi-disciplinary group of mostly early-career professionals, working in settings described as creative and experimental, would often rely on their friendships with one another to create significant and meaningful spaces of shared inhabitance. I was interested in openness as a *form of life* (Fischer 2003).

I’m interested in how open science workers reflect on the practices by which they maintain the material components and articulations of infrastructure (e.g. the backend of a framework database, an open API, or the design of an experimental replication). As with similar anthropological studies of infrastructure (Elyachar 2010; Von Schnitzler 2013; Jackson 2014; Schwenkel 2015; Barnes 2017), unstructured conversations were opportunities to capture some of the stories which surround open science infrastructures

as alternative forms of social solidarity; the stories we tell surface issues of maintenance and care that are no less instrumental than lines of code or experimental protocols.

As I begin this project, the meanings surrounding conversation in this cultural and political moment grow increasingly strained. Particularly amidst the ambivalent proliferation of conversational infrastructures, “connection” across communicative media ostensibly stages more horizontalized, participatory (Kelty 2016a), and “flattened” modes of conversation (Turner 2017). This project reaffirms conversation as more than a shared or agreed upon “interface” through which to mediate information. These unstructured, open-ended conversations sprang up sporadically, as I followed open science workers and researchers to bars and grocery stores, shared meals in their apartment living rooms, traded sips of bourbon at a craft whisky festival, and toured a free community makerspace. Conversations in these settings embodied more than simply opportunities through which to share information, to extract “expertise” about open science infrastructures and research practices. They’re much more important as critical and potent instances of understanding how sociality is maintained and reproduced in uncertain circumstances. It was through these meandering, often “off-kilter” (Rutherford 2012) conversations¹⁰ that I grew to understand how cognitive workers who perform ostensibly

¹⁰ When I think of conversations that are “off-kilter,” I think of all the times interlocutors would apologize for “going off the rails,” or of how these conversations only began to appear significant with temporal distance. I also think of how conversations that took place while walking, rather than via interoffice chat platforms, but instead in the heavily tech-centric and developed atmosphere of downtown Charlottesville were a kind of *dérive*, a meandering or “drifting” (Debord 1958), a generative practice of collaborative alternative navigation across physical and imaginative place in ways that potentially cohere into generative political re-imaginings, or *situations*. Thinking-with *dérive* also reminds us how historical practices, such as the innovative navigation of space and place as a condition for survival amongst racialized and policed communities are often appropriated and fetishized by overwhelmingly European and Euro-American, white male philosophers (Weheliye 2014).

“immaterial” labor (producing digital things and knowledge) must also navigate the tangle of embodying “social” (i.e. affective) skills as much as coding or scientific ones. I argue that these conversational meanderings represent uniquely potent junctures for animating and radicalizing techno-political movements designed to democratize information—such as open science but also including social media—for imagining how to configure knowing and the circulation of information in building relationships of solidarity beyond localized, particular social orders (Gershon 2019), research disciplines, and labs.

In the context of STS scholarship, through which much cognitive labor has been expended on meticulously tracing dynamic and radically diverse practices of knowing and knowledge production across particular sites of practice, e.g. across “epistemic cultures” (Knorr-Cetina 1999), my interest in comparison, in relation to labor, alienation, and political agency, across multiple sites of design and different kinds of research might be legitimately considered too broad. Indeed, early laboratory studies (Latour 1987), and the ethnographic studies of creative design they informed (Murphy 2016), originally emerged out of a commitment to “implode,” drawing on the extensive body of Donna Haraway’s work, to trace the intricate relationships embedded in, and that simultaneously *sustain* even the most seemingly mundane technical objects and things (Dumit 2014).

Other methodological orientations, such as Actor-Network Theory (Latour 2005) sublimate conversation in relation to an ethnographic project of animating and “imploding” a proliferation of commingled actants. My project works in the playful junctures composed of critical, queer and feminist-Marxist strands of social theory and

methodology to imagine ethnographic conversation as a mode of “implosion” toward configuration, rather than flattening. While attempting to avoid reifying (alternative) “master narratives” (Lyotard 1984)—e.g. to affirm that a transdisciplinary, monolithic figure of Science adheres to functional binaries, that something like Science exists and is/isn’t “broken”—but rather toward configuring alternative relationships predicated on understanding and recognizing shared material circumstances (the “solidarity” in “creative solidarity”) and mutual flourishing (Gramsci 1972; Dean 2005; Donna Jeanne Haraway 2016; Puig de la Bellacasa 2017).

Ethnography of Platforms

In its’ relative openness or closure, the “interface” represents, for many open science workers, a vibrant field of potentiality and connection and participatory collaboration. Configuring relationships across an interactive platform, interfaces produce infrastructural preconditions for reciprocity across open and transparent, efficient, decentralized and accelerated information and data sharing ecologies. For example, *application programming interfaces* (APIs)—web software applications which act like gateways designed to seamlessly share data between two or more web applications—function as technical arrangements of protocols and standards that not only allow web applications to exchange streams of data between one another, but in doing so, also *configure* these relationships, the data exchanged, and thus relations of power, in particular ways (Bucher 2013).

A part of my project attempts to deal with how we approach contemporary interfaces (“platforms”) ethnographically (De la Cadena et al. 2015; Monteiro 2017). Feminist STS

scholarship has proven particularly useful in understanding entanglements and entwinements between material and political technologies (e.g. symbolically rich systems of subject-making and categorizing as much as “hardware”) and embodiment as contextual and relational processes (Traweek 1988; Martin 1991, 1994, 2007; Haraway 1991, 1997). Donna Haraway describes an iterative feedback loop wherein which bodies and practices of seeing, of retrieving or interfacing information are co-created as

“[...] objects of knowledge are material-semiotic generative nodes. Their boundaries materialize in social interaction. Boundaries are drawn by mapping practices; "objects" do not preexist as such. Objects are boundary projects. But boundaries shift from within; boundaries are very tricky. What boundaries provisionally contain remains generative, productive of meanings and bodies. Siting (sighting) boundaries is a risky practice” (1988, 595).

Media studies scholar Alexander Galloway (Galloway 2012) insists on turning away from thinking of interfaces as inert, static windows or doorways that are either “open” or “closed.” Criticizing the ways in which interfaces come to stand-in for goals of “transparency” and “efficiency,” Johanna Drucker (2014, 178) argues for a “shift from conceptions of interface as things and entities to that of an event-space of interpretive activity.” Software interfaces, Wendy Chun (2011, 8) similarly argues, *mediate* data and information, providing “means of navigation [that] have been key to creating “informed” individuals who can overcome the chaos of global capitalism by mapping their relation to the totality of the global capitalist system.” By *imposing* certain representational frames around the information that is passed through them, interfaces exhibit certain kinds of

political agency; interfaces powerfully interact in the *becoming* of complex technosocial worlds (Knox and Walford 2016).

To understand how interface constructs sociality and communities, my ethnographic purview extends to the software frameworks and platforms developed at the center, to digital “tools” designed to allow researchers to share experimental data, methods, materials, and protocols. I direct much of my focus on the flagship web application developed at COS, osf.io (formerly called “Open Science Framework”)—a free and open source research workflow and data management program designed to stimulate open research practices.

Early in the ethnographic process, it became apparent that one of the difficulties of platform ethnography is capturing the dynamic and constantly changing nature of the platform. Web-based platforms like OSF are constantly, iteratively reformed, as new features and user-feedback are integrated into the site. While I rely on screengrabs to understand how relationships are mediated across the OSF graphic user interface (GUI), these are merely imperfect, static representations of a lively inter-relating. Therefore, I couple these screengrabs with fieldnotes which attempt to document, as a participant-observer, the experience of navigating through the platform as a “sense-making,” *social* infrastructure—i.e. an infrastructure designed not only to circulate particular materialities, but in doing so, to configure a particular mode of sociality (Larkin 2008, 2013; Anand 2011, 2012; Von Schnitzler 2013). Attempting to ethnographically apprehend a diffuse, trans-local open science discourse produced and mediated across multiple interfaces and platforms, I also incorporate portions of conversations in the

public domain, which take the form of posts and comments in social media and online open science forums (see e.g. TallBear 2013 for a brilliant incorporation of online discourses in her ethnography on the use of DNA testing in tribal citizenship negotiations).

Rather than attempt to “unmask the ideologies” embedded within particular software platforms, ethnographically interfacing platforms facilitates a deeper understanding of how particular software programs reproduce alternative objectivities, while also supporting “specific embodiments... the active perceptual systems of bodily organs and prosthetic devices” (Strathern 2004, 32), pieces of *tech/noculture* that potentially configure open science as a plural and multiple “ecosystem.”

Data Analysis and Interpretation

In the preceding sections, I described the methods through which I sifted through a surprisingly intensive and bewildering set of experiences in collecting certain types of ethnographic data. I tried to construct working boundaries and categories, culminating in a working circumscription of the conduits of information flowing across my own, embodied “methodological interface” (Galloway 2012). Here, I disentangle practices of data interpretation/analysis.

As I discussed earlier, in ethnographic fieldwork, data collection and analysis are widely regarded as coupled practices, a real-time folding, configuring, weaving, and stitching of sensory alterity, of different ways of interpreting and recreating complex lifeworlds (Strathern 2004). The interpretations and analyses we make “in the field,” during ephemeral moments of down-time, iteratively “feedback”, informing the events,

happenings, doings, things, and technocultural “alliances” (Latour 2004) to which we become sensible (Haraway 1988), that we capture and eventually come to see and interact with as “data.”

Among metascientists, a coupling of data collection and analytic procedures is often regarded as a potential weakness, an enfolding and splitting of the integrity of an experimental apparatus (Barad 2007); a rupture, glitch, or crackle in the experimental “immune system.” A point of vulnerability and susceptibility to invasion and contamination by biases that can replicate undetected by our abilities of conscious apprehension (e.g. “confirmation bias”), an entanglement of methods and analysis eventually weakens results, sometimes to critical levels. Obfuscation (as opposed to openness) here emerges, not because of researchers consciously “hoarding” their data, methods, or procedures, but rather as a result of the lack of clarity regarding the *temporality* of a dataset (i.e. its’ genesis relative to its interpretation). As a technology of the experiment(ing/al) self (Foucault 1988; M. Fortun 2005), preregistering research methodology is a voluntary mode of *inoculation*, a prophylactic which functions by delineating a clear “line between confirmatory and exploratory analysis” (Veldkamp et al. 2018).

Despite attempts by open science workers to universalize a clear demarcation between binary choices (i.e. confirmatory or exploratory) across different fields and disciplines, STS scholars, particularly in laboratories have demonstrated how the configurations of temporality that underwrite “good science” are often particular to disciplines and fields (Knorr-Cetina 1999; Rheinberger 1999; M. Fortun 2005; Thompson

2013), as well as spatially or culturally particular to specific labs and research settings (Latour 1987; Traweek 1988; Mol 2002). Despite the integration of digital research workflows into ethnography, ethnographic temporality proceeds in loops and spirals, emerging and unfolding in the midst of its doing. Comprehending modes of ethnographic analysis are therefore more of a retrospective than a clear “roadmap.”

Tags, Trees, and Nested Sets: Digitizing Interpretative Workflows

In their recent retrospective on the legacies and potentialities of computers in/of anthropology, Kim Fortun, Mike Fortun, and George Marcus (2017) argue for developing interpretive ethnographic infrastructures that open onto “kaleidoscopic logics,” systems able to encapsulate the circuitous drifts of ethnography since the publication of *Writing Culture* (Clifford and Marcus 2009). They argue for creating platforms that create multiple “configurations of disparate elements [that] are open to sudden change and shifts” (M. Fortun, Fortun, and Marcus 2017, 19). In this section, I consider how interpretive work performed across digital platforms and frameworks helps to structure my approach toward interpreting openness as a social infrastructure. I also consider the aspirations and limitations surrounding open ethnography.

Over the course of three months at the Center for Open Science, I collected over seventy hours of audio data (MP3), consolidated across one-hundred audio files of semi- and un-structured conversations. These conversations range in duration from just a few minutes to several hours. I also amassed (along with several gigabytes of photographs and pieces of gray literature) hundreds of ethnographic fieldnotes, transcribed from handwritten “jottings” I’d quickly scribbled into my notebook and later wrote-up into

fieldnotes I kept in an encrypted folder in the cloud-based software Evernote. Evernote was particularly useful for keeping up with the often dizzying pace of design and research work at the Center, as it allowed me to move across multiple physical spaces and interstices (e.g. from meetings to one-on-one conversations, to lunch, to drinks), rapidly and reliably syncing images and quickly typing-out short fieldnotes and reflections across multiple interfaces (e.g. from my smartphone to my laptop).

Each research object, or *artifact* (i.e. each audio, text, and image file or piece of gray literature) (M. Fortun, Fortun, and Marcus 2017) was categorized in an encrypted Excel spreadsheet that acts as an evolving archive of ethnographic metadata: containing notes regarding the setting, date, key terms and key topics discussed around each conversation. Each audio and text file was uploaded to an encrypted project on the proprietary (“closed-source”), web-based qualitative data analysis software, Dedoose.com. Despite the name, the software supports an *inductive*, grounded approach to conversational content analysis (working from intensely small or local themes to larger ones). For my research, this often consisted in an iterative process of listening/categorizing; i.e. transcribing conversations while “tagging” sections of the audio artifact with relevant descriptive codes as they repeatedly “emerged” and formed patterns. As with the conversations and fieldwork interactions themselves, “grounded” data interpretation involves continually recognizing those categories and themes which I *expected* to find, while (more importantly) also emphasizing themes, ideas, and categories as they were replicated and repeated across the entire dataset, the totality of recorded (either audibly or written) conversations and interactions (Clarke 2005).

Tags were applied with reference to their relation to higher-order themes, such as “collaboration, creativity, labor/work, design, infrastructure,” and “data/information flows.” I imagine the combined relationship between tags and themes to function like a branching tree (or rather the mycorrhizal communications networks that stitch together relationships across many trees in a forest) (Wohlleben 2018), rather than a nested, hierarchic set (wherein which relationships between portions of audio or written notes exist in mutually exclusive relationship to one another). Rather than a descending order of the ways in which stories about technological/experimental design and sociality group together hierarchically, open science is brought to life most compellingly through stories that radiate outward, looping into more complex lifeworlds and relations (Povinelli 2011). I wanted to find a way to represent these forms, to surface and articulate multiple points of political solidarity across multiple stories, without resorting to static, monolithic social forms; i.e. that of a singular “open science.” Journeying through the interfaces of multiple ethnographic workflow management platforms surfaces a particular awareness of the performative agency such infrastructures exhibit on the kinds of knowledges we gather, repurpose, and re-present.

Conclusion

How do we become sensible to moments and practices which represent tendential, alternative, and vibrant potential? How does knowledge-building participate in creating bonds of social solidarity toward re-imagining and repairing our broken worlds (Gramsci 1972; Puig de la Bellacasa 2017)? Anthropology *potentially* illuminates spaces for hope, by for example documenting the alternative ways in which people make sense of,

navigate, contest, and iteratively recreate their lives under conditions of struggle and oppression. The method of “studying up” was initially conceived of as inverting anthropologists’ relationships to axes of power, a sort of “inside-out” way of dismantling systems of oppression (Nader 1969). That dream seems to have sputtered out. Like much of so-called “counter-” cultural production (e.g. the commodification of punk music), that initially sets out to contest and disrupt a dominant hegemony by exposing the underlying cracks (Fisher 2018), North American anthropology seems particularly adept at becoming complicit in its own recuperation. Crafting fashionable linguistic and theoretical “commodities” at economies of scale (Tsing 2012), anthropology of the New Left has really always obscured its own part in replicating and reifying capitalisms’ exploitative and abusive machinations. For example, Zoe Todd (2018) shows how the recent exposure of worker abuse at *Hau* surfaces an ongoing need to (re)turn to the matter of decolonizing anthropology. Such critical scholarship demonstrates how anthropological institutions remain deeply entwined with, and codependent upon, mechanisms of extraction (West 2018).

Embodied ethnographic interfaces are always already partial (Strathern 2004). What might it look like to seriously confront how our own ethnographic interfaces facilitate patterns of extraction? Have we grown too pessimistic to attend to the political potentiality embedded in technocultural forms we otherwise prematurely define as technocratic, neoliberal tweaks “around the margins” of larger systems of oppression? Throughout this work, I try to contemplate how my own pessimism about academia might methodologically impinge on that to which I’m made sensible.

In this moment we're doubly consumed by a sense of estrangement, burning away at multiple affective ends; horror and disappointment regularly surface in the delirious consequences of late capitalist techno-utopianism, lurking in figures like "big data" and algorithms propelled by a breathless technochauvinism; endless promises to *fix* and control every aspect and domain of social life (Broussard 2019). As an embodied orientation—a situating and experiencing of multiple intersecting worlds (Sara Ahmed 2006)—ethnography tweaks our moral economy (Daston 1995), creating space for re-valuing comparatively *small* data (boyd and Crawford 2012). (Even if the often-subtle moments of peoples' lives, into which we're immensely privileged to be allowed, often escape our notice in the moment).

In my ethnographic study of open science, I'm interested in how people come to pour so much of their lives into seemingly small things (e.g. subtle details of software and experimental design). How then, do these small things radiate onto larger technocultural systems? Studying a social infrastructure, crafted amidst ongoing and uncertain crises of verisimilitude, my own tangled relationship with experience(s), data, objectivity, and ethnographic representation haunts at every twist and turn. Here, I've attempted to reflect and clarify to some extent, to demystify and *surface*¹¹ the particular processes through which I arrive at situated (Haraway 1988; Suchman 2007), particular and *partial* conclusions more akin to a surrealist interpretation with loops and often disorienting lines

¹¹ "Surfacing" borrows from open science workers, figuring prominently in conversations and presentations with open science workers and advocates; underwriting an imagined potentiality for data and information, "insight" was often thought of as being "surfaced" through collaboration afforded by open infrastructures, for example.

of flight, rather than the clear linearity implied by *planned analysis* (Strathern 2004). In the following chapter, I explore how my expectations of finding a disruptive and deconstructive spirit at the root of metascientific practice began to deteriorate, giving way to a sense of metascience communities motivated by a collective ethics of care.

Chapter Three

That's So Meta... Disruptive Care in 'Science About Science'

Affixed to several of the walls throughout the center are several reproductions of works by the elusive British street artist Banksy. Their presence echoes the aesthetic of “innovation” and “disruption” coursing through the imagined veins of Silicon Valley. A Schumpeterian aesthetic encapsulated, for example in the now widely-despised mantra of “moving fast and breaking things,” of asking forgiveness rather than permission (Wiener 2020). At the time these were put up in 2013 though, I imagine they felt like a natural expression of the contemporary laws of office cool (Liu 2004). In one of these artistic reincarnations, an image is stenciled onto a brick wall. In the image, a person sits, peering from beneath a beanie as they cradle in their crossed legs a takeaway coffee cup. They’re holding a cardboard sign which reads “KEEP YOUR COINS. I WANT CHANGE.”



Figure 3.1. Recreation of work of street art by Banksy hangs on a wall at the center. Photo by Kyle Harp-Rushing (2018).

Whether or not the recreation conveys the “aura” of the original with absolute fidelity (Benjamin 1986), its situation within this place feels like an act of conjuring; perhaps conscious, perhaps not. A symbolic interface meant to catalyze an aura of collaboration and creativity, a sense of collective effervescence around shared ideals (Durkheim 2008), the piece connotes a spirit of creative disruption. Such works are an aesthetic mainstay among contemporary tech startups in throughout Silicon Valley and its geographic replicants (e.g. in urban tech hubs imbued with the hope of urban revival in Detroit). The widespread practice of hiring street artists to create graffiti murals on the walls of tech offices was, for example ridiculed in an episode of the HBO series *Silicon Valley* (Berg 2014). Less a consequence of their reproduction, and more of their physical emplacement, their *emplotment* (Bakhtin 1984) in the institutional contexts and narratives wherein which conditions of late capitalist exploitation are experimented on, reproduced, and scaled-up, such works become sapped of their political substance, irreconcilably rendered devoid of any legitimate claim to a radical “aura” (Benjamin 1986). All that remains is a haunting portrait that belies the fiction of teleological, inevitable progress, a ghostly echo of a politically vague, disarticulated appeal to “change.

‘Just Another N’: Making Metascience Ordinary

I first visited the Center for Open Science in the winter of 2015, a few months after the Reproducibility Project in Psychology (RP:P) was published (Open Science Collaboration 2015). By this time, what metascientists would often describe as “the narrative” of the study had already begun to slip loose from their control. It wasn’t as though they’d wanted to “control” the narrative per se, but they certainly took issue with

the more apocalyptic interpretations of the study that were circulating throughout science social media. As I discussed in my literature review, the massive, collaborative study to independently reproduce findings and effect sizes across one hundred research articles had touched off a controversy regarding the state of the field. For some, who were either directly involved in or interested in the field of social psychology, the findings of the project represented a clear “crisis” of veracity (see e.g. Fanelli 2018). For others, it raised a techno-dystopian specter of academic “trolling,” of character-assassination tailor-made for the digital age (Fiske 2016; Dominus 2017).

For many at COS however, RP:P represented merely the collective scientific process behaving as it should, through steady, “unbiased” systems of self-correction articulated together in independent verification using advanced technologies of collaboration and communication (Nosek and Errington 2019).

Within anthropology, my primary interests reside in the anthropology of science. I’m drawn to explore the connections and relationships that sustain complex technoscientific systems, as well as those that become constrained, wear down and (eventually) become exhausted. I’m interested in the cultural assumptions and presuppositions embedded in experimental systems (Rheinberger 1999), not just out of an impulse to deconstruct (Latour 1993), but rather out of the sincere belief that the process of attempting to understand how cultural categorizing systems actively participate within technoscience actually *improves* technoscientific processes and practices (Hartsock 1983; Haraway 1988; Puig de la Bellacasa 2017).

Ethnographically studying metascience, exploring the cultural categorizing systems at work in the “scientific study of science,” is simultaneously disorienting, and yet familiar to the legacy of anthropology. As an anthropologist of science, I often thought of metascientists as *fellow travelers*, groups of creative and thoughtful cognitive laborers of similar political imaginaries and ideological orientation, who had similarly grown disenchanted with the hollowing out of sociality within academia. As future-oriented thinkers, I found open science advocates nonetheless employ different techniques and strategies than my own. One of these distinctions began to center around reproducibility.

Reproducibility is familiar and mundane, nostalgic even. Pedestrian and dull. Indeed, open science advocates, metascientists in particular, will often openly and purposely *frame* reproducibility as an established, mundane practice in scientific research. Several articles published by metascientists based at COS continued to reference reproducibility as a settled, “founding,” or “core” value of sound scientific research (Nosek and Bar-Anan 2012; Nosek et al. 2015).

In conversation, reproducibility was similarly downplayed in tone and made to feel mundane and unexceptional in a way that often felt at odds with what I’d expected of a technology and culture-change start-up dependent on flows of philanthropic capital. Despite supporting a range of politically moderate, quasi-progressive and center-left causes, the primary, “angel-funder” of the center, the Laura and John Arnold Foundation appeared to have an interest in funding “ground-breaking,” “innovative,” and “data-driven” solutions to complex socio-political issues. This interest and orientation was not markedly different from much of the rest of the “philanthro-capitalist complex” (McGoey

2016), an arrangement of state and non-state actors that collectively serves to reproduce the supposed legitimacy of “compassionate,” neoliberal capital by working at the margins of the social, environmental, and infrastructural problems wrought by the privatization and hollowing out of civil institutions (such as public universities). Working to clean up a small portion of the same messes they helped to create, many non-profit foundations are no less entranced by the allure of a disruptive technological “fix” than venture capital firms. So why would a non-profit foundation care so much about something so mundane as reproducibility?

Rick, the metascience team leader, would often describe metascience as nothing more than the practice of gathering more data on a specific experiment. For him, reproducibility studies were simply a way of gathering “another N.” Replications only provided supplementary data points in an experiment that was conceived broadly and openly, as existing beyond the temporality and physical confines and borders of its initial *doing* (Puig de la Bellacasa 2017), that extended beyond the observed causes and effects that constituted an experiment’s technosocial gathering (Latour 2004). By the time I arrived in 2016, many metascientists had begun to discuss the importance of deflecting reproducibility away from its association with the disruptive spectacle that RP:P had ignited in press about social psychology. I found this surprising, given that RP:P had generated a significant amount of interest in the center and their mission.

However, reproducibility is also, perhaps surprisingly, speculative. In this chapter, I argue that reproducibility is indelibly and irrevocably attached to particular forward-looking, techno-utopian logics of progress, modes of sense-making that are by their

definition, disruptive. As widespread irreproducibility (i.e. the inability to reliably reproduce similar findings and effect sizes across psychology and cancer biology labs) emerges out of distorted “incentive structures,” publication mechanisms that disproportionately value product over “care of the data” (M. Fortun 2005), features of practice such as scrupulousness and housekeeping that articulate the possibilities of experimentation. Recent and emerging technological advances are imaginatively configured in reparative arrangements, uniquely suited to mending the shorn conduits of scientific communication and collaboration¹².

In this chapter, I focus on the roles that metascience, reproducibility, and replication play within open science. Over the course of three months spent at the center and in remote communication via phone and video chat, I followed several metascientists at the center from summer 2016 to winter 2018. I focused on the ways in which metascientists analyzed data and coordinated results from the reproducibility studies actively conducted at multiple contracted labs in social psychology and cancer biology, coordinated through a Bay Area biotech firm. Though I also reached out to several social psychologists whose research was unable to be reproduced in RP:P, to capture some of the “downstream”

¹² Many open science workers are mindful of the obfuscating effect of much of the immaterial and speculative hype that surrounds figures of technological *disruption*. Over after-hours drinks for example, summer intern developers (who were relied upon to provide much of the R&D labor at the center) would often openly joke about finding ways they could work speculative tech buzzwords such as “AI,” “machine-learning,” and “block-chain” ledger systems into the new features they’d been working on. The hope was, that by seizing on such buzzwords, they could capitalize on the rarified air encompassing fetishized technologies, artificially inflating their reputation and “skillset” to potential employers.

effects of the study, only one researcher returned my e-mail. We were able to speak via video chat about their reactions to the study.

When I was at the center, I drew primarily upon unstructured conversations and participant observation in team meetings. As a cultural anthropologist, I tried to capture as much of the minutiae that underlay metascientific methodologies and strategies as I could (e.g. when it was considered appropriate to use Bonferroni correction in statistical analysis). Even after a year and a half, in person and remotely, many of these details remained extremely difficult to place within the larger context of open science. Unstructured conversation and participant observation were for me modes of attending and being sensible to the much more subtle and potentially overlooked and undervalued relationships that create and sustain open science. I learned to use unstructured conversations to follow-up on these minutiae, to better understand how they articulate with one another, at times creating friction with one another, enfolding, sustaining, and replicating metascience as a complex technoscientific system.

While I focus to a large extent in this chapter on metascientists as a particular group within the center, I also examine how reproducibility cut across multiple domains of practice at the center, emerging as a particular kind of *social fact* (Mauss 1967); that is, I argue that reproducibility configured a kind of enticing, orientating principle, a set of values that substantially re-configured multiple relationships, between for example open science advocates, their design imaginaries, and the infrastructures they built and maintained across teams and projects. Experimental reproducibility is interesting because while it is simultaneously regarded as technoscientific common sense, it is also

constructed as an aspiration for an anticipatory future of research practice that doesn't yet exist and is yet to be fulfilled.

I employ ethnographic methodologies to explore how reproducibility configures in relation to (open) knowledge infrastructure. Although articulated through reference and appeal to established norms and values regarding scientific practice, the emergent field of metascience is also configured as an alternative, “forensic objectivity” predicated on the controversial view that research can be productively subjected to statistical and collective analysis, providing a “snapshot” of a field (Freese and Peterson 2018). In titling this chapter “Disruption.” I don't intend to “take sides” in the controversies surrounding reproducibility. Though I'm interested in technosocial disruption, I don't argue for or against *disruption* per se. I argue instead for following metascience, which I argue underscores how open sciences are more multiple than they might first appear. I hope to understand how an ostensibly singular movement unfolds instead through recombinant (Fischer 2007) imaginaries and hopes, working toward a future of a less exploitative research ecosystem. Whether or not a future of less exploitation is able to be achieved through the kinds of open knowledge infrastructures, research, and policies created at the center lays beyond the temporal scope of this project.

Metascience and the debates over reproducibility reflect in part, a liberal democratic ideological investment in the cathartic, reparative effects of informational exposure and transparency that has historically demonstrated itself to be of limited efficacy in radically and fundamentally reorganizing existing relations of power and knowledge toward liberatory, emancipatory ends (Caduff 2017; Yong 2017). Particularly in the

contemporary geopolitical milieu of rapid, deterritorialized, and “open” information and knowledge sharing across multiple participatory platforms, the idea of a rationally ordered, freely flowing “marketplace of ideas” is as untenable as ever (Han 2015). As this project began to take shape in 2016, following the presidential election, cultural skepticism toward technosocial disruption and open information infrastructures loomed large. This chapter explores how disruption influenced metascience; but it’s also about my own deep appreciation and admiration for the sincerity and care with which metascientists think (de la Bellacasa 2012).

Data-Sharing as a Continuum

Over tea on the downtown mall on a spring day in 2017 Eric, a lead developer, told me how he believed developers built open science tools out of hope. Like much of technology, he told me that “nerds” build out of a hope that the tools they craft will substantially shift the way scientists behave and interact with one another. Yet, the idea of inducing collective change, at least partially through the participatory agency of built things, was not confined to the design imaginaries shared by developers. Culture change had infused into multiple domains of practice at the center, including metascience. In summer 2016, I walked along the downtown mall with Mary, a metascience researcher and reproducibility consultant with a Ph.D. in psychology. I wanted to learn more about how she became involved in open science. As an early career researcher, she described feeling shut out of academia by the increasingly bleak job market. I told her I could empathize. She responded that she had grown personally during her time at the center,

wanting to contribute to what she felt were the positive effects of the movement to increase reproducibility across different fields of scientific research.

Initially, she had only been interested in replication as a corrective for “bad science” (science that had made huge claims, but that couldn’t be independently verified). She grew to recognize and accept the validity of arguments that others had made, that the products of research should be treated as a public good within a fair, and therefore more efficient collaboration mechanism. Her idea of open science would later be echoed in the way Eric felt about software. For her, open science was more of a tool than a social movement. Transparency was a kind of technology, a means to an end (rather than an end in itself) for creating particular kinds of cultural and behavioral changes. As we settled into a small bistro table on the crowded mall, she described what had begun to feel like a rift just beginning to open up within open science discourse.

I tend to think of open science as the openness of the research stuff from the process. I think other people will often times broaden it out, to talk about open science in terms of both the stuff, and as openness in terms of a collaboration model. [...] When I first started at the center, what I really cared about was reproducibility. The openness was not my main focus. It was ‘openness helps in reproducibility; therefore, it is important for that reason.’ What’s interesting is you’ll see these two perspectives usually arrive at the same conclusions. *Occasionally*, you’ll see them diverge, and the one place where I see this the most is when I talk about data sharing as a continuum. (Personal communication, 2016)

By 2016, Mary had felt pushback from others in the open science community who insisted on total openness and transparency, insisting instead on exposing researchers to incremental, subtle changes to their data sharing processes. Changes that could be easily ‘merged’ into their existing research workflow. This was like what I’d heard described weeks earlier by Walt, a member of the community team. Both described a range of what Walt had—I felt charitably—called “enthusiasm” within the open science community that, at times felt *too* disruptive and radical. Walt had completed his PhD in biology just a few years prior, studying mating behaviors in extremely small fishes. His work at COS now primarily involved working closely with journal publishers and academic societies, maintaining friendly relationships with corporate entities within the wider scientific publishing “community,” ultimately to try to convince them to adopt relatively soft policy measures which COS had devised to incentivize openness amongst researchers.

Walt’s view of “extreme” open science advocates, groups who argued for “radical” openness and transparency in subgroups of open science like the “open notebook movement” (Bradley and Neylon 2008) recognized their value as friends within the large umbrella that is the movement to increase transparency in scientific research. Yet, he felt that the ultimate effect of many of these groups was to alienate potential, albeit hesitant adopters of open science policies. As part of his work at COS, he worked to develop and communicate softer policy measures that open science advocates at the center felt were most likely to be easily adopted and incorporated into existing research workflow and publication models. Such soft measures included a series of badges loosely informed by


gamification theory, which were devised to symbolically reward open data and materials¹³.

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Genotyping and phylogenetic placement of *Bacillus anthracis* isolates from Finland, a country with rare anthrax cases

[Taru Lienemann](#), [Wolfgang Beyer](#), [Kirsti Pelkola](#), [Heidi Rossow](#), [Alexandra Rehn](#), [Markus Antwerpen](#) & [Gregor Grass](#) 

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Figure 5.2. An open data "badge" developed by the center directs researchers to the precise location where the data has been digitally deposited (Lienemann et al. 2018).

Such relatively “soft” measures also included a set of “transparency and openness promotion (TOP)” guidelines, which consist of “eight modular standards, each with three levels of increasing stringency” (Nosek et al. 2015). Implementing research standards regarding “data transparency,” “analytic methods (code) transparency,” and “research

¹³ Among digital scholars, *gamification* (incorporating relatively small goals and achievements into routine and mundane tasks in education and work), has proven controversial in recent years (see e.g. Bogost 2011). One of the criticisms is that gamification often translates into attempts to stimulate competition, rather than cooperation and collaboration.

materials transparency,” TOP guidelines appealed to a stepwise, incremental framework that allowed journals and societies to opt-in to specific standards and protocols regarding transparency, as deemed appropriate by specific fields and disciplines. Walt often spoke of how much of his day consisted of trying (often in vain) to persuade journal publishers and academic societies to adopt guidelines for journal publication that were based on research process, communication and data-sharing standards, and protocols that they decided were relevant to each discipline: “provid[ing] flexibility for adoption depending on disciplinary variation, but simultaneously establish[ing] community standards” (Center for Open Science, n.d.). For Walt, this work would often take on the frenzied, laborious, and physically exhausting form of contemporary affective labor, sending out thousands of cold-call email messages, often without response, to journal editors, elected society representatives, and publishing executives.

In contrast to approaches that were considered more brash, the “modularity” of policy proposals like journal standards substantially configures relationships across the open science “community,” constructing data and materials-sharing practices within what Mary had come to describe as a “continuum of practice.” The continuum of data-sharing practices employs enticing appeals to voluntary participation, attracting research journals and academic societies to flexibly adopt individual standards *a-la-carte*, at the level of stringency and requirement most relevant for their field and discipline.

On the one hand, the idea of such a continuum reflects an understanding that, despite working to shift the ways in which scientific research is generally conducted, scientific research and communication practices are not monolithic. Existing within complex

technosocial arrangements, the idea of a data-sharing continuum fits with the anthropological insight that knowledges are situated (Haraway 1988), albeit configured through what are often intersecting and co-productive strategies, procedures, protocols, and standards which are, in some sense, unique and particular to multiple communities of technoscientific practice (Traweek 1988; Knorr-Cetina 1999; Mol 2002; Jasanoff 2006). Communicating a modularity of standards was considered crucial in avoiding the possibility of alienating potential “adopters,” institutional agents who might otherwise feel turned away by a sweeping, “one-size-fits-all” approach to becoming “open.”

In both infrastructure and policy, a reserve army of “early adopters” was often considered vital to catalyzing a grassroots, self-replicating groundswell of “culture-change.” During one of many conversations that took place in the interstices of an otherwise highly structured workday, in a small conference room, I asked Mitch in 2016 about what stakes were involved in “marketing” open science. What was it like to “market” a movement? Though the community team preferred to think in terms of raising awareness and activating a movement, rather than marketing a product for sale, Mitch recognized that there were interests that paralleled with those of corporate technology entities. For example, Mitch gestured to the “google graveyard”—a ghostly accumulation of all the apps that Google had “killed off” over the years, (Killed by Google, n.d.)—to underscore the necessity of continual growth and expansion, even at a tech nonprofit. In 2016, he believed that the center was “still in the early adopter phase, both from just individual users of the OSF, people who use OSF or people who have chosen to adopt

open practices in their day to day workflow, but it's not the mainstream. The mainstream is still a closed workflow" (Personal communication 2016).

Even for a non-profit infrastructure whose work involved altering the course of technoscientific practice to align with principles of transparency, it was becoming particularly valuable he insisted, to understand and capture how data and information were *consumed*:

One of our continual challenges is, how do we keep moving beyond our current adopters? It's the same problem a commercial company has, in terms of marketing and awareness [...] we have an interesting pivot point coming around. We may not be as concerned with users or contributors of data, to tracking *consumers* of data. As the OSF shifts from a place where you contribute data, it becomes more like a Wikipedia, a place where you go to discover scientific research in various forms. Registries, preprints, projects, pre-registries, meetings... the entire life-cycle. (Personal communication 2016).

The image of tracking "consumers" of scientific data felt like the kind of disruptive transformation economies that had recently precipitated around the rapid, translocal hyper-connectivity of "platforms" on the contemporary Internet (Jarrett 2015; Bell 2015). It's difficult to keep up with discourses of disruption that envelopes print media (disrupted by social media monopolies and massive participatory information infrastructures like Facebook and Twitter), or music and television (disrupted by streaming platforms such as Netflix, YouTube, and Spotify). I agree with Gershon's (2017) argument that one of the more interesting and compelling effects of "new media"

is perhaps the extent to which they restructure arrangements amongst discursive participants, drawing groups into a reflection on the very meanings of what underwrites the novelty of “new media” (see also Beck 1992 and Kelty 2008 on contemporary cultural discourses on how media restructures lives, and vice versa)¹⁴.

Mapping data consumption flows across OSF would continue to prove difficult. In 2018, the community team was still trying to standardize the kinds of “data about data consumption” that they were able to accumulate, analyze, and re-present. I was able to find that most visitors to the site were based in North America (U.S. and Canada) and Europe. By the time I began writing up my dissertation in fall 2019, a query of the OSF API would show that the platform had accumulated almost one-hundred and ninety-thousand “users,” or individual accounts that had registered via email to the site. By March 2020, that figure had surpassed two-hundred thousand. In 2018, five years after Spies had initially developed OSF, developers at the center were in the early stages of integrating automated A/B testing software into the platform. By analyzing how users engage with one of two randomly presented configurations on a user-interface (e.g. a solid vs. a transparent or “ghost” button) on the platform, A/B testing is often used to automate the process of gathering insights regarding user interactions and experiences with different interface layouts (e.g. analyzing the time it takes a user to navigate between

¹⁴ In my chapter on “Repair,” I speculate on the relationship between the “contentification” and anxieties surrounding the “quality” of scientific data. I explore anxieties surrounding the proliferation of infrastructures for storing and managing a capacious understanding of “information and data,” and what this might portend for the labor of creating research data, as well as what we might crudely define at this point as data “quality.”

one of two, randomly presented feature placement options, in order to find the most efficient configuration between multiple possible features on a website¹⁵).

When I asked several developers why they felt this kind of testing hadn't been conducted before, they replied that when the platform was first conceived and built, it was done so as to meet what felt like an urgent need in the scientific community for free and reliable data management. Because assessment procedures like A/B testing require more time and resources (e.g. with A/B testing, programmers must develop two distinct options whereas before, they were only expected to create one). Emphasis and resources had been allocated toward ensuring the integrity of the platform's backend, the underlying architecture of the website often most closely associated with the function of the site itself. Focusing on ensuring that the site was stable and not riddled with bugs that might increase the likelihood of site crashes, the initial focus had been directed toward ensuring that researchers who used the platform would trust the site with their research workflow and data.

Now that the structural integrity of the platform had felt more assured, development had begun to “pivot,” shifting toward what was imagined as a coeval appreciation of backend/architectural, and user-interface and experience (UI/UX) design. Allocating more resources and energy toward A/B testing and data consumption analyses

¹⁵ The podcast series *The Butterfly Effect* (Ronson 2017) examines the effect of free porn hosting platforms on the porn industry, and on the lives of its workers. It also discusses the ways in which software A/B testing is much more than a passive or neutral assessment or quantification mechanism. A by-product of A/B tests performed on different tags on one such platform, for example was a proliferation of increasingly niche content categories which impacted the kinds of sex scenes which came to be regarded as more valuable, demonstrating that even seemingly relatively minor “tweaks” to a software platform had dramatic effects on workers' lives.

represented the hope of becoming ever more responsive and attentive to the highly granular needs and desires of the complex community of practice made up of researchers.

However, front-end and full-stack developers such as Greg felt that the organizational transformation was long overdue. In 2016, a full-time developer who preferred to have our conversation partially masked by the roar of *muzak* and the large water feature in the center of the hotel lobby described the difficulty of integrating principles of design into a platform that had been heavily “engineered” from the beginning (Personal communication 2016). Arrangements on the interface, such as the linear, hierarchic and nested relationship of “projects” to “components,” for example had become integral to the function of the site itself. They were therefore rendered *inflexible* by the dense web of dependencies that had come to be engineered around them.

For front-end and full-stack developers, unseen or background architectural and user-facing or interactive aspects of design were ideally conceived and created dialogically, in communicative feedback loops informed by an understanding of relationships with the researcher-user, loops described as more “empathy-driven” (Personal communication, 2018). These loops were imagined to be more responsive to the iterative and constantly evolving needs and desires of researcher-users working within a complex and constantly evolving research ecosystem. Aspirations of modularity, they insisted weren’t able to emerge spontaneously, but emerged instead from the (limited) possibilities created by what had materialized in the arrangements of code that had come before, that had been engineered “upstream.”

Although often fetishized in popular discourse through logics of ostensibly immaterial and seamless acceleration and “pivots,” what Eric described as “communicating through tools,” transforming history and sociality through software was recognized as deeply material (Dourish 2017), and therefore unable to be radically changed and transformed “on the fly.” Especially for front-end developers like Greg (who had been interested, from the beginning in designing ways that would allow OSF to be more open to more radical ways of representing data and workflow through the use of tags and data clouds), “dependencies” in the code ran too deep to allow for truly radical reconfiguration.

As a “programmed vision,” the materialization, the *becoming* of a platform “as thing is inseparable from the externalization as memory” (Chun 2011, 11). Despite articulating infrastructural nodes and conduits through which cognition becomes in some ways diffused, software fails to materialize as a vehicle through which we transcend the stubborn materiality of existence (c.f. Hayles 1999). Software, like much of infrastructure is instead materially and socially *ambivalent*, reconfiguring some material relations and opening up particular spaces of political possibility (Srinivasan and Fish 2009), while simultaneously reifying and ossifying colonial modes of extraction (Amrute 2019). For several developers at the center, front-end design in open science was a heretofore overlooked and undervalued *matter of care* (Puig de la Bellacasa 2017), a re-configuration of material relations which, by extension re-configured relations between researchers toward a future that was imagined to be predicated on relationships of creative solidarity rather than corruptive competition. Might the memory externalized in

the form of OSF be too closely attached to fixed, static and impermeable principles of software engineering to become sufficiently modular to externalize open and porous communities of technoscientific practice?

Rather than a means through which to *disrupt* communities of technoscientific practice, what Greg described as “empathy-driven” design was articulated by front-end and full-stack developers as a mode of dialogic communication which, to him more accurately reflected the hope of a collaborative and supportive community of knowledge producers by integrating the insights of people in the community into their work. It was partially because of its association with empathy-driven design, Abdi (a full-time developer) said to a group of intern-developers and I gathered in the kitchen one day in 2018, that front-end design work was feminized and often devalued within software development communities. Despite the contemporary proliferation of male programmers in the industry, he continued, it was important to recall that modern computing as it began to emerge in the 1950’s was mostly performed by women. As programming began to be regarded as a high-prestige industry associated with creativity and a path to socio-economic mobility in the ‘80s and ‘90s, Greg echoed, women programmers began to be pushed out of the field and displaced by men, much like prestige jobs in the rest of society. Looking even further into the history of computing, Gwen responded, we see foundational, early contributions by women like Ada Lovelace are often supplanted or subsumed into the work of men like Charles Babbage (see e.g. Monteiro 2017). While she’d never mentioned it to me directly, I later recalled how she’d once been sidelined,

asked to “take notes” at a large hackathon being run for one of the platforms she’d been involved with from the beginning.

The toxic masculinity of software programming, the rampant abuse and harassment experienced by women in tech, they agreed was not inevitable, but was instead a direct artifact of social arrangements and configurations that had been articulated throughout history and that have a direct bearing on the possibilities and life-chances experienced by women and queer programmers of color today. It was only a year earlier that software programmer and former Google engineer James Damore had circulated a highly incendiary memo critical of what he described as a left-leaning “ideological echo-chamber” at the company (P. Lewis 2017). Several of them had also followed the horrifying harassment of several high profile women gamers that formed online after a journalist had written a negative review of a game, just a couple of years prior (Massanari 2017). They were all deeply aware and reflexive of the power of online platforms to facilitate the emergence and acceleration of certain communities and social orders at the expense of others; empathy-driven and civic design, attending to the social use and uptake of software, they felt was far too often overlooked in tech.

Modular Acceleration: Open Science and Temporality

Before spending time at the center, I was aware that policy recommendations were a significant way in which open science workers and advocates were trying to steer the ways in which the “tech” was being used; to inculcate a kind of “culture-change.” It was clear from early in the ethnographic process that the center was as much a civil society organization as it was a tech and research institute. Compared with more well-known tech

startups, the “mission-driven” portion of COS had materialized into relatively more concrete policy-change recommendations from within compartments at the agency which were intended to work in symbiosis, alongside and in collaboration with other departments. The center’s web presence is constructed in such a way as to underscore the hope of parity between each of the three “pillars” of the non-profit institution (i.e. Infrastructure, Metascience, Community), to underscore their coeval value in relation to “the mission” of opening science, in the hope that “the tech” or the “metascience” wouldn’t overshadow the rest of the mission.

Despite appealing to a meta-category of scientific practice, of opening “Science” conceived broadly, open science advocates frequently spoke in terms of flexibility. Transparency in open science was often conceived of in modular terms, as able to cater to particular, individual disciplines. Before spending time with open science workers, I expected open science advocates at the center to be more explicitly motivated by a collective sense of creative destruction and disruption. The publication of RP:P just a year prior was still sending shockwaves rippling through the field. At least in conversation however, open science advocates would often emphasize relatively slow and steady, incremental cultural change over rapid, revolutionary paradigmatic shifts (c.f. Kuhn 1994).

In conversations such as these, the temporality of open science advocacy seemed riven with contradictions. Aspirations for the future were, at times underwritten by imaginaries of acceleration. Open workflow management platforms and metadata search engines were designed in part, to “accelerate the pace of discovery” by circulating

experiments in a collaborative ecosystem built on modular streams and conduits of “immutable mobiles” (Latour 2012), lively artifacts which would allow experimental processes to be seamlessly reassembled and replicated/reproduced. Openness and transparency were configured in these imaginaries as mechanisms of reducing sources of “data friction” (Edwards 2010), bottlenecks in data pipelines that had been imposed by inefficient research communication infrastructure. Such friction is only ever an *obstacle* to scientific progress. In summer 2016, Christopher expressed the relationship between speed and scientific research in relation to his personal mission, stating

goal number one for me in being in science is, ‘how can we get more knowledge, more quickly, with fewer resources?’ And that’s ultimately the goal at COS, right? Openness and reproducibility are values on the assumption that they accelerate knowledge accumulation. In terms of speed, and in terms of resources. And if it doesn’t do that, then what’s the point of transparency? What’s the value of transparency, other than to facilitate knowledge accumulation, which is the goal of science. (Personal communication, 2016)

At the same time, metascientists and developers would often point to open science infrastructures as mechanisms of data quality assurance, upsetting the academic hegemony that valued novelty over procedure by articulating an alternative economy of knowledge which prioritized experimental processes over products. In a hypothetical scenario, Mitch once imagined a not-too-distant future in which otherwise obfuscated and black-boxed processes which are crucial to the experimental process could be prioritized over novel results. In his example, when a researcher in this imagined future came up for

tenure review, they might eventually be able to tell their committee, “more importantly [than the number of articles I’ve published], this data set has now been forked five times... my data is more important than the article,” adding that, for him personally, “data is the more important thing if you want to think about the *extensibility* of science” (Personal conversation, 2016).

Developers would tell me that the “forking” feature of OSF is inspired by a feature of the same name on Github, which allows subsequent users to share and copy software code from another repository. In the case of Github forks, Adrian Mackenzie (Mackenzie 2017) demonstrates how the vast majority of “Fork events” on the site are often extremely short-lived. However, forks figure prominently into the re-presentation of activity on the site, often becoming skillfully packaged by Github marketing teams as a means of generating revenue.

“Forking” in OSF allows users to copy any component of a project (or an entire project) which the project administrator(s) elect to make public. Individual forks can include for instance, data, registered reports, materials and procedures, and entire manuscripts if they’re stored in OSF. For Mitch, the value of “forking” events isn’t that they eliminate reputational metrics entirely, but instead help to achieve a more realistic goal: attaching standards by which we assess research prestige and status to measurements of research *quality*, rather than novelty. The hope of forks and their metrics is that they would come to participate in a wider “cultural” shift, reconfiguring scholarly assessment protocols toward metrics perceived to be more closely associated with research skills and procedures, rather than published findings. In the context of a

data gift economy, “forks” are alluring in that they purport to provide a quantifiable representation of an experiment’s afterlife, an index of data and metadata reuse, repurpose, and re-assemblage. If an experimental procedure or data has a lively, quantifiable afterlife, this is a measure of a research team’s scrupulousness and housekeeping (M. Fortun 2005).

My conversation with Mary demonstrates how temporality was likewise an issue for metascientists and community team members, for whom collectivity and participation in open science infrastructures were perceived to be predicated on *moderating* disruption. In 2016, I broached the question of disruption in a conversation with Carl, a PhD in biology and the metascience team leader for the reproducibility project in cancer biology. He’d often spoken of what he felt was a heightened importance of “avoiding narrative” in writing-up reproducibility research. Preferring to include “just the data,” he elaborated that he’d always tried to write-up results of the project in as neutral a style as possible, particularly now in his work as a metascientist. He gestured to the RP:P as an example:

when you read RP:P, and you look at the way its structured, it’s very straightforward. It’s very modular. There’s continuity across the paper, it’s written very well, but it doesn’t make strong claims. [...] it’s very specifically written in the manner *not* to suggest what’s going on. (Personal communication 2016)

When I asked him to clarify what he’d meant when he described the RP:P article as “modular,” he explained how the process behind each experiment was meticulously documented on the OSF project management platform, so that the metascience team were

able to write up the research findings in such a way that focused simply on the data, without getting involved in drawing inferences. Because the process was entirely open, other researchers could follow-up and conduct their own, independent replications of the original experiments and/or directly attempt to replicate their replications.

As with the infrastructure itself, experimental *modularity* (engineering an experiment such that it allows for seamless flow, for downstream researchers to “fork,” components “dragging and dropping,” reassembling and reusing multiple constituent parts and components) was regarded as a method of mitigating against the kind of technosocial strain that might otherwise impede scalability. For metascientists, “merge conflicts” would periodically emerge not (as with developers) when trying to combine particular lines of code in the software language Python, but instead in the vagaries of the reassembled experiment, as metascientists attempted to reinvigorate an experiment, reaching as close as possible toward the exact same experimental conditions of the original study.

During a team meeting in 2018, the metascience team spent a significant portion of the meeting grappling with the potential effect of different reagent lot numbers, for example. Though the experimental protocol specified a particular reagent to stimulate tumor growth in laboratory mice, the laboratory conducting the experiment was unable to acquire the reagent with the exact same lot number. When the experiment didn’t reproduce the same effect, Carl noted that the team would be unable to specify with absolute certainty if the reason for the irreproducibility was because of a flaw that had been overlooked in the original research design, producing a false positive result, or if the

reagent used in replication had been ever so slightly different from the one used in the original study, slightly altering the outcome of the replication. While the team was, in this case *able* to acquire supplementary information not contained in the original report (e.g. the original reagent lot numbers), interpretation was rendered more uncertain by ostensibly “outside” circumstances, matters which *came to matter* (Barad 2007) from outside the physical boundaries of particular labs, nonetheless significantly reasserted their agency within a complex technosocial assemblage of the experimental apparatus.

In follow-up conversations, some metascientists would occasionally confide that they had felt a personal discomfort with the resulting uncertainty surrounding irreproducibility. Kim, another member of the metascience team who had recently completed an undergraduate degree in psychology, was surprised. She’d worked on both RP:P and RP:CB, and although she’d originally anticipated that there would be an increased likelihood that the ambiguous format of social psychology research would lend itself to messier, and therefore irreproducible research practices, working on RP:CB during the last year had made her realize that the complexity of cancer biology research often made it especially difficult to reproduce original findings.

When I asked Carl what the team planned to do about the ambiguous replication results, he replied that they planned to treat it like any other replication, including the discrepancy in the write-up as more “context” for the study, as a possible factor in the outcome. They planned to publish the findings via a pre-registration agreement with the open-access biology journal *eLife*, that had ensured that whether the results were “positive” or “negative,” they would be published regardless.

For Carl, the point of metascience wasn't to insinuate that original researchers had ever conducted "bad science," that they had fabricated data, or that their interpretations were either wrong or correct. Verisimilitude and truthfulness weren't binary. Rather, replication outcomes were articulated as supplementary "data" in an open-ended research, information that would either increase or decrease relative confidence in an *initial* experimental result. For the metascience team, "replication is a study for which any outcome would be considered diagnostic evidence about a claim from prior research. This definition reduces emphasis on operational characteristics of the study and increases emphasis on the interpretation of possible outcomes" (Nosek and Errington n.d., 2).

Having studied positivist knowledge claims as part of my background in anthropology of science, I was originally surprised to find that what replications *weren't* imagined to do was to either clearly confirm or throw out original results. Whether in the field of social psychology or cancer biology, metascientists consistently told me they wanted to be mindful that replications adhered to what they all agreed were established standards and protocols regarding "good" and rigorous science. Fastidiously and scrupulously documenting how they navigate what Carl later described as the "landscape of possibilities" for why a replication produced different results from the original was a matter of ethical commitment not just to the original researchers, but also to the metascientific sense-making process, the stakes of which were those artifacts of experimentation that had become settled and arranged as matters of fact (Latour 2004). For Carl, the idea of sinking massive amounts of time and financial capital into cancer

biology research that built on results that had not been independently tested meant that the stakes couldn't be higher (Personal conversation, 2016; 2018).

Anthropologists of science Kim Fortun and Mike Fortun, studying collaborative toxicogenomics teams, argue that what becomes regarded as “ethical” science involves continually making decisions about how best to uphold competing values. It is in these judgments, in our view, that ethics “happen.” In the sciences, this means that ethics happens in research design, in modes of collaboration, in the way people choose and use technologies in their work, and, especially recently, in the way people “care for the data” (K. Fortun and Fortun 2005, 47).

Among metascientists, at points where ethical commitments to original researchers and conducting good science might potentially come into friction with one another – considering which, for example among an effectively infinite range of experimental circumstances that might differ from the original to the replication were relevant or irrelevant—the team could gesture to their “care of the data” and modular archival practices on the research management platform OSF. Both reproducibility projects, RP:P and RP:CB were designed as open-ended experimental systems (Rheinberger 1999), temporally-indeterminate systems designed with the hope of “facilitate[ing] shifts and displacements that allow something new to emerge” (K. Fortun and Fortun 2005, 47). Reproducibility projects were designed to *invite* other research teams to seamlessly repurpose their data and/or protocols in order to independently assess their work, to replicate their replications. While other research teams had previously conducted large-scale replications that had thrown into doubt the state of pre-clinical cancer biology

research (see e.g. Begley and Ellis 2012), RP:CB and RP:P were both unique in exposing the identities of the original studies being replicated. In a video-chat conversation with a social psychologist whose work was featured in the original reproducibility project as one of many that wasn't able to be replicated, he identified this as an aspect of the project that he found troubling, given the career stakes involved. While he felt personally secure in his position as a tenured professor, and supported the project overall, he wondered aloud if the method of universal exposure might place other researchers (e.g. junior, female scholars of color) in increasingly precarious positions¹⁶.

Sociologist of science Harry Collins (1985) insisted several decades ago that there was nothing intrinsic to the process of conducting independent experimental replications which was able to reliably arbitrate questions of confidence regarding particular results. What often emerges instead is a potentially open-ended “loop” of counter-testing and counter-interpretation with no clear resolution, what Collins described as an “experimenter’s regress.” As the social psychologist from outside of the center with whom I spoke pointed out, it was unclear if tenure committees would see the reproducibility results as simply “more data,” rather than evidence of either shoddy or duplicitous research (see e.g Dominus 2017). An example of this “loop” began to unfold shortly after the publication of RP:P, when a separate team of social psychologists insisted in a comment published in March 2016 that the Open Science Collaboration had

¹⁶ While I reached out to several other original researchers whose findings were unable to be replicated in RP:P, I only received one response. It is significant however that this research identified this as a possible side-effect of the project, demonstrating that it is very much worth considering the downstream effects of the totalizing, universal approach to *exposure* facilitated and pursued by a mediated reproducibility study (Chun 2017).

“allowed considerable infidelities that introduced random error and decreased the replication rate but then compared their results to a benchmark that did not take this error into account [...] us[ing] a method that severely underestimates the actual rate of replication” (Gilbert et al. 2016, 1037-b). In the same issue of *Science*, members of the Open Science Collaboration responded that although they “agree with them [Gibert et al. 2016] that both methodological differences between original and replication studies and statistical power affect reproducibility [...] their very optimistic assessment is based on statistical misconceptions and selective interpretation of correlational data” (Anderson et al. 2016, 1037-c).

As an anthropologist, I felt it wasn’t really my place to pick a side in this particular “regress.” Rather, the most interesting feature of the reproducibility “crisis/debate” is that it continues to be unsettled. While media discourses re-present the matter as a “crisis,” a possible indication that science is “broken” (Cara 2019), spending time with metascientists and community-builders reaffirms the ways in which science is continually “broken” and “fixed,” refashioned and “fabricated”¹⁷ in local, situated spheres in which practices, politics, and values are negotiated and contested (Haraway 1988; Mol 2002). At the technology and culture-change development hub, a contradictory, that is simultaneously systemic and infrastructural, yet often individualist view on the issue of (ir)reproducibility began to emerge and be reaffirmed. Metascientists often took care to

¹⁷ While “fabrication” in science often carries a negative connotation, I do not use the term to suggest that metascientists ever “fabricated” data. In fact, the ways in which they worked with data very much reflected their commitment to data as a matter of care (Puig de la Bellacasa 2017) which they took very seriously. I draw instead upon Donna Haraway’s (2013) appreciative use of the practical metaphor to gesture toward the common practice of drawing upon existing elements of technoculture when conducting knowledge-work at frontiers and borders.

shift discussions of irreproducibility *away* from individual research practices. In addition to distorted “incentive structures” which reproduced irreproducible research practices, the temporality of the scientific research process was also impeded by constraints in informational bandwidth which were imposed by “cultural” artifacts such as a continued attachment to outdated publication models. In a technosocial context of rapid and responsive information flow, open science constructs an anticipatory imaginary of arrival, a unique point in time in which scientific values and practices can (finally) align, constructing technoscience as a decentralized, democratized community of practice.

In the following chapter, exploring how “innovation” infused into the center, I demonstrate how open research practices become configured as matters of technological design which are imagined ecologically, “scaling-up” through the accretion of individual interactions across a workflow management platform. I begin to follow the movements of a particular object (the social science research preprint) to explore how ideas of collective action and community-building become embedded into technocultural forms, underwriting imaginaries of accelerating and “fixing” science through phenomena such as modularity and responsivity.

Chapter Four

Innovation: Communicating Through the Tools we Build

In this chapter, I follow *innovation* through three connected movements: labor, infrastructure, and circulation. I begin this chapter with a focus on trying to apprehend the often ambiguous labors within which innovation is embedded. Creating innovative platforms for knowledge sharing is often cited as a primary motivation for many of the developers who came to work at the Center for Open Science. This section explores how these open science engineers came to reflect upon the relationship between place, creativity, and labor. I build on the work of anthropologists who argue for *ecological* interpretations of infrastructure which “emphasize the “when” rather than the “what” of infrastructural formation" (Star and Ruhleder 1994; Harvey and Knox 2015, 5). I argue that, despite an appearance of timelessness, the materiality (i.e. labor and interfaces) of open science comes to encompass spaces and places saturated with intoxicating atmospheres of innovation. Rather than subvert the conditions of post-Fordist labor, across the “open office,” we see them reasserted.

The second section of this chapter more closely explores the products of design labor, following the social life (Appadurai 1986) of what I call *aspirational infrastructure* (i.e. infrastructures saturated with aspirations and promises of alternative sociality). Through conversations with open science engineers, I follow a specific software platform for managing scientific workflows and cultivating knowledge sharing publics, developed at COS (OSF.io, formerly the “Open Science Framework”). In this part of the story, I examine how aspirations of creativity and innovation often come into tension with

technical demands for scale. I demonstrate how these demands came to be met through an ambivalent technopolitics of modularity.

In the final section of this chapter, I follow the thread of *aspirational infrastructure* from the previous section to explore how data, information, and knowledge are circulated in the open science ecosystem. I discuss how open science engineers responded to the extractive recuperation of “open science” by for-profit publishers beginning around 2016. I demonstrate how open science came to be regarded as a digital *frontier* (an open-ended future, rife with potential *and* uncertainty). I also underscore how the spontaneous collectivization of a research gift economy is imagined through aspirations of seamless relationality, an alternative sociality through good design.

Open Labor

Along the entire length of one wall, large windows stretch from floor to ceiling. The openness of the place jumps out at you all at once. The lightness suggests the way windows of an ornate cathedral can illuminate, coating an atmosphere in thickly reverberating pools of innervating sunlight, even in the enveloping, saturatingly ashy gloom of a Southern Winter. In a special issue of *The New York Times Magazine* (2016) dedicated to “rethinking the office for an always-on economy,” author Nikil Saval traces the “fun office” to the “sudden efflorescence of the tech industry in the late ‘90s [that] took us from the desert of cubicles to the milk-and-honey offices of today.” With a criticism out of step with the general breathlessness of an issue splashed with richly colorful advertisements for office furniture and photos of hipsters in new-wave offices, Saval (2016) goes on to identify some of the ways in which the contemporary blend of

aesthetics, labor, and politics (labor/atories) that one design firm dubbed the “ethonomics” of workplace design “is intended to make it increasingly difficult to separate our work lives from everything else.”

The aesthetic transformation of the office workplace in the early 2000s became synonymous with a new mode of performing knowledge work, in line with what Alan Liu calls “the laws of cool” (2004). Office landscapes became simultaneously dominated by temporarily occupied desks and a sense of flow across spaces devoid of dreaded, isolation-inducing cubicles. Gone too are some of the more overt symbols of hierarchy, executive corner offices. Sociologists Luc Boltanski and Eve Chiapello (2007) argued that the imperative of self-management encouraged through the aesthetic of the contemporary office inscribes a “new spirit of capitalism,” wherein which critique is not necessarily held in abeyance, so much as it is continually tweaked and modulated.

Founded in 2013, the Center for Open Science occupies a leased office on the ground floor of a moderately priced hotel. The office was built during the wave of popularity of the so-called “open office floor plan.” Mary, a metascientist, once expressed cynicism when I asked her about the office layout. “It’s that way because it’s cheap,” she replied dismissively. It wasn’t “open” by design, she elaborated, but just because cubicles are expensive. “Liberated” from cubicles, work in the open office most often hums along quietly, amidst a steady cadence of lightly clicking keyboards, hushed voices, awkward hellos exchanged on the way to the restroom or the kitchen, and in the choreographed, subdued banter and check-ins of structured meetings called “scrums.”

In a short piece of speculative fiction called simply “Open Office Plan,” published in an issue of *The New Inquiry* focusing on the phenomenon of fan fiction, author Hannah Gold (2017) uses the figure of the open office plan as metaphor for the alienation and disaffection wrought under contemporary conditions of subjective openness in new-age knowledge economies. It primarily follows the story of Tana, a recent hire at a social media firm, what she describes as her dream job. Through the course of the story, the office transforms into an increasingly ludicrous, carnivalesque character. In a tour of the company, Tana is told by a manager that total devotion to the company, transforming yourself into a spectacle of excess (e.g. participating in a new version of the reality cooking show “Chopped” that entices participants to cook one another’s pets) and mediating every detail of your entire life through the platform, will ensure that she’s eventually able to experience the pleasures of the fifteenth-floor open office plan:

the company’s pride and joy. Of course, every floor follows a related layout, but each is also special, featuring its own unique delights and trashbars. At its center is Sauvage, the bar that gets us the most fucked up. And at the center of Sauvage is a submissive in a gimp suit with no name who holds a tray of cocaine steady for all eternity. You must go there sometime. (Gold 2017)



Figure 6.1. A view down the length of the open office floor plan at the center, facing away from the kitchen and toward the Bullpen. Photo by Kyle Harp-Rushing.

Unlike the rumored and actual offices that dot the tech corridor in Silicon Valley and that fill the imaginaries of fiction writers, the Center for Open Science is notably more subdued and mundane. As we walked toward the downtown mall one day in summer 2016, I asked Cory, a developer-intern, to describe his feelings about the office. He'd had a major deadline coming up for an R&D project that he'd been working on for the last few months, and I could tell he was anxious. I told him that we could always have our

conversation later, after his deadline. But he quickly replied that he needed a break anyway, and that the walk would give him a change to get some fresh air. We walked past the roaring water feature in the center of the hotel lobby and out into a wave of heat, coming to settle at a small bistro table outside a café.

Turning back to the office, he responded with frustration that the office had come to “be more of a source of anxiety than anything” in recent weeks. When he first started, he was just as entranced as anyone with how “cool” the office felt. He still liked the relative sense of “freedom,” to get up and grab a snack or step out of the office without feeling guilty. But he’d quickly grown disenchanted with the constant sense of *potential* surveillance. After he got into coding a few years ago, he’d quickly found that his ideal workflow was characterized by a kind of *modular labor*, an entanglement of circular play and labor that he described as “hopping around.” Spending long stretches of time focused on a problem, he’d periodically “plug-in” to something else to give his mind a break before returning to the problem. “But,” he confessed, “I don’t want to run the risk of someone catching me on Reddit when I’m supposed to be working.” When I asked if employees were explicitly restricted from taking short mental breaks to browse, he quickly responded that in some ways it was actually the opposite. Employees were essentially given free rein to manage their time independently, as they saw fit. But he still felt that, particularly as an intern trying to get hired on as a full-time developer, it just wasn’t worth the risk that the boss might happen to look over your shoulder at the precise moment you’d decided to consume some memes.

In his article on open offices, Saval (2016) notes that one-third to one-half of employees in open offices describe a constant and distracting lack of auditory and visual privacy (Kim and de Dear 2013). In summer 2016, following a disappointing performance review, Gwen had asked Colin (a lead developer) for help. Before coming to COS, he'd worked for toy companies, writing software for robots. In early 2016, he'd commandeered an empty supply closet at COS, transforming the empty room into a "makerspace," complete with Arduino programming kits, random bits of wire and capacitors, and the crown-jewel: a 3D printer. He could often be found in the makerspace during his breaks, in between reviewing code or running meetings, the rhythmic clank and buzz of the 3D running in the corner. Frustrated, Gwen asked if he could print her some "blindners." Made of yellow plastic, the small panels slid over the temples of her glasses, restricting her peripheral vision and minimizing distraction.

The contemporary, open office departs in significant ways from the compartmentalized offices spaces that began to materialize as Taylorist management regimes were imported from factories to offices, beginning in the early twentieth century (Leffingwell 1917). As historian Michelle Murphy argues, "the built environment of office buildings was not the passive backdrop that ventilation engineers had intended; rather it actively choreographed laboring bodies" (2006, 37). Under Taylorism, this choreography was predicated on isolation and functional modularity as the basis of routinized, and therefore objectively measurable and manageable labor.

The atomization of bodies in space inevitably contributed to a pervasive sense of alienation and detachment amongst office workers. Conveniently for management,

compartmentalization and detachment thus also contributed to efforts to suppress solidarity, configuring what Murphy (2006, 10)—in her study of efforts to articulate the embodied effects of sick building syndrome, and to have it legally recognized—describes as a *regime of perceptibility*, a configuration of bodies and objects in space in such a way as to amplify uncertainty amongst predominately women office workers.

Contemporary, *open* offices often conjure an intoxicating image of office sociality and collaborative knowledge-work in contradistinction from these conditions of atomization. Experimentality, sparks of inspiration and spontaneous knowledge-sharing converge across moments of seamless encounter. Perhaps as an unintended side-effect of co-inhabiting more seamless and fluid office space, workers within large corporations build networks of office-work solidarity (Pardes 2019), despite efforts to suppress class-consciousness¹⁸, a sense of solidarity is likely amplified through the friendly interactions and encounters facilitated by office designs which allow flow. However, Cory and Gwen both gestured to how, in the hyperactive atmosphere of the “agile,” open office, the hierarchy of the Fordist office continually reasserts itself in subtle ways, even in the temporal distance ostensibly demarcated by the “post-” prefix. Experimentality becomes an assemblage, a re-configuration of bodies, objects, and senses in space, such that innovation and experimentation become entwined, required to function and remain productive in the ostensibly “open” choreography of cognitively laboring bodies.

¹⁸ For example, the action of over two-hundred Google workers in November, 2019 was in response to the firing of two employees for their reputation as activists trying to raise awareness of the “company’s pursuit of defense contracts and decreasing internal transparency” (Bhuiyan 2019).

The walls of the entire office were coated in a special whiteboard paint. A meaningful kind of disjuncture in the way diagramming and concept-mapping are invited in the boundless and spontaneous interface of a communal, analog medium in a place of digital design. There's something I love about the whiteboard walls; perhaps only in the way anthropologists are drawn to mundane objects. They remind me that even "innovation" draws on existing modes of praxis, of thinking and doing, they draw upon a kind of embodied *bricolage* (Lévi-Strauss 1966). For some, their presence is *indexical* (Peirce 1960), a physical manifestation of innovation's signified that elicits or conjures an anticipation that the work performed will be innovative. Anna, a former intern and current ambassador to the center and I often shared a mutual fondness for the creative and collaborative potential of a partially open whiteboard wall.

When I asked a project-lead why, after about a week I never seem to see anyone actually *writing* on the walls, Edith laughed as she responded that they were '*kind of like cave-paintings.*' I took this to mean that their origins had been lost long ago to the sands of time, particularly when she added that they were probably better suited to the study of an archaeologist. Indeed, many of the diagrams, hastily scrawled in red, green, or orange, had weathered and faded, their meanings inscrutable. Some embedded themselves into the walls. Over the course of the next few months however, everyone from community team members to programmers and metascientists used the walls frequently, although mindful of the politics of wall-writing, they would often pause their train of thought for a moment as they searched, either for blank space or for something likely to be considered disposable, before they'd launch into a choreographed writing, using the walls to map out

complex concepts and architectural relationships imagined to occur in the backend of OSF.io, or to map out relationships amongst categories that most clearly define “good science.”

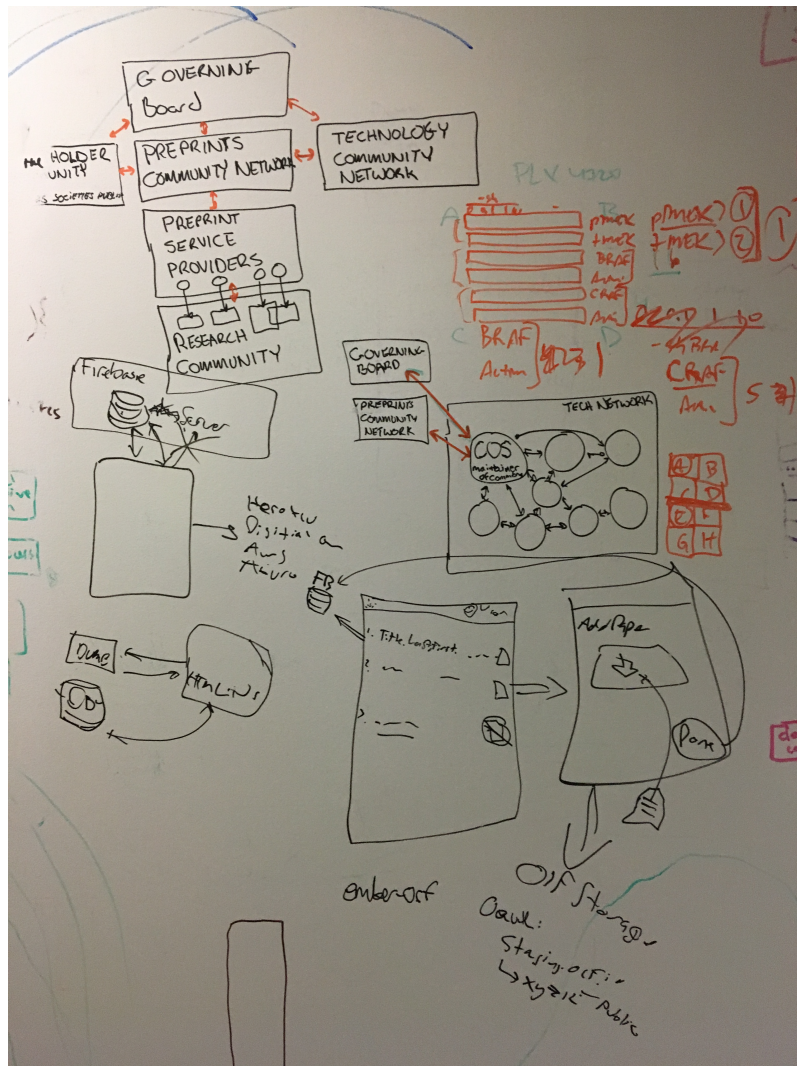


Figure 4.2. An architecture diagram drawn on the wall inside a conference room depicts relationships between preprint software services and stakeholders. Photo by Kyle Harp-Rushing.

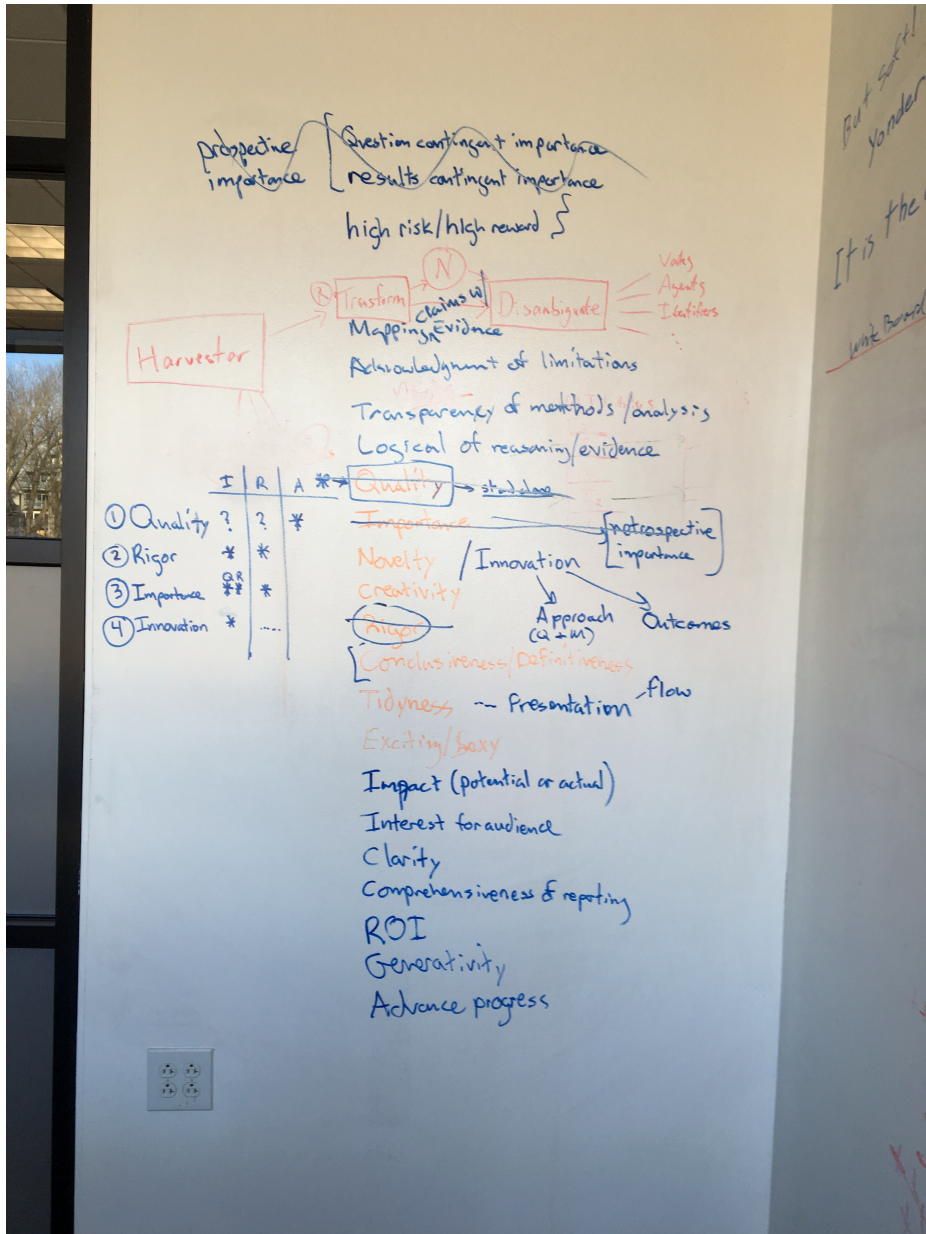


Figure 4.3. Drawn during an hour-long metascience team meeting, a diagram attempts to find components of innovative and impactful research for a survey. Photo by Kyle Harp-Rushing.

The Center for Open Science is surrounded by an intoxicating “affective atmosphere” (Anderson 2009), a kind of transpersonal configuration of experimental space(s) and

subjects, a structure of feeling (Williams 2009). “Tech” is underwritten by an *experimentality* conjured through the hazy *economy of appearances* that simultaneously relies upon and *accelerates* regimes of contemporary finance (Tsing 2005). When sitting along the downtown promenade, I’d often overhear interoffice political gossip from developers employed at nearby tech companies; complaints and rumors intermingled with the revelries of drunken undergrads.

Nestled in a medium-sized urban landscape dotted by venture-funded tech startups, an *experimentality* and a cultural appreciation for hacking and tinkering frequently permeated the downtown mall. A local newspaper reported in 2016 that Charlottesville was the country’s “fastest-growing market for capital investment since 2010” (Quizon 2016). The majority of investments, according to the report, are funneled into technology companies, many of which (including COS) operate in close relationship to the university. The center itself had been funded through a combination of speculation and philanthropy in March 2013, with an initial capital investment of over five million dollars from the Laura and John Arnold Foundation (Apple 2017). Known for backing a range of political and social causes, the foundation¹⁹ headed by a former-Enron-executive-turned-energy-futures trader often positions itself as a leading funder of data-driven, “evidence-based solutions that maximize opportunity and minimize injustice” (Arnold Ventures n.d.).

¹⁹ The foundation rebranded in 2019 for reasons that remain unclear, the organization was renamed “Arnold Ventures.” Among several of the techno-fixes the organization has funded, one of the more recent and controversial was an algorithm-driven pretrial risk assessment recommendation application (Simonite 2020), which they’ve begun to abandon after more than two-dozen digital scholars identified several alarming racialized discrepancies in the data used to train the algorithms.

Innovative Places

As several of my friends pointed out in 2016, dreams of urban innovation and progress in this part of town are set against a racist backdrop with a recent history. During the period of post-Civil War reconstruction, through the Jim Crow era, and up to the early 1960's, the 20-acre area of downtown Charlottesville that had become known for its cocktail bars and restaurants, had been known as "Vinegar Hill". By the 1920's, Vinegar Hill had become home to a thriving, predominately African-American community. The landscape consisted of primarily black-owned businesses, including jazz clubs, grocery stores, and scores of family homes. In January 1954, the Charlottesville City Council established a housing authority with a mandate to address the "unsanitary and unsafe inhabited dwelling accommodations [that] exist in the city" (Saunders and Shackelford 2017, 3). On June 14, 1960, a redevelopment referendum—which required residents pay a \$1.50 poll tax—passed narrowly. In a lengthy multimodal digital essay and interview with several residents who remembered the redevelopment scheme in the downtown area, investigative journalists described it as,

part of a larger, white-led, effort to push black families out of the city's central downtown areas by condemning their neighborhoods as "slums" or "blighted," while arguing that their presence was hurting the city's tax base. But, as evidenced in CRHA [Charlottesville Redevelopment Housing Authority] records, homes in the Garrett Street area were not "slums" or "blighted." In 1969, according to records, the CRHA assessed them as valuing a total of \$2.1 million — adjusted for inflation, this would be \$14.8 million today. ("How Did We Get Here?" n.d.)

By the time demolition had been completed in 1965, twenty-nine businesses and one-hundred and fifty-eight families (one-hundred forty of which were black) had been uprooted and displaced (Saunders and Shackelford 2017; Weissmann 2014). Through an intoxicating, heavily racialized discourse of revitalization and urban innovation and re-invention, many of the Vinegar Hill and Garrett Street residents who had been displaced began to move to portions of town far from the downtown mall.



Figure 4.4. *Vinegar Hill: A Forgotten Neighborhood*; a plaque affixed to a concrete plant retaining wall beside a trash-can. Photo by Kyle Harp-Rushing.

Many at the center understood the significant degree to which they felt surrounded by a larger local network of technology companies which felt saturated by an intense atmosphere of innovation. Several developers were active in local meetups dedicated to

learning specific programming languages and frameworks. Zaheen, a developer, who in 2016 had recently graduated from UVA with a bachelor's degree in biology and who was often described by several at the center as an extremely talented programmer, was active in a monthly meetup held at the center which focused on supporting women in local tech companies. Several of the developers and community team members had worked at other technology corporations involved in developing data management software in the area before coming to work at the center.

Others had left COS to work at other, mostly for-profit companies in the area. As Greg (a middle-aged developer who'd worked at AOL before the dot-com crash in the early 2000s) lamented to me one day over lunch, he'd left COS in 2016 to join what he half-jokingly called "the dark-side," working as a developer at a nearby, for-profit online scholarly content management software platform development company. The pay was better. But what really drove him there was the prospect that he'd finally get to focus more exclusively on design-oriented, "front-end" programming. He'd gotten back into programming after a hiatus of a few decades, because he wanted to hone his creative process developing aesthetically pleasing and user-friendly experiences online. This interest had infused into his other work as a freelance professional photographer and documentarian. In his downtown studio, stacks of books on UX design regularly commingle alongside photography books and electronic music equipment.

When he started at COS, Greg was excited to be working on the front-end side of things. After bringing up questions about usability on the OSF, he'd found himself suddenly stuck on the backend. He quickly grew frustrated working on backend projects

that, while important to the maintenance and functionality of the tech, simply weren't the kinds of tasks which he'd found personally stimulating and rewarding. He wasn't certain that the meeting and reassignment were related, but it didn't "feel" like a coincidence. He missed working with the friends he'd grown close to over the years. He would often attend events like drinks after-work and go out of his way to keep up with many of the close friendships he'd built with other developers and community members at the Center. Though he felt personally fulfilled that he'd found an opportunity where he could create "innovative" and aesthetically-pleasing user experiences, he was also conflicted about working for an organization that profited from what he felt was the "opposite" of COS—"closing" science.

Developers often talked about how they'd felt drawn to software programming out of a creative impulse. As we both sat in a small conference room watching the steady cadence of workers quietly hovering over their keyboards in the center in January 2018, Daniel, a junior developer, described coding as a kind of "liberation from reality."

In software, one person can write some code, and it's just information. You're not constrained by reality. You're constrained by *some* types of reality, but it's a lot more abstract. Software, writing code, is closer to writing poetry than building a bridge. Except if you think of it that way too much... you'll write terrible code. You have to find a balance." (Personal conversation, 2018)

Daniel hadn't grown up all that interested in computers. When he'd started college at the local university, he'd planned to study to become an engineer, but he became hooked on coding a few years into his undergraduate degree, when he'd taken a computer science

course as an undergrad. Unlike Greg, Daniel most enjoyed working on the “backend,” “hammering away” deep in the architecture of web programs like OSF and SHARE. He’d been drawn to the kind of abstract creativity that he’d felt was afforded by the materiality of particular kind of work. He felt that, in programming,

when you reach web code—like we [at COS] write in Python and Javascript mostly—those are things which are several levels removed from any of the constraints of hardware. Those are high level languages where you work more with ideas and stuff.” (Personal conversation, 2018)

In June 2016, at a coffee shop filled with people hunched over their laptops, Zaheen laughed as she told me that she’d gotten the sense from some of the developers (particularly some of the interns) at the center that they would be just as content working at the center if they were working on tech that was intended for streaming cat videos. She didn’t want to sound bitter, she followed up... after all, programming “takes all types.” But for her and most of the other developers, “the tech” (as exciting as it could be at times, particularly when they were working on something innovative) was generally considered secondary to the larger mission of opening science. She was one of several developers who had only really started learning programming after she was hired as a developer intern. Like Gwen, she’d spoken to a COS community team member at a science conference and at once became drawn to the mission. A collaborative spirit of tinkering and hacking infused into the ways in which they both had learned the intricacies of programming in an iterative and collaborative environment, of how to find and merge someone else’s code you found on the code-sharing and discussion forum

stackoverflow.com, or of how to make “pull requests” and “commits” on github.io. “My approach to coding is definitely ‘hackier’ than others,” Gwen told me one day as I asked about hacking. “I’ll often fumble around, chipping at a problem for a long time until I finally figure it out.”

Having been frustrated with the (often gendered) aggression they’d encountered in online coding communities (where for example, threads seeking advice were often met with comments stating simply “RTFM” – Read The Fucking Manual), they believed deeply in the recursive reciprocity of “openness” (Kelty 2008). They often helped others to acquire and apply programming skills by leading programming workshops, working extra hours to teach girls how to code, and volunteering time to update the web presence at a free local makerspace.

A year and a half later, speaking with Daniel, the idea of being motivated by a principled mission hadn’t faded. I quickly got the sense that Daniel was one of those developers who wouldn’t be as interested in his work if he were helping build cat video streaming software. He’d booked the conference room for us after I’d asked if we could follow-up on a conversation that we’d begun late one night, as he drove me home on winding, icy roads to my apartment from a friend’s house. I told him I wanted to learn more about something he’d only gotten to touch on briefly—how he conceived of the value and forms of decentralized information. Daniel had become interested in working at COS after he found out the mission was to create “non-specialized” (discipline-neutral) infrastructures for sharing information. He’d believed that local, “community-driven”

content moderation was a much better alternative to large-scale, centralized information control.

When I asked what he'd meant by "centralization," he responded that in his view, information control in science occurs less through a particular body of gatekeepers, and more like a diffuse, "culture" which was based on things like prestige and distorted incentives. He went on to describe how a certain potentiality for decentralization is embedded in the relative lack of constraint afforded by web-based platforms, which again operate and function at several levels removed from the material constraints of hardware. Abstraction, the detachment of web-programming from the limitations imposed by hardware, meant that information conduits can be innovatively and creatively re-directed. When "scaled-up," this re-channeling and decentralization translates into a *horizontalization* of entry-points for participation, which was good for science because it helps to prevent bias and inefficiency.

Because the infrastructures themselves are iterative and open to participation from "members of the community," he elaborated, they're much more responsive to the needs of researchers (because they're able to make feature requests and even propose changes to the code that they write themselves), compared with "closed-source," or proprietary research platforms. This image of a spontaneous, participatory online research community is an intoxicating and enchanting one. Surfacing repeatedly, it functioned as an imaginative infrastructure, underwriting the principles and ideas that surrounded the mission of the center.

Platforming Innovation

Completed in 2013 as part of a PhD thesis in Psychology (Spies 2013), the Open Science Framework (rebranded in late 2017 as simply, “OSF”) was designed to be a free and open source "integrated platform" to "support researchers" across research in any and all disciplines and fields and "throughout the research lifecycle." The research management platform was inspired by similar, online workflow management applications, most notably *Github*. By 2015, *Github* had been widely regarded as the world’s largest platform for hosting open-source software (Metz 2015). As a web-based platform developed to help facilitate iterative and responsive collaboration among open source and proprietary software programmers, *Github* is well-known for features intended to streamline collaborative work, such as version control, archiving, and real-time communication of coding modifications.

In an article examining *Github* as an instance of “platform capitalization,” Adrian Mackenzie (2017, 48) demonstrates how the platform,

configures coding as a ‘social’ practice, replete with organizational or collaborative affordances. Both code itself and coding as a form of work are tangible assets here in all their practical varieties and intangible dimensions.

Processes of collaboration and programmers’ identification with specific bodies of code are structured as assets alongside the code itself.

Mackenzie (2017) argues that *Github* regularly uses the ambiguity of platforms and the obscurity of their data to their advantage, inflating images of collaborative, participatory labor to accumulate finance capital. As a framework, the interactive

structure of OSF mediates a tension regarding the issue of capturing and representing *participation*. The conflict between creativity and scalability materializes into a hierarchical, nested framework built on the principle of a “modular” order of things, similar to the linear directionality of *Github*. As Christopher (one of the founders) told me in 2016 (Personal communication), the principle of modularity was infused into the backend architecture of the framework itself, in order to avoid running into constraints later on, which “don’t allow you to reinvent,” pointing out that,

If we can build a system, both a technical system and an organizational system that is highly modularized, so that if any part can be improved or changed, it’s easy to take it out, and drop in something new, without disrupting the rest, right? If it’s all interconnected, and one part gets removed, everything falls apart and then you end up with a lot of debt and you can’t change it.

As an example, he said, they had built the *wiki* (a central landing area for description and other information considered pertinent to a project) so that it would be easy to remove without “breaking” the entire platform. Across communities of design, from software (Raymond 2001) to international aid and development (Redfield 2013), the principle of modularity underwrites aspirations for scalability, for continual growth. In her argument for non-scalable world-building projects, Anna Tsing (2012, 508) reminds us that, despite its pervasiveness in contemporary “tech” discourse,

the term “scalability” had its original home not in technology but in business.

Scalability in business is the ability of a firm to expand without changing the nature of what it does. “Economies of scale”—organizational practices that make

goods cheaper because more are being produced—comprise one kind of business scalability.

In software design, modularity fulfills a *protocological* function (Bucher 2013), informing a set of standards and rules for ensuring that the relationships between different features aren't too closely and rigidly nested, or “dependent.” When I asked developers what it meant to “write good code” for instance, they would often describe a kind of awareness, a sensitivity and a *feeling* for the ways in which different lines of code interact with one another, in a collective sense. It never made sense to talk about “code” in isolation. What mattered, they would often insist, was how lines of code behave with and through one another. Writing good code meant paying attention and taking particular care to these relationships, ensuring that you weren't, for instance creating too many “dependencies.”

Writing good code also meant anticipating the work of other developers who would have to work with your code at a later date; not only was “good code” determined by how it interacted with the rest of the code base. Good code was also defined by writing helpful and detailed comments. Writing good code required a close attention to relationality and context, an anticipatory vision not only for how the code would interact once it was “merged” into the backend of the platform, but also for how other coders would come to interact with the code when performing routine maintenance, or when developing new features.

Gwen had once self-deprecatingly described her particular coding style as “hackier” than others. She told me how she'd often incorporate bits and pieces of code pulled she'd

pulled from *Github* and pasted into whatever she was working on, over and over until she found something that worked. It was clear to me however that she still saw writing good code was a matter of care. She confessed that, throughout the course of this “hackier” approach to software coding, a picking and repurposing that was widely common in open source programming communities, she would often nonetheless worry about introducing unintended, *downstream* effects. She worried that she might be introducing densely packed “dependencies,” or too tightly coupled relationships between pieces of code that might throw up roadblocks, a tangled web that someone would have a tough time dealing with later. While she had felt drawn to coding in large part because of the sense of community that came from sharing and repurposing bits and pieces of code, I was surprised to find that she worried about borrowing too much. For Gwen, being a good coder wasn’t just a matter of plugging in bits of code until it worked, but also of trying to anticipate as much as you could about how those bits might *fix* and constrain possibilities.

The (im)modularity of code speaks to the richness of its *social life* (Appadurai 1986). Several programmers who worked at the center before moving on to other institutions came to acquire a reputation based on the quality of their code. Particularly during after-work drinks, programmers would often express frustration muffled through wry smiles as they agonized over what they’d “broken” earlier that day. Often after tweaking and tinkering around the obscure margins of the code, they’d manipulated what they had gone into thinking was only a tiny part of the code base, that quickly turned out to be densely interconnected to many other components of the framework.

In the jovial atmosphere of the dimly lit cocktail bars, they would joke that they were fairly sure whose code it had been that caused them to “break something.” Judging by the lack of commentary and the proliferation of dependencies in the code, presenting as an enormous difficulty in teasing out all of the nested relationships, components and features in the backend software architecture that the code had been plugged into, the previous coder had apparently not paid enough anticipatory care to how the code would live on in the future.

While her coding style was admittedly “hacky,” Gwen took particular care to prevent acquiring a reputation as a “sloppy” coder. She often sought advice from more senior developers with a more detailed knowledge of the programming language (*Python*) or the application framework. In a two-hour paired-coding session with Anne, a more senior developer, both coders patiently worked their way through several hundred lines of code. While the particular lines of code seemed to work well with the rest of the code into which it was to be merged, Gwen was particularly concerned with anticipating the social life of the code; she wanted to determine whether or not her code was sufficiently *modular*, or if she might be introducing too many dependencies that would make maintenance for subsequent developers more difficult than was necessary.

As Anne and Gwen dialogically, collaboratively moved through Gwen’s *Github* user interface projected onto one of the large flat screen TVs in the conference room, deletions and additions to the code are demarcated in a pastel shade of red and green. The focus of their intense discussion was less on whether or not the code “worked.” That the code was able to be compiled (i.e. translated from code written in Python by Gwen into “machine-

readable” code) without returning error messages was evidence enough that the code *worked*, that it had fulfilled the intended function of the project delegated to her weeks ago during a meeting. Instead, it is in these moments when anticipating non-modularity becomes a matter of maintenance and care (Puig de la Bellacasa 2017), a set of infrastructural—and, while digital, nonetheless deeply material (Dourish 2017)—articulations and connections for circulating experimental data and digital materials that are sustained through a care-ful attention to the future, social life of code, attending to the ways in which code is circulated and manipulated for the purposes of creating innovative features as well as for guarding against the onslaught of “entropy” (Russell and Vinsel 2018), for preventing what she had once called “code rot.” Gwen reaffirmed how being “open” meant, “not only sharing the “source code” (content and modules), but devising ways to ensure the perpetual openness of that content, that is, creating a recursive public devoted to the maintenance and modifiability of the medium or infrastructure by which it communicates” (Kelty 2008, 256). For Gwen, coding is an act of *creative solidarity*, of not just creating cool things, but also of predicting all the ways in which fellow coders will come to interact with the code in the future, taking care to ensure the maintainability of the code.

Opening Spaces of Possibility

In addition to the backend architecture of the platforms themselves, *modularity* comes to inform the ways in which users come to interact with the platform across the user-interface (UI). As Galloway (Galloway 2012) and other (digital) scholars note (Drucker 2014; De la Cadena et al. 2015; Monteiro 2017), interfaces are rarely (if ever) passive

media through which information and bits of data are exchanged between servers and clients. Rather, interface also *shapes* and configures modes of seeing and perceiving. Experiment(al) workflow management platforms don't simply and passively mirror or *represent* experimental practices and procedures "in the lab;" they also dramatically alter the ways in which research is conducted, shifting the value(s) associated with scientific knowledges (Daston 1995).

While open science workers on the one hand rhetorically downplay the significance of open science (e.g. insisting that "open science is *just* science"), they also recognize the play of this dialectic. The imagined effect of "good design" is that researchers will become active platform users (sharing their data and digital research materials), not out of institutional compulsion, but out of a seamless experience with the website, mediated through well-crafted interface. While open science concerns itself with what's often institutionalized and instrumentalized as a researcher's "conduct," imaginaries of open science design are appealing and alluring precisely for the ways in which they bracket, or throw out entirely, conventional, top-down institutional tropes and mandates.

Open science platforms are instead designed to function in the "background," in the subconscious of the researcher. As a mechanism for cultivating particular kinds of experimental practices and behaviors, OSF for example is constitutive of what Michel Foucault (Foucault 2010; Lemke 2001) defined as an ambivalent, *microcapillary* extrusion and diffusion of disciplinary power, particularly in the wake of a proliferation of neoliberal political and social institutions designed to fetishize the entrepreneurial, self-motivated, and self-made subject. At the center and in the surrounding downtown

mall, an area in which the most recent incantations in long and racialized history of urban “revitalization” revolve around the speculative promises of “tech development” (Quizon 2016; Saunders and Shackelford 2017), the idea of self-direction figures prominently. Self-innovation materializes into open workstations and open-ended work tempos, as well as explicit and unspoken expectations to learn “on the fly,” through self-directed, project-based learning. As cognitive workers laboring in a “new spirit” of capitalist production (Chiapello and Boltanski 2007), employees were regularly allowed to *drift* within and beyond the confines of the office. In contrast to the Taylorist models of rationally ordered cognitive labor performed in modular office cubicles (Leffingwell 1917), time in the open office is always already *out of joint*, and all the more “experimental” for it.

Gilles Deleuze (1992), building upon Foucault’s delineation of increasingly diffuse power arrangements in the rapidly approaching digital age of the early nineties, articulated a view of increasingly modulated, fine-tuned *societies of control* made up less and less of atomized “individuals” and increasingly of “dividuals” transformed into highly granular “masses,” a topic recently taken up by Makenzie Wark (2019) in their argument that the proliferation and complexity of *information asymmetry*, of lives mediated through extractive interfaces have amplified and accelerated *vectors* of exploitation.

Over the course of several decades of research into scientific platforms and practices, ethnographic work underscores the ambivalence of infrastructural forms in scientific communities and spheres of practice. In a critical piece examining Bruno Latour’s An

Inquiry into Modes of Existence (AIME) (<http://modesofexistence.org>), a platform designed to stimulate digital, experimental ethnography around the topic of the Anthropocene, Kim Fortun (2014, 318) argues that the platform “doesn’t leverage what I see as a critical paradox of digital, experimental ethnography—the paradox of hosting and hospitality” which throws into simultaneous tension questions of mastery and flexibility. Fortun (2014, 323) goes on to argue that digital experimental platforms in ethnography should be “disruptive by design—not as an experimental end, but as a means to open up spaces of possibility.”

Digital experiment(al) platforms are most speculative, aspirational and alluring in their (disruptive) capacity to open up “spaces possibility.” In the following section, I engage more deeply with COS’ flagship experiment(al) workflow management software application, OSF. I consider whether spaces of possibility are opened or foreclosed in the specific configurations of the OSF interface. Embedded within the OSF interface, I argue is a reconfiguration of experimentality as *modular* and *scalable*. It is in this configuration of workflows as modular and thus scalable, that we see a particular, *ecological* and metabolic conceptualization of experimental collaboration, as well as the introduction of an emergent research output form: the preprint.

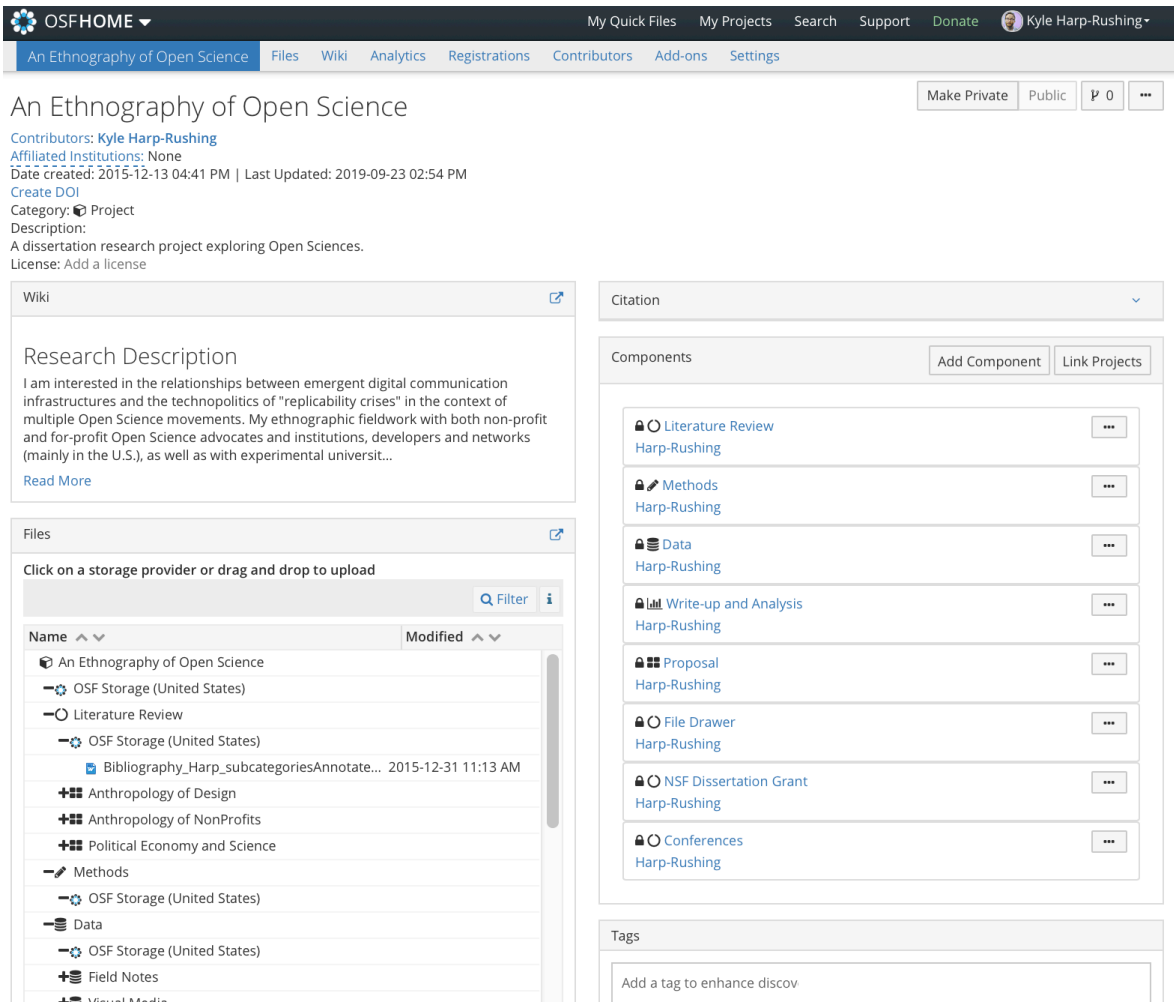


Figure 4.5. Screen grab from An Ethnography of Open Science, hosted on OSF (<https://osf.io/c48bn/>).

Knowledge Infrastructures

Within an OSF “project,” users create their own, nested sets of experimental “components” (e.g. "methods," "materials," protocols," "data," "literature"), or components within components (e.g. separate components for "fieldnotes” and "transcripts" within a component labeled "data"), or even components within components within components and so on... always within a nested set. The level of "project" sits at the highest order of organization. Researchers keep administrative control over projects

and their constituent components, deciding which to make public, and which to keep private. User-generated tags "enhance [the] discoverability" of a project and/or those individual components which they choose to make public. A window labeled "Files" holds a scroll-down menu that supplies the ability to quickly upload/download files (e.g. a transcript) to components, while another window labeled "Recent Activity" provides an archive of modifications made by a researcher to a collaborative project.

The "Recent Activity" tab is worth exploring in greater depth. When I asked developers about this feature, they would usually respond that the original hope was that such a metric would create a lab environment in which otherwise often "invisible" labors, essential to maintaining data quality could be re-valued. *You can imagine, for example, a graduate student being able to point to the activity log when approached by a PI and asked to account for their (apparent) lack of progress.* When I asked if it was possible that the feature might contribute to an increased sense of surveillance, they often responded that in dysfunctional lab environments, a record log wasn't likely to make much of a difference. In their essay examining the (in)visibility of collaborative work across computer interfaces, Susan Star and Anselm Strauss (1999, 9-10) propose that "Lucy Suchman (1995) provides an elegant analysis of the complex tradeoffs involved in making work visible. On the one hand, visibility can mean legitimacy, rescue from obscurity or other aspects of exploitation. On the other, visibility can create reification of work, opportunities for surveillance, or come to increase group communication and process burdens." Along with the possibility of enhanced surveillance, highly granular

activity logs also potentially increase informational throughput, potentially even worsening conditions of information saturation within labs.

Rather than examine OSF in isolation, I suggest that it's perhaps most useful to think of the platform as a particular instance of what Paul N. Edwards (2010, 17) describes as “knowledge infrastructures—[...] robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds.” When humming along in good, working order, infrastructures connect and circulate. OSF articulates linkages between researchers with one another, forming a basis for circulating an open-ended array of experimental artifacts, such as data, protocols, and data analysis code. Particularly in open knowledge infrastructures, such artifacts become *sticky* with aspirations and potential, underwriting the hope of spontaneous collaboration, innovative repurposing and remixing; data and materials *bricolage*. It was the idea of endless open-endedness and discipline-neutrality that was particularly intoxicating for many open science advocates in particular. As a truly “open” platform, in which researchers weren’t bound by typical infrastructural constraints around particular kinds of content (and at least early on, by constraints around individual file sizes²⁰), OSF functioned as ideological infrastructure for expanding and broadening imaginative, cultural horizons, *opening* ideas about what science could become. In the next section, I explore how this imaginary gave rise to an emergent, innovative kind of research output.

²⁰ When I asked developers to describe which OSF project they’d been most personally “enchanted” with, they usually described the work of Adam P. Summers, who they simply called “fish guy.” Summers is a biologist known for taking advantage of the large file-size limit on OSF to host 3D scans of every species of fish in existence.

Circulation: Innovation and Extraction in the Research Lifecycle

There's a certain social choreography to navigating cramped conference rooms with plates of food. It's July 2016, the peak of the intern season. About 70-80 employees, including developers, metascientists, community-team members, and an anthropologist cram into a single conference room. We settle in, jostling elbows and water bottles, cans of coke and Styrofoam plates piled high with locally catered Nepalese food. Once every two weeks during the summer months, the Center would hold a conference lunch like this. A member from each of the "three pillars" at the non-profit (infrastructure, metascience, and community) is expected to present. Particularly as the size of the organization expands, the institution can run into what Mary, a metascientist trained in psychology, referred to several months earlier as "theory of mind issues."

Particularly during the intern season, as information throughput is dramatically accelerated, it's as though open science workers begin to lose the thread of where their work fits within the organization and (more importantly) within the overall social project of "opening science." These presentations were meant as a kind of routine inoculation of sorts; a preventative measure against the "mission-drift" that can occur when design workers in complex institutions begin to feel themselves becoming untethered from the larger vision and goals of the organization. In contrast to the "team meetings," lunch conference meetings were intended as settings in which to stimulate a sense of collective belonging by sharing knowledge across teams. For a "think-tank," lunch conference meetings represent a "hub" of cross-pollinating ideas, a fertile ground for collaborative innovation.

Conference lunches are also deeply performative. An exercise in intersubjective boundary-work (Star and Griesemer 1989), they're often a re-configuration of one's particular work and repertoire (Ankeny and Leonelli 2016), a kind of alignment that occurs in relation to a larger, widely contested and ill-defined set of constructs. For example, when groups of 2-3 interns, in the course of a lunch presentation became mired in the "backend" of a feature in development, the founders could often be relied upon to ask the developers to reflect, to remind the group in attendance of *how* this particular feature figures into the larger project of opening science.

While lunch meetings at COS were theoretically spaces in which to grapple with questions regarding legitimate technosocial arrangements in contemporary knowledge infrastructures, there was often a tension between experimenting with ideas and arriving at a shared vision. Biweekly lunch meetings were (mandatory) structured encounters that functioned as a space that was as much ritually *phatic* (i.e. intended to reproduce a shared affect of office-place conviviality and social warmth) (Gregg 2011), as it was interpellative (Althusser 2014). While many employees usually found the lunch meetings to usually be enjoyable, they also understood that the ultimate purpose of the meetings was to enlist individual employees into personal alignment with the non-profit's mission. Presenting and participating in Q&A works toward achieving a reconfiguration of the self as an open subject.

This particular week, Brian (the co-founder and executive director) is giving the lunch presentation. It's meant to be a "roadmap" presentation, a "big-picture" overview of the center's overall direction. Brian's talks usually are well-received among the office-

workers. Though on first impression, he's intimidatingly tall, he speaks with an easy-going combination of warmth and enthusiastic intensity. His talks always weave a compelling story, given with a measured clarity, charisma, and charm honed over several years as a professor in the psychology department at the nearby university.

Gesturing periodically toward brightly colored flowcharts and concept maps on a PowerPoint presentation (Nosek 2016), he explains how the launch of pre-print hosting services will figure into the larger mission of open science. COS is hoping to position itself as a "free and open source option" for servers like the hugely popular physics and mathematics pre-print platform Arxiv. Infrastructurally, COS-hosted pre-print services would connect researchers across other COS platforms, with the Open Science Framework (OSF) serving as the central conduit. By providing convenient "entrance points," services to meet multiple different needs (e.g. a feature on OSF that allows researchers to share a link to a file), Brian tells the group, more users will be brought into the OSF ecosystem, where they'll begin to "curate their own research without even realizing it. [...] what really makes this possible is the modular structure that we operate on, creating a multiplicative power." He reminds the group that researchers rarely think of they are within "the research lifecycle," but search instead for solutions to meet particular needs. *But we want to use that need to get them to host their data on OSF, providing an easy, seamless experience so they'll eventually make their data public, literally at the push of a button.* The issue of participatory collectivization, of the scalability of open science is imagined (at least partially) as an issue of configuring an

“architecture of choice” that *nudges*, (rather than forces) researchers toward adopting open practices (Thaler and Sunstein 2009).

Just four months ago, the social sciences research hosting platform SSRN had announced that the academic publishing behemoth Elsevier was acquiring it. SSRN had been a significant pre-print server for social sciences researchers. The platform represented a free, alternative science media platform. Academics used the site regularly to circulate their articles for free, before they vanish behind private paywalls. While the predominate fear was that Elsevier would suddenly restrict access to millions more articles (Kelty 2016b), Brian suggested that the acquisition indicated that the long-term implications for the “research lifecycle” were perhaps more worrisome.

It was becoming increasingly clear to those in the open science community that the long-term, eventual goal of corporate publishers was to create a new mechanism of extracting value from the labor of researchers. Publishers hoped to invent new frontiers in which to capture value from knowledge production processes, to couple the increasingly popular project of “open access” (i.e. making research articles widely available for free) with mechanisms of infrastructural “lock-in,” effectively locking-down the rest of the research lifecycle. Recognizing that the inevitable tide of open access will render the consumption of most if not all research *articles* free of charge, open science advocates need to act now to ensure that all the data, materials, methods, and procedures *behind* those articles aren’t locked away. “Where they’ll want to close up has to be non-obvious. It’s not likely that they’ll try to lock down individual data. Instead, they’ll try to make all

the services researchers rely upon [to get] the data so seamless, that you're effectively locked-in by how those services interact together," Brian maintained.

Publishers were becoming simultaneously aware of the multiple scales and collaborative linkages being articulated and opened to capture in contemporary scientific research communities (the multiple infrastructures and platforms researchers rely upon to generate data). They were also becoming increasingly aware of the impending obsolescence of research articles as stable commodity-forms. As Eric, a developer in his mid-twenties, and I spoke a year later over tea outside a café on the downtown mall, he made the point that this transformation was not unlike that of the music industry in the years following the creation of Napster in the early aughts. Since then, the ability to make music has been "opened-up" in some ways (now you can just "upload your songs to any platform"), and "closed-off" in other ways. In their status as "content-creators," musicians have become increasingly dependent on touring in order to make a living (a requirement that Eric notes, excludes working-class folks trying to raise a family, in the same way that volunteerism in open-source communities often excludes coders who aren't independently wealthy).

In the moment, I failed to ask what, in hindsight feels like the logical follow-up, *'Are researchers destined to become the next wave of deskilled "content creators," our compensation tied to the modulative forces of big data analytics and a funding infrastructure predicated on algorithmically-determined grant acceptance?'* But, later in the conversation, he expressed an alternative, optimistic vision of value that I'd often heard amongst open science advocates, a vision of infrastructures as entities able to

reconfigure the value of the mundane. “In some ways,” he continued, “*GitHub* [the code-hosting platform that many institutions and programmers use to host free and open source code] has become the resume of the developer.” A programmer’s employability was often helped when they made the record of their labor open. Like open source programming, he’d hoped that open science would similarly create space for researchers to be valued for the labor they perform, labor that often doesn’t make it into the published article.

Building Intellectual Collectives

As Eric pointed out, the infrastructure of the Internet creates conditions in which corporations in the contemporary culture industry find it increasingly difficult to exert direct control over the flows of creative content. This “crisis” extends to the long-term sustainability of the academic publishing industry. The illicit research-hosting platform, *Sci-hub* continues to gain popularity as an alternative to prohibitive publishing paywalls. Resistance to enclosure persists through diverse political strategies, such as the 2019 boycott of Elsevier led by librarians and other open access advocates in the UC system (Fox and Brainard 2019).

In some cases, resistance to extractive copyright law has even been met with state violence, as in the case of Aaron Swartz, a 26-year old transparency activist, co-founder of the social news site Reddit, and creator of RSS, who committed suicide in 2013 as federal agencies pursued an aggressive prosecution case against him after it was found that he had used a guest library account to scrape and make public approximately 4.8 million journal articles from the server JSTOR (Taylor and Doctorow 2016).

While specific instances and artifacts of creativity (like a song or journal article) become increasingly difficult to contain, corporations continue to “innovate,” writing algorithm-driven platforms through which to expropriate new frontiers of capital. For example, Spotify, Netflix, and YouTube—contemporary responses to Napster—generate revenue counter-intuitively, providing a constant stream of music and content while capturing and selling user data to advertisers, and charging for premium service, like the ability to choose your own songs. Leslie Chan (2019) and others (see Mirowski 2018) have identified a similar logic at work in the context of (open) knowledge infrastructures, wherein which research is rendered forecastable, predictable, and therefore highly valuable as an iteration of “platform capitalism” (Srnicsek 2017).

Uncertainty and innovation exist in co-productive entanglements (Jasanoff 2006). The one precedes and invites the other (and vice versa), in a dialectic production of a particular social order fetishizing novelty. As anthropologist of design Lisa Suchman (2011, 5) argues, innovation is “embedded within a broader cultural imaginary that posits a world that is always lagging, always in need of being brought up to date through the intercessions of those trained to shape it: a world, in sum, in need of design.” For Brian and many at COS, the uncertainties that had surfaced throughout contemporary research communities were primarily epistemic in nature, gaps in logic and experimental designs and protocols, which were able to be filled-in through innovative and creative design. Configuring robust research ecologies and infrastructures becomes attached to the idea of simultaneously working *with* and *against* extractive entities on a case-by-case basis (Nosek and Bar-Anan 2012; Nosek, Spies, and Motyl 2012).

In his presentation, Brian went on to describe how corporate knowledge infrastructures seize upon principles of design in order to emulate the sensation of voluntary action in order to “lock” researchers in to a parasitic relationship of extraction (not unlike how Las Vegas casinos enlist digital design to lock gamblers into a perpetual experience they describe as being “in the zone,” Schüll 2014). For example, Brian went on to suggest, one can begin to imagine how researchers will end up being enrolled in a proprietary digital research ecosystem purely as a consequence of convenience. Because of their reliance upon multiple interconnected platforms (e.g. to manage their data, manuscripts, protocols, materials, etc.), once corporate publishers effectively seize all the means of knowledge production, individual researchers will be “locked-in,” likely never able to extricate their data, or themselves. While COS, through software objects like an open application programming interface (API), provides multiple, interconnected services across a “research ecosystem,” the purpose is not to generate profit, but to make research processes more transparent.

Despite (or rather *because* of) its vagaries, transparency remains a deeply potent sociopolitical logic underwriting imaginaries of information flows (Caduff 2017; Yong 2017). In the contemporary milieu of techno-optimistic hype, distributed (i.e. “Cloud”) computing (Hu 2015), big data (boyd and Crawford 2012), block-chain ledger systems, and artificial intelligence (e.g. machine learning, neural nets) breathe new life into the threadbare fantasies of superior “knowledge production based on informational infinitude” (Halpern 2014, 84).

This logic functions similarly to what design anthropologist Keith Murphy, studying Swedish design agencies, termed a “cultural geometry” (2013). For Murphy (2013, 123) a cultural geometry is “an aesthetic idealization, a formal tendency that subsists “in” things, such that those familiar with its profile recognize an object shaped accordingly as belonging to a type, provoking, for instance, an assessment that a table “looks Swedish” or “looks Italian.”” The “cultural geometry” employed for example at Swedish design firms, Murphy argues, reflects and further reproduces a specific logic of democratic socialist care able to be enacted through care-fully designed things.

In the open science ecosystem, data and metadata—the often overlooked information that create the narrative of data’s *journeys* (Leonelli 2016) as a product of labor—are similarly saturated with agency, enacting less extractive relationships according to the arrangement among things. For many at COS, effective decentralization occurs less through explicit ethico-political commitments to openness, and more through seamless interactions and experiences with and through digital things. In this imaginary of design, openness is configured as a by-product of *good* design; a gift economy predicated on networks of data reciprocity whose formation is immanent to technological, infrastructural arrangements. When I asked Eric to describe the relationship between technology and openness, he maintained that, for him technology is:

just generally how nerds influence culture—they build the tools that literally change the way people perceive stuff and interact with the world. Nerds are nerds because they may not be the most persuasive. They don’t communicate necessarily through their words; they communicate through the tools they build. One way to

change science is to build tools to push people to behave in a certain way.

(Personal communication, 2017)

For Eric, research workflow management tools designed to enable more seamless collaboration are deeply communicative, in the sense that they simultaneously *enable* communication and *represent* modes of creative expression. Such tools are also *communicable*, transforming and conjuring (counter)publics through their spread and use (Kelty 2008; Caduff 2015). My conversation with Eric demonstrates how workflow management tools exercise an *infrastructural* agency, functioning as “built forms around which publics thicken” (Boeck 2011; Harvey and Knox 2015). Reconfiguring perceptive and interactive relationships with and through experimental “stuff,” research workflow management infrastructures articulate an ecological vision of infrastructures as “social-material assemblage, a process of making relations between bodies and things that is always in formation and always coming apart” (Lockrem and Lugo n.d.).

Open knowledge infrastructures materialize an imaginary of an emergent collective of intellectuals, a counter-public which takes shape around networks of research data. Such platforms are simultaneously aspirational, imaginative, and *constitutive* of alternative forms of sociality. An ethnographic engagement with free and open source research and experimentation platforms asks us to continue to consider how ostensibly “purely” technical apparatuses come to reconfigure relationships between researchers, the public, and experiments. Drawn from my own extensive experiences with the flagship research management platform developed and maintained at COS (OSF), as well as participant observation and unstructured conversations with the developers who create

and maintain it and the community members who help market it, I find open knowledge infrastructures give shape and materiality to an intoxicating, aspirational political aesthetic of responsive hyper-connectivity. Built and maintained as an ecology, a web of connections across an ever-expanding, collaborative collective of researchers, platforms, and data, OSF articulates an imagined future of people as (spontaneous) infrastructure (Simone 2010). The *platformization* of open science gives form to the allure of an autopoietic research commons mobilized by the logic of self-reproducing scalability, an imagined steady accretion of small, incremental features of iterative and innovative design.

In the following chapter, I trouble this idea of self-reproducing scalability by exploring issues around *maintenance*. When I returned to COS in 2018, the matter of long-term, consistent maintenance had begun to surface more prominently. In this chapter, I illustrate how *imaginary-maintenance* began to emerge as a significant practice, specifically with regard to the matter of preprints.

Chapter Five

Maintaining Imaginaries

As we stood in the kitchen, overlooking the rest of the open office at the center in January 2018, Gwen and I wait for our tea. Though I've been granted permission to consume the food provided in the kitchen, I still feel a pang of guilt every time I do. It's not as though I really have all that much to contribute to the center. I've gotten used to trying to justify to myself my presence in the office by insisting that I provide a kind of ethnographic focus group of one, a sounding-board on the history and anthropology of science. Most days, I feel like I'm kidding myself. The perceived status and sense of being a constant interloper is, of course a perennial part of ethnographic fieldwork. Eventually getting over the awkwardness of participatory liminality is a kind of rite of passage toward becoming a "true" anthropologist. Carrying out ethnographic fieldwork at a tech startup, in a cultural milieu steeped in a reverence for entrepreneurialism and innovation, of making one's "own job" in the organization and "acting first and seeking forgiveness later" (Wiener 2020), my sense of pointless redundancy and personal wastefulness felt particularly acute. Everyone, employees and interns, seem to have clear focus and direction, clear projects and deadlines they're scrambling to meet. I on the other hand, often feel adrift, like the antithesis of productivity.

A senior developer with the center in her early thirties, Gwen had started at the center soon after its founding. She had taught herself how to code, from scratch (with Google and Stackoverflow) after she'd been hired as a developer intern. She'd seen the organization grow through the typical stages of a successful tech startup: "storming,

forming, and norming.” We’d become close friends in the months that I’d been hanging around, and we’d kept up with each other since my first visit, checking in with how each other was doing over text message, occasionally chatting over remote video chat. We often bonded over interesting citizen science projects (like the project to crowd-source amateur astronomer labor to classify distant galaxies), retro video games, and science fiction and fantasy novels.

As we both waited for the cappuccino machine to heat our water, she asked how the project was coming along. I’d been back at the center for several days, and I still hadn’t gotten used to bitter cold. Gwen suggested that we take our tea and take a walk on the downtown mall. She’d had a busy day of working on the backend for the preprints component of OSF. In particular, she was undertaking the tedious task of de-duping, or cutting duplicates in user-generated tags on the sociology ArXiv platform. I bristled internally at the thought of walking out into the cold. “Sure!” I replied. As we began to walk along the red-brick walkway, glistening with frost, she asked what’s been like being back. “Have you noticed any substantial changes?” I noticed a slight smile begin to form at the edges of her mouth as I told her that I felt like I wasn’t really capturing any of the kinds of moments of creativity and innovation that I’d been looking forward to. During my first trip a year and a half ago, I elaborated, it felt like there was so much happening that it was hard to keep up. Now that I’ve had time to unpack some of the things I’d recorded earlier, to follow-up on many of the same themes, it feels like most of the design work occurring now was much more mundane, ordinary, and frankly, boring.

She replied while chuckling a bit that this was kind of like the issue they were starting to face with their long-term funders. I asked what she meant. She began to explain that a number of their primary funders, institutions that been with them since the beginning, had begun asking some variation of ‘when will the OSF be done?’ They seemed to be expecting some sort of a terminal endpoint. At times, it felt as though they were expecting a finished product that unequivocally speaks, that shouts ‘here it is! *Here’s* the key to how we open science.’ At the same time, several of the products and platforms they built, like OSF, had begun to *normalize*. There simply weren’t that many more features that needed to be added, from the view of the developers. If there were features and changes to be made, they weren’t ones that required substantial changes to the existing code base. Most of the changes were on the backend, deep in the architecture, or subtle design tweaks around the margins.

Perhaps because there wasn’t as much “noticeable” innovation happening on the website, funders were beginning to expect that the infrastructure team was starting to reach an end point. For instance, she elaborated, there were nowhere near as many intern-developers last summer, so there wasn’t as much time and energy being invested into R&D (research and development into features that might someday become a part of OSF, for example). Five years on from its’ founding, the center has really normalized, concentrating on developing particular kinds of infrastructure and features to meet specific needs in the research community. Yet, even though it’s up and running, and even though the user-base is constantly expanding, the nature of web software is such that, as she elaborates, it’ll never really be *done*. “We’ll *always* be iterating, integrating user

feedback and fixing bugs.” At the very least, products like OSF and the preprint servers will “*always* require constant, routine site maintenance.”

As Gwen (perhaps unintentionally) pointed out, anthropologists aren’t immune to the sparkling allure of the “innovative” or “disruptive.” Her sense of frustration with the vagaries of funding also helped articulate a better understanding of my own sense of ethnographic ennui. Perhaps it wasn’t as though I’d failed to apprehend the machinations and “real goings-on” that I thought surely percolated beneath the surface of the superficial. Perhaps my failure was instead an inability to be sensible toward a pragmatic shift in the year and a half that I’d last been there. Perhaps I’d failed to comprehend or conceive of practices and actions which are simultaneously routine, and yet deeply significant in the ensuring the technosocial reproducibility of open science at this particular site. An ethnographic turn toward maintenance asks that we consider how mundane labor underwrites the health and vibrancy not only of particular instances of infrastructure, but also the imaginaries and aspirations with which they’re underwritten (Jackson 2014; Barnes 2017; Russell and Vinsel 2018). Maintenance, care, and repair turn our attention to the relationships through which social movements are themselves reproduced and maintained, long after the embers of “collective effervescence” (Durkheim 2008) that had ignited around fetishes of innovation have faded.

In this chapter, I focus on how issues of technosocial maintenance began to take shape at the center, how open science became a matter of care across teams of open science workers. Disarticulating from matters of solely technical concern, by the time I returned in January 2018, maintenance was moving through multiple domains of practice

(e.g. funder relations, infrastructure, metascience, and community relations). In this chapter, I explore these movements, building on the preceding chapter and following the figure of maintenance across these multiple, interconnected spheres. I'm less interested in this chapter with how particular infrastructures are maintained, though I recognize the value and importance of this work. I'm instead interested in how open science workers came to recognize a movement as less an autopoietic unfolding of technocratic arrangements, and more as sets of relationships in constant need of up-keep, maintenance, and repair.

I'm motivated in this chapter by an appreciation for what might be called *curatorial labor* in knowledge infrastructures, for the often-unseen collective work of attending to configurations and assemblages, of caring for relationships, articulations, and connection points between digital objects and the assemblages that make up research cultures.²¹ I argue that open sciences are politically vibrant and potent, not because they circumscribe normative, moral protocols and standards governing experimental procedures. Open science instead opens new possibilities for attending to configurations, articulations, and connections between experimental data, information, and knowledge. As Bridgette said in 2016, open science creates space for narrating a more complete telling of a research experiment's "story" (Personal communication, 2016).

²¹ In his work on Mexican curatorial assemblages, anthropologist Tarek Elhaik (2016, 23) argues that curation in media assemblages "indexe[s] the emergence of a new form of life and figure of care, the curator." He goes on to link curation to knowledge economies, suggesting that "the rise of the curator seems to be filling the void left by both the withdrawal of the figure of the public intellectual and the crisis of the contemporary university."

Building on this contextualizing work, I demonstrate in the next chapter on “Repair” however, how sciences’ *openings*, the engineering of new research media and infrastructures, are made sticky with liberal aspirations of circulation and exchange that occur in an atmosphere of good faith. Such openings I argue, are thus rendered *anti-curatorial*, incapable of coping with unintended consequences, in particular the contemporary right-wing, reactionary repurposing of openness as an infrastructure of recruitment, a vehicle through which to circulate nativist, misogynist, and white supremacist pseudoscience²².

Visualizing Value

Seated at a restaurant-style booth padded with gray bench seats and white melamine tabletops, situated within a corner of the kitchen, the low drone of the office ambience is periodically punctuated by passing office chatter and the occasional flush of the toilet from through the adjoining wall. Constance, a member of the community team, seemed regretful as she described her sense of the center’s relationship with their primary, “angel” funders—the Laura and John Arnold Foundation (LJAF). Several days earlier, the center had laid-off several full-time employees (including developers, human resources workers, and reproducibility trainers), so the mood was one of turmoil, uncertainty, and sadness. For a relatively small organization with only about eighty

²² As I demonstrate in the next chapter, the figure of “pseudoscience,” particularly the efficacy of the work it is imagined to perform as an unambiguous signifier for flimsy and biased “science,” is rendered increasingly precarious in the proliferation of multiple, participatory, decentralized open knowledge infrastructures.

employees, most were shocked and saddened by the sudden layoffs. Roughly ten percent of the full-time workers were let go. Those that remained were predictably heartbroken.

In recent months, the leadership at the center had begun to hear from their contact persons at LJAF that they needed to begin “diversifying” their funding streams, to rely less exclusively on angel funding from the foundation. I began to notice emails and email marketing campaigns requesting donations from members of the open science community, e.g. users of the platforms, like OSF. At the top of the OSF website, a bright green “Donate” button directs users to multiple options for making donations to the maintenance of the center, including Paypal, wire transfers, and stock donations. Under a tab that reads, “impact of your gift,” users are provided with a chart that enumerates the tangible, material effects of their charitable donations, including coding labor and the cost of minting digital object identifiers (DOIs).

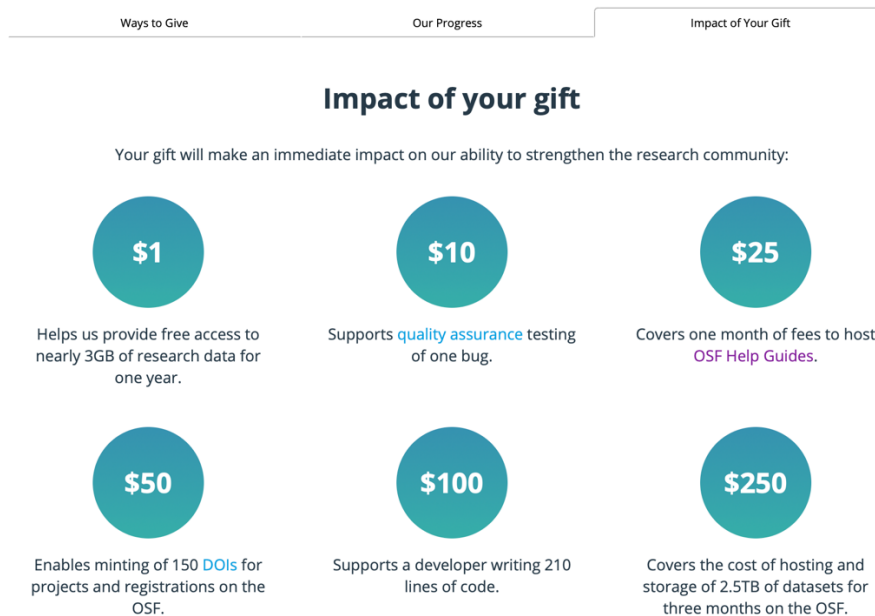


Figure 5.1. Screenshot of a graphic which articulates the costs of free services provided by the center as a way of stimulating charitable giving (<https://cos.io/about/support-cos/>).

By clearly articulating the immediate impacts of charitable donations, the graphic attempts to enroll users to contribute to a cause that is otherwise often very difficult to categorize. As Constance described it, to contribute to a mission that is slightly askew, or off-kilter, “thirty degrees to the left” of that which members of the philanthropic “community” might be used to. By surfacing and rendering visible a fungible metric of the costs of maintenance labor embedded into what are often considered invisible, immaterial, digital things, the graphic also coalesces and congeals an image of the materiality, and open-ended temporality of cognitive labor (Pink, Ardèvol, and Lanzeni 2016). The materiality of internetworked digital infrastructure, e.g. the potential for misalignments between software and emerging hardware, bespeaks a counterpoint to posthumanist narratives of technological transcendence (Hayles 1999). Software is rendered mundane. Ordinary. An ostensibly immaterial entity developed and maintained by laborers. Bugs will always need to be surfaced by the work of quality assurance testers, and they’ll always depend on the labor of software coders to be “squashed.” Over cocktails in a basement bar lined with bricks one evening, I asked several developers if they were concerned about the impact of automation on their industry. “Not really,” Greg replied. “There’ll always be a need for human programmers, people skilled in complex problem solving. There’s a lot in coding that can’t be automated” (Personal communication, 2018).

Particularly in the two years since preprint hosting had been integrated into the mission and the technologies developed at the center, as Brian had said during the lunch meeting, to further expand the scope of the “research lifecycle,” Constance felt that the

work of maintaining and stewarding existing relationships with funders had been overlooked. “We treated them like we tend to treat our loved ones, we felt like, ‘*surely you get us,*’” she said, shrugging her shoulders and releasing a deep sigh.

As the mission of open science grew beyond the scope of the research workflow and data management platform OSF, it began to encompass discipline-specific, and international preprint hosting platforms (Arxiv). The meanings and significance, the very contours of this emergent community of practice and values called open science had, themselves became somewhat muddled and cloudy, at least for those not directly immersed in the institutions where these communities were being designed.

To be clear, I don’t believe, and they never indicated to us that they were unhappy with the direction that we took. But *we* could have done a better job of explaining the lift that preprints was, why it was a driver to build communities, why it was a driver to build accountability for data. (Personal communication 2018).

I followed-up with, “do you think this issue stems at all from the fact that funders are typically made up of groups of people from outside of scientific research communities?” Constance responded that while this may be a part of it, she had felt that it was simply a part of their job as advocates for open science to more clearly articulate how new components like preprints already fit *within* the mission of open science. While it was obvious to open science workers at the center that preprints (an established alternative to traditional article publication models in *some* fields, like physics for example) were an important mechanism through which to disseminate and surface more data and information regarding scientific research processes and practices, it wasn’t at all

surprising to her in hindsight that funders might potentially see their introduction instead as an aberration, a drifting away from the mission of engineering tools for managing and making public research experiments.

For Constance, the funding uncertainty that began with the 2016 rollout of preprint server hosting was a case in point, an argument for why the center was reliant on a consistent, “angel” funding source. Because open science advocates work to continually expand the frontier of an emergent technocultural horizon, futurity is itself in a continual state of being reassembled, reworked, and refashioned (Scott 1999). In the course of reconfiguring futures of scientific practice and data sharing, Constance felt that relationship maintenance had been deferred under the assumption that there was a correspondence of imaginaries between LJAF and the center. In her view, it wasn’t so much that funders had grown frustrated waiting for Godot, endlessly awaiting the technosocial project of open science to reach a definitive point of narrative resolution. Rather, the layoffs felt much more like a particular kind of communication breakdown. Particularly for members of an organization for which scientific communication is such a meaningful, recursive (Kelty 2008) matter of care (Puig de la Bellacasa 2017), a coordination of collaborative action performed in creative solidarity to materialize alternative and communal modes of collaborating, the idea of a breakdown in communication felt particularly, even ironically... painful.

It often feels like anthropologists are drawn to breakdown. Here, in the midst of my friends’ lives being suddenly upended, I felt a bit like a local TV stringer who happened to be on the scene of a violent car crash. I felt like a parasite, feeding off the pain and

uncertainty my friends were experiencing. Behind their assurances that they'd "land on their feet," I often wondered if I'd seen hints of dread and fear.

Communication breakdowns often present as a tear in a shared cultural fabric, a split, a rupture, a "severing of ties" that signifies a relational termination. In her widely cited, groundbreaking ethnographic work on infrastructure, Susan Leigh Star (1999) argued that it was in moments of material breakdown that infrastructural systems are often rendered visible for the first time. In ethnographic work on infrastructure since, anthropologists have demonstrated how frequently infrastructures coalesce *poetically*, out of ad-hoc articulation-work amongst previously disarticulated material forms (Larkin 2013). Infrastructures of open science similarly coalesce out of the articulation of multiple, seemingly disparate components engineered in real-time, to meet the needs of a decentralized and multifarious community. For open science advocates like Constance, the emergence of preprint hosting for example, was merely a continuation of an iteratively unfolding and evolving narrative of open science, a technosocial becoming of an otherwise abstract and partial set of imaginaries. As I demonstrated particularly in the chapter on "Innovation," continual, open-ended, and iterative articulation was materialized in infrastructural and ideological forms configured as "modular," for example in the way OSF is built to continually connect to similar platforms (e.g. Google Drive, Dropbox, Evernote) via add-ons mediated through the protocological functions of open application programming interfaces (APIs); deeply significant pieces of code which inscribe, into software the potential for reciprocal communication and information standardization (Bucher 2013).

Preprint hosting services had been *imagined* in 2016 as similarly both modular *and* modularizing; that is, preprints were thought to be a “feature” that was easily able to be “plugged-in” to the imaginative schema and the funding mandate of the organization, dialectically re-configuring, in turn experimental research as a modular, scalable domain of practice predicated on reciprocity. Yet, Constance had demonstrated with regret, preprints were perhaps not a *sufficiently* modular object; preprints had proven unable to “speak” for themselves (Daston 2004), they were unable to *scale*, or “expand—and expand, and expand—without rethinking basic elements” (Tsing 2012, 505). On their own, preprints were unable to draw together open science advocates into a “complex gathering,” an alliance (Latour 2004). This is not to argue that preprint hosting services have been a “failure” (on the contrary, the center now hosts and maintains over a dozen discipline and international, region specific ArXivs, with over two million preprints)²³.

By 2018, the preprint had come to be regarded as a *queer object* (Sara Ahmed 2006); an entity that was simultaneously aspirational and utopian, ill-defined, off-kilter, askew... and transgressive (Rutherford 2012). For Constance, preprints were a matter of care (Puig de la Bellacasa 2017), a material becoming in need of constant relational stewardship. Contrary to the imaginary attached to an infrastructure like OSF, which was imbued with familiar aspirations of “ballooning” into a collective, participatory community of over

²³ Two years after completing fieldwork, as I began drafting my dissertation, EarthArXiv (a climate science preprint server) announced they were beginning the process of moving all their preprints to another hosting service, citing disputes with the center’s new fee-for-service funding model, which EarthArXiv’s advisory council argued “is competitive - pitting preprint communities against each other for the same funding sources” (The Advisory Council of EarthArXiv 2020). The center now makes public the institutional fee schedule for each ArXiv, (e.g. twenty-five thousand dollars a year for ArXivs hosting five-thousand to ten-thousand preprints, per year) (<https://cos.io/our-products/osf-preprints/>).

two-hundred thousand “users” mediated through the frictionless, accelerated protocols afforded by “the cloud” (Paul N. Edwards 2010; Mazzarella 2010; Hu 2015)—as Mitch had once said in 2016, “bringing people along for the open science ‘ride,’ because they value the tools we build”—preprints had unintentionally become a point of friction.

If preprints had failed to “scale” in the imaginary of funding agencies, it wasn’t because they were seen as a threat to the status quo of academic capital accumulation predicated on novelty and exclusivity (Mirowski 2011), but because open science workers hadn’t performed the care required to ensure that they would draw together a shared and collective sense of aspiration, ambition, and enchantment. More cynically perhaps, it was unclear how preprints would fit within the contemporary neoliberal capitalist logics of “measurable” and “actionable” achievements along a teleological trajectory of progress and knowledge accumulation (Strathern 2000; Fisher 2009).

For many, particularly communities in post-colonial urban environs, infrastructures—particularly time sensitive circulation networks that guide water distribution and sewage removal—are simultaneously uncertain, and obstinately present figures of daily life (N. Anand 2012; Von Schnitzler 2013; Schwenkel 2015). Contrary to Star’s (1999) suggestion that it is only in the moments of breakdown that infrastructure becomes visible, Brian Larkin (2013, 336) argues that infrastructures thus inhabit a “range of visibilities that move from unseen to grand spectacles and everything in between.” Paradoxically, infrastructures often bely the progressivist aspirations and ambitions of engineers and planners (Larkin 2008), becoming *mechanisms* (rather than unambiguous

mitigators) of relational breakdown through the imposition of state agendas and the uneven rationalization of daily life (de Boeck 2011; Von Schnitzler 2013; Barnes 2017).

The idea of communication breaking down between the center and the funders had begun to emerge around objects like preprints, drawing into sharp and sudden relief the precarity of technosocial forms, the indeterminacy and open-ended futurity of not just the physical and material, but also imaginative infrastructures of open science. For many at the center, they were a reminder of not only the open-ended temporality of the open science sociotechnical project, but also of the continued dependency upon labors of care for crafting and maintaining imaginaries and social relationships along with technical forms (Puig de la Bellacasa 2017).

From Platforms to Publishers

Two years after completing fieldwork, as I began drafting my dissertation, EarthArXiv (a climate science preprint server) announced they were beginning the process of moving all their preprints to another hosting service, citing disputes with the center's new fee-for-service funding model, which EarthArXiv's advisory council argued "is competitive - pitting preprint communities against each other for the same funding sources" (The Advisory Council of EarthArXiv 2020). The center now makes public the institutional fee schedule for each ArXiv, based on the anticipated volume of preprints submitted for the year (e.g. twenty-five thousand dollars a year for ArXivs hosting five-thousand to ten-thousand preprints, per year) (Center for Open Science, n.d.). Although the funding model change was announced a year in advance (Mallapaty 2020), the long-term sustainability of other, especially volunteer-run ArXivs in the global South, is

increasingly in doubt. One of the most popular country-level ArXivs (INA-Rxiv, an Indonesian preprint hosting service), which receives approximately six-thousand submissions a year, recently announced that it will close entirely (Mallapaty 2020). Several other ArXiv servers have begun to throttle or suspend submissions entirely to cut costs.

As with other software “platforms,” the center is likely to become increasingly regarded less as a workflow management tech developer, and more as a *publishing* nonprofit. As Mitch expressed to me in 2016, concerned with the *consumption* of data and information less than its production. As other digital media scholars studying the open knowledge movement have demonstrated, the scale of maintenance costs associated with archiving digital research entities like preprints, compared with the relatively steady materiality of books and manuscripts is potentially staggering, demanding that publishers design our documents, data, and systems to be as easily upgradable as possible for the day when we update the codebase of our website, or the next version of XML comes down the line. There is an enormous amount of labor required every time you upgrade or move your data to a new system, and the labor needed grows in proportion to the size of your catalog of content (Elfenbein 2014, 296).

In the next chapter, I try to follow some of the downstream flows of preprints. I suggest that the same imaginary of seamless and accelerated conduits of information which configures techno-utopian visions of social media (e.g. achieving “economy of scale” (<https://cos.io/our-products/osf-preprints/>), which, according to Tsing (2012),

closely nests within capitalist visions of growth and progress, whereby “popularity” helps to reduce costs) *also* comes to underwrite the aspirational, future-oriented technopolitics of social science preprints. Recognizing, on the one hand the potential for such infrastructures to dramatically re-configure the possibilities for research participation and radically for democratizing research communities, I also critically consider the particular kinds of research entities that are allowed to accelerate, becoming-viral in the era of platform capitalist science.

Chapter Six

All That is Solid Melts into Lulz: Open Science Infrastructure in the Age of Trolls

Wild Data

On May 8, 2016, a team of online researchers uploaded (and made public) on OSF a large dataset which they'd scraped from a popular dating website. A graduate student in psychology from Denmark and a colleague had used a script developed by a third colleague to "scrape" data from dating profiles on the website OkCupid from November 2014 to March 2015. Days later, the dataset was found by social media commentators following social science research to contain easily identifiable user information, including ages, religion, usernames, sexual preferences, turn-ons, and survey responses from over 70,000 users (Resnick 2016). By May 11, several Twitter users began to discuss the significance of the data dump. In one tweet, a user notes that the data seemed easily re-identifiable and asks the study's lead author directly if they had taken steps to try to anonymize the data. In his response, he implied that anonymity wasn't required because, in his view, the "data is already public."

The tweet throws into sharp relief the ambiguity which increasingly surrounds categories of "public" and "private" data in contemporary online research. While it's not common that a team of online social science researchers would demonstrate such a seemingly deliberate disregard and consideration for basic research ethics standards (such as anonymity), the latest digital social science scandal nonetheless demonstrates the ways in which conventional demarcations of public/private are (again) rendered blurry (Warner

2010). Writing for the tech section of Fortune magazine, a reporter suggested that, as the team asserted,

the data, collected from November 2014 to March 2015, is indeed public—sort of. Some of it like bios, photos, age, gender, sexual orientation is easily accessible through basic Google (GOOG) searches. Answers to some 2,600 of the service’s most popular dating survey questions are restricted to people who are logged into the site and who have answered the same questions. The site’s users can also set certain answers to “private,” which makes the responses inaccessible to others. In this case, the researchers scraped and presented the data accessible through Google and Q&A responses from individual profiles (Hackett 2016).

While some of the data scraped had indeed been “public” in the sense that it was easily obtained by anyone searching the site, the aggregation of even public data rendered the totality of user data much *more* public than OkCupid users had likely anticipated or intended. However, in a piece for Wired magazine, science reporter Michael Zimmer (2016) noted that “it remains unclear whether the OkCupid profiles scraped by Kirkegaard’s team really were publicly accessible.” Zimmer demonstrates that, according to the team’s initial methodology, which involved the use of an automated bot designed to scrape data from dating profiles that were recommended to it by the OkCupid algorithm, the bot was likely made to appear as an authentic, logged-in user, which allowed it to scrape (and publish) data from users who had restricted access to their profile to only other (logged-in) users.

Underscoring how contemporary online communication renders the boundaries between “public” and “private” increasingly fuzzy, digital humanists danah boyd and Kate Crawford (2012, 663) argue that, “Big Data is less about data that is big than it is about a capacity to search, aggregate, and cross-reference large data sets.” In other words, there is nothing inherent or essential to a data set that makes it “big,” apart from the sets of relationships and connections into which it is able to nest and enfold. “Big” data is, like all data, never formed in a cultural vacuum, and never indistinguishable from its grounding, histories, and relatings (Gitelman 2013). As the #OkCupid saga continued to unfold at the breakneck speed of social media, Scott Weingart, a digital humanist at Carnegie Mellon University, clearly articulated the stakes involved in publicizing the dataset, noting how easily this particular collection lent itself to malicious doxing (i.e. cross-referencing public and private user data across multiple platforms to expose information related to one’s off-line identity, such as street addresses and phone numbers).

Three days after the dataset was made public on OSF, the center restricted access pending an internal review. In an interview posted to the science blog Retraction Watch (McCook 2016), Nosek drew an explicit connection to other software platforms that rely on user-generated content, asserting that

OSF is like Youtube [sic.], Facebook, Instagram, and other places that users post content. We don’t know in advance what people will post. We respond to potential misuse with an investigative process. When we learned on Wednesday that there was the possibility of users identifying information in that file, we

initiated an investigation. By Wednesday evening, we had enough preliminary information to request that the person posting remove the user datafile or make it private. He agreed and converted the file to a password protected version on Thursday morning. We also removed access to prior versions of the file at that point. Then, we took Thursday to conduct a full review and determined that the file should be removed. We confirmed with the poster, and he agreed to have it removed. Later Friday, we received and started to address [sic.] the DMCA request (McCook 2016).

The data were ultimately found to have violated the center's terms of use and were permanently removed from OSF before a Digital Millennium Copyright Act (DMCA) complaint was filed by OkCupid on May 13. Before it was removed, however the data was reported to have been downloaded from OSF over five-hundred times (Resnick 2016). When I visited the center a month later, in June, the controversy had dulled into a kind of silent embarrassment. For most open science workers, the data dump hadn't shaken their faith in the open science movement as a whole; there were bound to be "bad actors" in any positive social movement. *'How do we learn from it and try to anticipate similar misuses later on?'* Several months later, during an R&D presentation by a team of interns working on a feature that would create "static mirrors" of OSF projects as a way of backing-up researchers' data, Jeff (the chief technology officer) had caught the team off-guard when he'd asked how a feature that automatically created static duplicates of a project wouldn't create a situation like what had happened with the OkCupid data, where

hundreds of unauthorized copies are allowed to continue to “float around,” even after the original was removed.

Although the OkCupid data publication was generally regarded amongst developers, community team members, and metascientists at the center as at the very least, highly unethical, the mechanisms to intercede any earlier (either real or imagined), were few. While it was unfortunate that the identifiable data was downloaded so many times before being taken down, investigation into the propriety of the data was only able to take place *after* it had been made public. For several days, the data inhabited a kind of liminal-space, a gray area; it was mostly obscure, and unknown. Days later, as it began to surface on research psychology Twitter, it was immediately regarded as unethical, although not in any immediately obvious violation of the terms of service of either OkCupid or COS. While Twitter acted like an infrastructure of open, post-publication peer review, the Tweet storm that ignited around the data dump likely contributed to many of the more than five-hundred downloads.

Anthropologists studying infrastructure have demonstrated how infrastructural systems often emerge less out of planned engineering, and more out of ad-hoc arrangements and couplings, a kind of patchwork assemblage (Tsing 2015), formed between existing networks of circulation and exchange (Larkin 2013). The coupling of participatory, social media channels with an openly accessible data archiving infrastructure had effectively *surfaced* an otherwise relatively obscure research entity, amplifying and intensifying its reach and spread. In the spirit of “accelerating scientific

discovery,” the open knowledge infrastructure had performed (to some extent) as intended.

On the eve of the intensification of participatory media forms, Patricia Clough and Jasbir Puar (2012, 14) mused on the temporal and affective threads woven into contemporary expressions of the “viral.” They insist that, while the figure of the “viral” (e.g. in the sublime spectacle of becoming, or “going viral”²⁴) is often rhetorically distinguished from that of the “virus,” intensified replication and repetition mediated “through code” carries a kind of “parasitic” potential. Contemplating the participatory modulation of affect, they argue that, “if the virus can invoke anxieties about trespassing borders, the containment of contagion, or failure thereof, the viral can instigate a panic around measure or measuring that takes us beyond human perception, consciousness, and cognition to the incalculable or the yet-to-be-calculated” (Clough and Puar 2012, 15).

Just a year earlier, the primary findings of the reproducibility project in psychology had “gone viral.” Circulating widely through a patchwork of conventional and social science media channels, RP:P had instigated a panic, to echo Clough and Puar (2012) “around measure and measuring” (i.e., whether or not the totality of significant, deeply meaningful findings in the field of psychology held up to independent scrutiny) that some quickly characterized as a “crisis” for the field (Freese and Peterson 2018). In his ethnography of pandemic prophecy, which explores the ways in which speculative,

²⁴ The sublime spectacle of “going viral,” (i.e. of a horizontalized and flattened potential for becoming (in)famous) is deeply informed by the figure of the sublime as that which simultaneously enchants, entrances, and horrifies (Larkin 2008).

future-oriented discourses of panic gain wide public traction, Carlo Caduff (2015)

similarly describes information as a concept that

structures both a scientific understanding of biology and its moral foundation as a science based on social relationships mediated by a form of generalized exchange.

Today's biologists of information are engaged in the difficult effort of constructing a biology of context, reflecting the crucial question of how to access the power of informational bodies (2015, 128).

Panic and anxiety carry a recursive potential, powerfully reconfiguring the conduits through which information becomes disseminated (Beck 1992). In the panic around reproducibility, the solution proposed by open science workers was, perhaps counterintuitive. Rather than argue for the virtues of *slowness* in research and discovery (Rosen 2011), the kinds of timescales, virtues, choreographies, and practices potentially more aligned with conventional conceptions of precision, maintenance, scrupulousness, and data quality (M. Fortun 2005; Thompson 2013), open science workers insisted instead on “greasing the wheels” and getting rid of stubborn “barriers to entry,” making experimental research and data-sharing infrastructures more seamless, accelerated, and resistant to “data friction” (Paul N. Edwards 2010). For me however, the OkCupid data dump had opened the question of what *kinds* of data and information flows are being accelerated.

As with other online platforms, i.e. web applications that rely on their users to generate and share content, open science advocates at the center generally felt, along with Brian, that the quality and content of data uploaded to the site and made public should be

the responsibility of the users that had uploaded said content. As we spoke about the role of content moderation in open science in 2018, Patrick told me his ideal view of the way that “gatekeeping” would operate hinged on a decentralized information ecology that centered around relatively small groups of researchers operating in the best interests of their own, individual research communities (Personal communication 2018). During another conversation in May 2017, Eric recognized how a seamless, accelerated ecology of data sharing potentially created “gray areas” for the organization, which were difficult to anticipate or mitigate with any clear policies or by any means of technology design. He recognized that this was the potentially “dark side” of the kind of technologies they were building, infrastructures to make it easier for researchers to seamlessly and instantaneously share their research data. *While you hope researchers will act in good faith in the interest of science, it just wasn't clear how to ensure, by either technological design or policy, that they always would.*

The center could always rely on their terms of use, which were in keeping with the standards set forth by other platforms, but it just wasn't possible to predict all the ethically gray areas which might surface. Under the terms of use, OSF users are advised that they're “encourage[d] to consider community norms and expectations in your use of the Websites and Services” (Center for Open Science 2019). By delineating the rules of use in a publicly accessible medium, the terms (not unlike those of most participatory software platforms) help to construct and maintain an image of neutrality (Caplan 2018). Users are advised that by using the site, they “represent and warrant to the COS that [...] all data [they] deposit is true and correct at the time of deposit” and that if users “later

discover that any data was not true and correct at the time of deposit, [they] must correct the data” (Center for Open Science 2019). Users are advised at least twice in the document that it is their responsibility to ensure that any data deposited does not “infringe on the copyright or other rights of a third party.” However, since the passage of the Bayh-Dole Act of 1980, which dramatically expanded copyright privileges to universities, researchers particularly in applied science fields might find the pathways to openness potentially too murky and risky. In terms of content, users are also advised that they are strictly prohibited from communicating on or through this site any unlawful, harmful, offensive, threatening, abusive, libelous, harassing, defamatory, vulgar, obscene, profane, hateful, fraudulent, sexually explicit, racially, ethnically, or otherwise objectionable material of any sort, including, but not limited to, any material that encourages conduct that would constitute a criminal offense, give rise to civil liability, or otherwise violate any applicable local, state, national, or international law (Center for Open Science 2019).

Compared with many social media organizations, which function largely through a “logic of opacity” (Roberts 2018) representatives of the center were surprisingly open and transparent about the process by which the rules and policies governing copyright were enforced after the OkCupid data dump. While the lines demarcating violations of property rights were considered clear, questions of content remained murky. In the winter of 2018, just a few months after the brutal slaying of anti-racist activist Heather Heyer as she protested against the surge of white supremacy during the “Unite the Right” rally that stretched from the university grounds to the downtown mall over several days, several

open science workers at the center had begun to grapple more openly with the question of online content moderation, and the idea of free and open conduits of information. Several workers had spent a few hours participating in the counter-protests on the day of Heyer's murder, retreating to their homes once they'd realized that the local and state police departments had no intention of holding back the more violent, more heavily arm(ored) white supremacists from attacking counter-protestors. Shortly after I'd arrived, one of my friends still fought back tears as she recounted her experience, *it was a shit-show from the fucking beginning... they never had any fucking intention of stopping it.*

As we made our way back to the office to get our stuff early one evening after drinking craft beers at a nearby brewery off the mall, we walked quickly, trying to stave off the cold evening air that had started to bite. I'd started what had ended up being a long, meandering conversation trying to get a sense of the tempo of open source software design and development, from Colin's perspective. I told him that I'd recently read an essay on the topic of prototypes by a well-known digital historian (Turner 2016) and that it had inspired me to want to get a better understanding of how open science workers at the center were thinking with and about time and creativity. *It doesn't really work like that, at least not here,* he'd replied. At least for he and many of the other developers, both time and creativity were closely structured and regulated, configured around deadlines and completing pre-defined tasks that had been delegated in small team meetings, or "scrums." To the extent that developers got to be creative, it was usually toward finding innovative ways of approaching a specific coding problem, though this usually didn't rise to the level of being "innovative" as such. There just wasn't that much work with

“prototypes” at the center anymore. Where developers got to be creative, it was usually just in finding an interesting way to fix a specific issue that was impeding the timely completion of their work. The rhythms of iterative development work were like cyclical contractions and accelerations that came in waves as developers tried to find a focused steady-state, or “flow” (Csikszentmihalyi 1990).

As we continued talking about time, creativity, and the futures of open science Colin and I passed by the road where Heyer and several others were mowed down by self-proclaimed member of the “alt-right,” James Allen Fields, when he violently plowed his car into the crowd. He’d been the one to point it out to me—*you know this is where it happened, right?* Members of the community had since erected a small make-shift memorial consisting of flowers and etchings and positive messages scrawled on the black asphalt in sidewalk chalk and partially preserved by the closure of the narrow road lined on both sides with two-story colonial-style buildings. Peeking through the space between the brick buildings, looking Northward onto Emancipation Park, we could still see, fading out of view as the sun set, the outline of the statue of Robert E. Lee astride his horse, shrouded in heavy black plastic secured with duct tape and hanging limp, like a pitiful stop-gap political compromise.



Figure 6.1. A statue of Robert E. Lee, cast in 1924 sits shrouded in heavy black plastic. Photo by Kyle Harp-Rushing.

In 2016, future-oriented narratives of progress saturated the center. As a technocentric nonprofit situated in the heart of a burgeoning downtown tech enclave, open science workers simultaneously drew upon and contributed to an intoxicating spirit of techno-optimism (Broussard 2019), an affective atmosphere (Anderson 2009) awash in the promises of creative, experimental sociotechnical progress. Now, it'd had started to feel

like there was an increasingly pervasive sense of unease and uncertainty. While uncertainties had recently started to emerge “internally,” around long-term, sustainable streams of maintenance funding, it was difficult to trace a clear line to problems with the aspirational ethos underwriting the very idea of accelerated, free, and open conduits of information.

In the last several weeks, however the subject of many of our informal, late-night afterwork drink conversations had frequently turned to the role of social media in the surge in white supremacist and nativist organizing. For many of the self-identified political progressives who worked who worked across different teams at the center, the shocking and horrifying events of “8/12” just months earlier had manifested a personal conflict at the heart of contemporary information flows. Colin was often particularly adamant that large-scale social media platforms like Facebook, Twitter, and Reddit shouldered a significant portion of the blame, because they’d consistently favored free speech ideals and refused to ban far-right enclaves such as r/The_Donald²⁵, despite users consistently being reported for utilizing the platform to recruit members to commit acts of targeted, far-right violence. While insisting that there’s nothing inherent in specific “arrangements of ones and zeroes” that would coalesce into far-right bigotry (Personal communication, 2018), open science developers in particular began to feel increasingly uncertain of the kinds of communities that participatory platforms supported and

²⁵ r/The_Donald is a far-right subreddit (channel or community on Reddit) that served as a highly popular online hub for the alt-right in 2015, in the months leading up to and following the 2016 presidential election and was widely criticized by digital media scholars as a vehicle for far-right radicalization. By February 2020, the white nationalist enclave had grown to become one of the most popular communities on Reddit since it was founded in July 2015, with close to eight-hundred thousand subscribers (“Subreddit Stats: R/The_Donald” 2020).

amplified. One evening, as we drove across town to a film screening, Greg and Finn (two front-end developers drawn to and deeply interested in the creative freedom afforded by web design) recalled how many of the rhetorical strategies employed online, by members of the alt-right—like the ironic, semiotic remixing, repurposing, and circulation of images and texts as memes designed to elicit a sense of shock, for the “lulz” (Coleman 2014)—were honed in previously obscure parts of the Internet (e.g. 4chan). For developers very familiar with cultures of transgression on the Internet (Coleman and Golub 2008; Nagle 2017), the alt-right was a matter of a difference by degree and amplitude, rather than quality.

Finn still felt a deep appreciation for the way in which decentralized, participatory platforms like Discord provided spaces for excluded and marginalized groups, like groups of queer gamers (i.e. *gaymers*) to which he belonged, who might not otherwise have an opportunity to meet one another, to come together in a community with a shared sense of belonging and solidarity with one another. None of us were sure what it meant that the capacity for such trans-local community-building increasingly comes at the cost of amplifying and intensifying the potential reach of previously obscure, far-right communities as well, though both developers agreed that the solution was very likely more political than technical. If large social media corporations were to start to make their advertising algorithms free and open source, allowing Internet scholars to study how recommendation algorithms worked, they speculated, there might be some insights to be gained about how online radicalization functioned, but the process of eliminating online hate speech wasn't something that likely could be fixed entirely with clever software

engineering. Despite working in an industry predicated on sweeping and often unfulfilled promissory speculations of future-fixes through “tech,” both developers were now notably circumspect in their own sense of techno-optimism.

Structuring Experimental Feeling

From the moment it began to coalesce in social and conventional news media outlets, the OkCupid data dump controversy primarily revolved around questions of research ethics. Comparisons were drawn to similar “big data” research projects, that had more or less surreptitiously gathered and analyzed user data without prior consent. In the article that first broke the story the event was compared to a data breach that had occurred 10 years earlier, in a 2008 study by sociologists at Harvard’s Berkman Klein Center for Data and Society (Resnick 2016). In a study that has since been retracted, data from 1,700 student Facebook profiles were scraped without user consent (Parry 2011). While the Harvard researchers had taken steps to anonymize user information, the team studying OkCupid user data had made no such attempts.

Before it had fizzled out, most of the online discourses focused on the impropriety regarding the procedures by which the team made the data public, i.e. without informed consent and without any attempt to anonymize information pertaining to the identities of individual OkCupid users. In a Tweet, the lead author stated that the decision not to anonymize user information scraped from OkCupid hadn’t been an oversight. Instead, the decision to retain identifiers was made *deliberately*, so as to allow other researchers who might be interested in reusing the open data to cross-reference and “fill in” missing data that the team weren’t yet able to scrape, such as users’ height. Although the dataset was

permanently banned from OSF, in a forum post the author later provided another link to the dataset on another platform. As of 2019, the link (which I refuse to provide here) continues to direct users to a working website with links to folders containing “data, figures, results, and scripts” related to the 2014-2015 scrape.

The data dump was seen by many as further evidence of the uncertainty and ambivalence surrounding social science research in the age of big data, particularly as barriers to conducting social media research were lowered. As interest in the controversy quickly waned, I became interested in the unspoken contexts surrounding this event. The data dump began to raise in my mind questions regarding the future of open knowledge infrastructures, not simply in regard to researcher (mis)conduct, but also in terms of more ambiguous and messy questions surrounding the kinds of research supported and accelerated in the contemporary reconfiguration of relations of knowledge and information production. As I pursued the contexts surrounding the OkCupid data dump, they surfaced an unintended potential of open knowledge infrastructures to support reactionary, right-wing knowledge production. In the next section, I engage with the more mundane spaces wherein which these communities cohere, ethnographically exploring the ways in which boundary-work (Star and Griesemer 1989), negotiations regarding the contours of the “opened frontier” of open research are performed across an assemblage of online platforms.

Although this chapter surfaces and exposes relatively fringe, controversial communities of open research, I don’t intend it to be read as an argument for shoring up or “repairing” the increasingly deteriorating hegemony and material monopoly of

extractive journal publishers. I argue instead for contextualizing the meanings and politics surrounding “open science” in the contexts of a contemporary surge in right-wing populism and the erosion of familiar institutions of liberal democracy across Europe and the U.S. Increasingly accelerated and decentralized, “open” information infrastructures are, in some ways configured as social “leveling” mechanisms, they are by definition also uniquely susceptible to co-optation by reactionary (e.g. racist, xenophobic, classist, and misogynist) pseudosciences.

Infrastructural co-optation doesn’t require that we abandon the project of open science altogether, or that we revert to established, highly extractive and exploitative publication models (plenty of reactionary social science research has been published in traditional, for-profit journals). However, I suggest that members within the self-defined “open science community” consider how ostensibly mundane, seemingly unambiguously socially positive “open” ecologies of scientific data and information production and circulation emerge within particular sociotechnical contexts, which are marked by race, class, gender, sexuality, and colonialism (Amrute 2019).

These sociotechnical contexts increasingly constitute discursive and infrastructural fields in which the efficacy of the traditional or conventional signifiers that scientists have continually relied upon to unambiguously delineate legitimate from illegitimate or “pseudo” sciences is increasingly eroded and unsteady (Mukhopadhyay and Moses 1997; Latour 2004; Hartigan 2008; Panofsky and Donovan 2019). The allure of open science is perhaps most often and most substantially related to aspirations and promises of speed

and acceleration (e.g. of ‘accelerating’ the pace of collaboration and discovery), of transcending the stubborn regulatory barriers of peer review (Nielsen 2012).

For specific fields of scientific practice, particularly cancer pre-clinical trial research, I found it personally difficult to argue against the virtue of speed in treatment discovery and efficacy assessment. As my dad lay dying from stage-four stomach cancer in the winter of 2018, my family and I clung desperately to the hope that he might qualify for promising, speculative experimental treatments like immuno-therapy. The scales of unresolved grief cloud my memory, but the news that he didn’t qualify for the treatment personalized the stakes of research temporality in ways I didn’t anticipate. Might he have survived if the pace of cancer treatment research were accelerated?

The histories of clinical research conducted in the U.S. are grim, and unlikely to be remediated by the promises of *acceleration*. In many cases, acceleration may worsen existing inequalities. Anthropologists have demonstrated the ways in which harms and benefits of clinical research have often been disproportionately distributed in ways that further disenfranchised, and often actively harmed participant communities along lines of race, sex, class, and gender, all in the spirit of utilitarianism and the good of the greater whole (Montoya 2011; Livingston 2012). Accelerated temporality, a kind of “race for a cure,” in the contexts of these histories functions as a kind of *de facto* necropolitics (Mbembe and Meintjes 2003), a form of social exclusion that ultimately determines the racially “unmarked,” ungendered, unsexed body of the straight, white male to be a default, “modular,” and scalable model of molecular intra-actions (Barad 2007) (e.g.

between novel drugs and cells) among an abstracted, unified category of “humans” as a whole.

In the globalized flows of clinical research, “accelerating discovery” has been achieved through reifying racially marked, sexed, gendered, and classed systems of categorizing between belonging and exclusion (Dumit 2012; Petryna 2009); nothing intrinsic to open science ensures that such reifications won’t resurface. In fact, it’s much more likely that, as with the majority of free and open source software that exploded into being in the nineties and that now comprises the backbone of much of the world’s proprietary, for-profit software entities (Kelty 2013), pharmaceutical corporations will continue to “innovate” new mechanisms of extraction and exploitation, generating and unevenly distributing on a global scale the benefits and harms of biocapital from the “communal,” and “open” data ecologies that increasingly come to digitize the stuff of “life itself” (Sunder Rajan 2006; Cooper 2008; Montoya 2011; Livingston 2012; & Reardon 2017).

Because contemporary knowledge infrastructures are “polymedial” (Madianou and Miller 2013), indeterminate research objects can flow rapidly, *wildly* through unintended conduits. As I write these words, much of the world is gripped in panic and anxiety about the possibility of an impending pandemic. As an example of the ways in which different manifestations of virality become ontologically entangled, a research blog reported that a preprint posted to the widely used biology research ArXiv (BioArXiv²⁶) (Pradhan et al.

²⁶ Founded in 2013 and managed by Cold Spring Harbor Laboratories, BioArXiv is not affiliated with COS.

2020) and linked to a Tweet by the authors had erroneously insinuated that “uncanny” genomic similarities between HIV and the novel coronavirus (2019-nCoV); indicating that the latter might have been a result of mutation that had occurred in-lab (Russell 2020). The preprint was retracted within days, when other researchers pointed out that the genomic similarities were hardly uncanny or unique, that “these same short sequences can be matched in coronaviruses previously found in wild bats and are commonplace in nature” (Russell 2020). Yet, as Russell (2020) points out, the wild, accelerated, and decentralized flows of new media meant that the preprint’s *ideological* reproducibility had rendered questions of *empirical* reproducibility effectively moot; regardless of how swiftly and effectively other researchers had tried to provide post-submission reviews which were critical of the study, the preprint provided fuel for a rash of online conspiracy theories claiming the virus was the result of an intentional government plot²⁷.

As aspirational and anticipatory promises of *speed* and *acceleration* underwrite multiple research fields of practice, matters of care shift from questions around the property rights of data and materials exclusively, and back toward questions of *epistemological* openings (i.e. to cultural configurations of knowledge, expertise, and belief) that have fallen out of favor in much of new-wave anthropology and STS configured around questions of ontology and (new) materialism (Ahmed 2008). In some ways, the *co-productive* (Jasanoff 2006), co-constitutive configurations of knowledge and social order are more “open,” decentralized, and participatory than at any other point in

²⁷ As Russell (2020) demonstrates, the entangled connections across this online movement are many, residing most prominently it seems, in the online movement associated with emergent white supremacy, Q-anon.

history; new media infrastructures serve as accelerated, amplified, and horizontalized mechanisms for reshuffling and renegotiating the meanings, stakes, and legitimacy of configurations between power and knowledge across such varied fields as vaccine research (Sobo 2016) to the shape of the Earth (McIntyre 2019).

Because such platforms are designed to function at the level of users' affect, erecting a kind of digitized "structure of feeling" (Williams 2009), pulling users into a kind of technosocial trance-state (Schüll 2014), user participation (e.g. assessed, visualized, and represented through such reductionist and disembodied metrics as "time on device") is maximized by exposing users to the genres of content most likely to generate a heightened, manic emotional response, such as a continual and insatiable desire to "update" (Chun 2016). In terms of the kinds of distributed agency afforded by such software platforms, these relationships reaffirm anthropologist Emily Martin's (2007) demonstration of cycles of mania and depression at the root of contemporary ad revenue and venture capital funding now associated with "tech." Internet scholar Wendy Chun (2016, 1) describes the entanglement of habits with platforms as one wherein which "through habits users become their machines: they stream, update, capture, upload, share, grind, link, verify, map, save, trash, and troll. Repetition breeds expertise, even as it breeds boredom." The kinds of discourses elicited are often, of course markedly different from Habermas' bourgeois dream of a rational, technocratic and anti-emotional sphere of deliberative debate (Habermas 1999; Warner 2010). As discursive infrastructures become decentralized and participatory, what forms of community are allowed to flourish? As many communities and relationships (including university courses) were

moved to virtual spaces in the early Spring of 2020, members of the online far-right took advantage of the designed seamlessness and lack of “entry barriers” of online meeting platforms, repurposing them to spread hatred and enact racial violence.

While the “structures of feeling” erected around experiment(al) workflow management and archiving software are often much more mundane and ordinary than those constructed through “new” or social media (Gershon 2017), they’re still designed with the idea of modulating affect and experience, of creating particular kinds of practice. As I demonstrated earlier, for several developers at the center, a perceived lack of care for user experience often culminated in personal frustration with the creative direction of the nonprofit. When configured within a polymedial (Madianou and Miller 2013), and therefore indeterminate ecology of information-sharing platforms that constitute much wider, more participatory *knowledge infrastructures* (Edwards 2010; Okune et al. 2018), the idea of modulating affect becomes much slipperier, as flows between multiple interconnected platforms are channeled with potentially unpredictable, unintended downstream effects. In the last section of this chapter, I loop back around to my opening; examining a particular, reactionary enclave of open science. Such an enclave, however obscure and marginal in the present moment, nonetheless surfaces several questions about the futures of open science. For instance, what kinds of knowledges are accelerated and amplified if openness and transparency are able to become techocultural fetishes—“fixed,” idealized modes of practice, which are imagined to seamlessly “scale” different fields and habits of research?

Open Knowledge and the Politics of Circumvention

Several years on, the open OkCupid dataset continues to flow across blogs, research platforms, and forums. The tweet announcing the data dump was published on May 8th, 2016 the same day the team published an article based to the online, open access journal *Open Differential Psychology*.²⁸ The journal is part of the OpenPsych open access journal network, a small collection of freely accessible research journals set up in 2014, “due to dissatisfaction with journals in the areas of differential psychology and behavioral genetics. These journals were all closed access, owned by Elsevier and used traditional reviewing practices” (<https://openpsych.net/about>).

While journals in the OpenPsych network regularly churn out papers with quick submission to publication turnaround times and are authored by members of the journals’ own editorial boards, neither the journal nor the OpenPsych network are currently listed on the well-known, revived, and often controversial list of “predatory journals” (<https://predatoryjournals.com>). Founded by librarian Jeffrey Beall in 2008 to combat what he saw as a rash of often extremely poor-quality journals that had begun to “exploit open-access publishing for their own profit,” the list was scrapped in 2017, allegedly due to “threats and politics” (Straumsheim 2017). Deriding open access as an “anti-corporatist” movement comprised of “advocates [who] want to make collective everything and eliminate private business, except for small businesses owned by the

²⁸ In recognition of the politics surrounding citation practices that disproportionately reward white Euro-American men with the cultural and material capital afforded by citation index metrics (Todd 2018; Guarasci, Moore, and Vaughn 2018), I provide links to ensure provenance, but refuse to cite the (often) overtly reactionary works discussed herein.

disadvantaged,” Beall (2013, 589) is widely regarded as a controversial figure in the world of academic publishing. The list has since been independently revived, often classifying open access journals as “predatory” on the basis of several “basic” criteria, which include:

1.) Charging exorbitant rates for publication of articles in conjunction [sic.] with a lack of peer-review or editorial oversight. [...] 4.) Quick acceptance of low-quality papers, including hoax papers. [...] 7.) Copying the visual design and language of the marketing materials and websites of legitimate, established journals,” and providing “10.) Fake, non-existent, or mis-represented impact factors (<https://predatoryjournals.com/about/>).

While the absence of the OpenPsych network from the list can be for potentially any number of reasons (e.g. perhaps the journal is too obscure to have caught the attention of the blog editors), the list of criteria is itself a compelling archive of the ways in which research authenticity is negotiated and contested within the emergent Open Access science media ecosystem. Particularly interesting are the ways in which the list of criteria deals with authenticity in the increasingly intermingled and accelerated *vectors* of contemporary and emerging research media infrastructures (Shaviro 2015; Duclos, Criado, and Nguyen 2017; Wark 2019). Rather than a promissory, aspirational precondition for enhancing authentic discovery, speed is figured (at least when identifying “predatory” journals) as a potential index of corruption. Despite persistent practices and patterns of exploitation (i.e. efficiently transforming, “at scale” the largely uncompensated labor of scholarly authors and reviewers into surplus value), established

journals and their publishers are notably absent from the list of predators. For managing editors with experience in the journal publishing industry, the exceptionally long, often drawn-out turnaround times from submission to publication are, in part a means of ensuring authenticity and quality (e.g. in terms of data, prose, and formatting). Unlike a book or printed manuscript, which exists “in a pretty good archival state,” with “digital files, there is no end to maintenance” (Elfenbein 2014, 296). Journal articles in particular are perhaps all-too-easily mystified (Marx 1981), commodities and objects which circulate through rarified air; entities for which value depends on ensure that cognitive, editorial labor is all too easily invisibilized, particularly in the contexts of ostensibly seamless, accelerated information conduits.

In the previous chapter, I argued that the recent movement of preprints into social sciences was a kind of *queer object*²⁹ (Ahmed 2006); an immanent and iteratively recombining and unfolding research entity, regarded as a potential transgression of conventional technosocial orders of academic publishing. Whereas platforms for organizing and archiving information relating to the social life of an experiment (e.g. OSF) (Appadurai 1986), were configured as valuable and fundable from the perspective of angel funders, preprint-hosting services were strange and unfamiliar; potentially *too* innovative and disruptive. What I did not consider at the time were the ways in which preprint-hosting stood for a kind of deeply systemic, or paradigmatic shift, a threat

²⁹ My use of *queer objects* draws from Sara Ahmed’s generatively expansive pursuit of those objects which *orient*, which render the strange familiar and that doesn’t just conceive of “commodities [as] fetishized: objects that I perceive as objects, as having properties of their own... are produced through the process of fetishism. The object is “brought forth” as a thing that is “itself” only insofar as it is cut off from its own arrival” (2006, 41).

toward the status quo of academic publishing that free and open source research workflow management software did not. As anthropologist Chris Kelty (2016b) has noted, academic publishing giants have already begun rapidly adapting, retuning their mechanisms of value extraction toward the potential, hidden monetary value of data related to research processes. As with social media logistics giants like Facebook, Twitter, Amazon, and Uber, it's increasingly likely that academic publishers will be able to leverage their extensive data-culling and advertising infrastructures, allowing them to offer services and platforms at low or no cost while maximizing surplus value from user data (Wark 2019).

Preprints therefore come to represent a kind of guerilla publishing I came to find reminiscent of the era of low-cost, DIY, collaborative, cobbled-together, underground print media that characterizes sci-fi zines in the 1930s, up to punk zines of the 1990s. Circulated in punk and comic book scenes, zines often represent a form of playful and politically transgressive and potent media re-assembly (Gitelman 2014). Preprints often make similar reference to a kind of *circumventional* politics (a politics of working with, but abandoning existing technosocial orders and institutions, if necessary)³⁰. Particularly for a developer like Greg, who'd been deeply involved in the fusion of punk/new-wave and the Internet in the '90s, it was this spirit that had drawn him to COS in the first place. As he drove Finn and I home late one night after hearing a local band play at a nearby

³⁰ For example, the "Utopia Papers," journal articles published by researchers at COS just before their founding includes specific language about the need to possibly "circumvent" intransigent journal publishers who are unwilling to adopt the principles of open science (Nosek and Bar-Anan 2012; Nosek, Spies, and Motyl 2012).

bar, he fondly recalled how his love of the Internet had been sparked by countless hours building his own website, piecing together scraps of code that he'd found on other sites. It reminded him of the kind of "patchy, DIY" zines he'd been into as "a dorky new-wave kid just trying not to get my ass beat in South Carolina."

Though it didn't occur to me to consider if preprints were simply too transgressive to existing capitalist technosocial orders of academic publishing, could it have been that the "angels" had been scared off? Beginning with experiment workflow management software designed to organize and archive massive amounts of information and data related to the iterative unfolding of a social science experiment, many at the center had felt that the next logical step was to develop infrastructures to allow researchers to essentially self-publish research articles. In the previous chapter, I concluded with an exploration of recent issues surrounding maintenance funding of open science infrastructures. Here, I consider potential, unintended consequences of preprints, asking what kinds of knowledges can take shape in the seamless, frictionless, and accelerated infrastructures of preprint-hosting.

Open Science in Moderation? The Reactionary Side-Effects of Free Knowledge

Across the multiple discipline, and region-specific³¹ preprint servers hosted by COS, the administrators of each individual server set submission guidelines and content

³¹ While beyond the scope of this project, it is worth noting that one of the concerns with preprint servers based not only on disciplinary, but also along national, linguistic, and geographic regions (e.g. InArxiv, the preprint server for Indonesian research in architecture, business, life sciences, etc., currently with over 16,700 preprints) is that they potentially reify globally racialized and colonial categories of research quality. Isn't it an integral part of the aspirational promise of online preprint-hosting that geopolitical boundaries in science are finally able to be recognized as arbitrary when a researcher can upload her research from anywhere in the world? Why then the need for nationally defined preprint servers? Considering the ways in which many software platforms reify existing modes of colonial extraction and

moderation policies. In a help guide, the center differentiates between pre- and post-submission moderation (Bowman 2020). In some cases, content moderation policies are clearly delineated, as with the Earth sciences archive, EarthArXiv (a preprint server with over 1,000 preprints), whose “Moderation Policy” appears as a link at the bottom of the landing page. The link directs me to a page that clearly lays out the kinds of submissions that are and are not accepted (the latter including “racist and derogatory language, commentaries and opinion pieces, and papers without citations to established scientific literature...”) (<https://eartharxiv.github.io/moderation.html>).

Content moderation policies on other preprint servers hosted by COS are notably less clearly defined. The preprint server for psychological sciences, PsyArXiv (with over 7,600 preprints) for example, simply directs site visitors interested in journal preprint policies to a link entitled “SHERPA,” a cross-disciplinary database for self-archiving policies. When I click on the link, I’m presented with a simple site query box for journals and “publisher copyright policies and self-archiving.” When I search for “PsyArXiv,” I receive a message that “no journals were found” matching my query terms.

While it’s perhaps obvious, given the politically fraught context of climate research in the U.S., why a preprint server dedicated to Earth sciences research would formally encode a set of content management guidelines, it feels strange on an equal order of

hierarchy (Amrute 2019), future research on the proliferation of preprints will need to contend with the likelihood that preprints will soon become yet another valuable knowledge entity siphoned from the global South to North and manipulated into surplus value (Comaroff 2016; *cited in* Amrute 2019; see also Posada and Chen 2018).

magnitude that a psychological sciences preprint server (particularly one with seven times the volume of preprints) wouldn't do the same.

In a white paper published Data and Society, which reviews content moderation policies in use at ten social media platforms, media scholar Robyn Caplan (2018) differentiates between three approaches to content moderation: artisanal, community-reliant, and industrial. She finds that, unlike the kinds of “industrial” scale content moderation that privilege consistency at platforms like Twitter and Facebook (see e.g. Gillespie 2018), moderation on smaller platforms is very often more akin to what she calls “context” moderation, shifting according to resource needs and specific organizational dynamics and attending to the contexts in which particular kinds of content are found (e.g. differentiating between images of breast-feeding deemed acceptable, and bare breasts deemed unacceptable).

As a kind of platform for platforms, the centers' approach to content moderation is in some ways simultaneously artisanal *and* community-reliant, reflecting the kind of imaginary of “decentralized” information management often enthusiastically lauded for example by developers like Daniel; allowing for context-specific and granular levels of control specific, unique, and appropriate for each discipline. While the center offers guidelines on developing content moderation policies (e.g. in their “help guides”), each preprint server handles the drafting and enforcement of their own policies. Regarding OSF specifically, content moderation becomes applied in a manner more like the “industrial” approaches of Facebook and YouTube, which favor consistency and an adherence to the supremacy of a self-regulated, “free market-place of ideas.” It wasn't

necessarily the *content* of the dataset as much as its (lack of) propriety that was cause for removal. Significantly, it wasn't through standardized peer-review metrics, but rather through the ad-hoc arrangements of polymedia (Madianou and Miller 2013), the patchwork of decentralized informal, social media channels that these norm violations were surfaced.

At the risk of amplifying and accelerating their spread, it's still worth considering the viral, intensely "social lives" of parasitic, exploitative, and toxic data. While Beall's (2013) critiques of open access are, in many ways monolithic, overstated, and sweepingly apocalyptic, the concern that open access potentially lends the "imprimatur of scientific legitimacy" to undeserving research objects is worth further exploration. Despite the controversy and privacy concerns surrounding its' release, the OKCupid dataset continues to live on. One of the original authors published a public project exploring the relationship between "Chronobiology and intelligence" using the dataset, created in January 2020 (<https://osf.io/x3r8v/>). They had earlier published an article in the journal *Psych* in December 2019, in which he used the OKCupid data to assert that "self-declared religious people had lower IQs than nonreligious people (atheists and agnostics)."

While the ways in which the dataset was extracted and disseminated had overshadowed much else in the immediate social media discourse, the dataset itself is unable to be uncoupled from its surrounding context and the social lives it goes on to lead afterward. I tried to follow the downstream flows of this particular dataset. While the data had been downloaded over five-hundred times from OSF, it's proven extremely difficult to trace the flows of individual datasets to other users. A blog posted on Medium by a

data science enthusiast in 2019 makes mention of a “genius” who “scraped over 1,000,000 rows with 32 columns of OKCupid data,” which the author used for their own project. In general, however it was impossible to follow with certainty, everywhere the data had flowed.

Despite the indeterminant flows of the OKCupid dataset (e.g. ‘why did other users download the OKCupid data, and what did they do with it?’), its use in the psychological study of “intelligence” proved significant. Of four preprints posted to PsyArXiv by the same author as the OKCupid data dump, all the papers investigate linkages between “cognitive ability” or “intelligence” and several markers of identity, including “race” and “religion.” While seemingly obscure, a preprint entitled “Race, discrimination, cognitive ability and income: analysis of the Add Health dataset” was downloaded over one-thousand times, according to PsyArXiv’s dashboard metrics. The preprint, which purports to use data from the “National Longitudinal Study of Adolescent to Adult Health” (1994) to essentially reassert long-since debunked (see e.g. Leacock 1971) “culture of poverty” theories (Lewis 1966; 1975), claiming that “other-perceived Black and Hispanic racial statuses were associated with either no differences or slightly higher incomes when cognitive ability was controlled for, whereas self-perceived Black status was negatively related to income.” By way of comparison, a preprint written about the highly controversial and widely discussed reproducibility crisis was downloaded over seven-hundred times (<https://psyarxiv.com/nt4d3/>).

While it’s entirely possible that the download metrics were artificially inflated (e.g. by the author themselves, through either manual downloads or an automated script),

assuming the downloads are authentic, it's difficult to follow where these files and research entities end up downstream. A simple Google search for the title suggests that the preprint has seen little, if any uptake, re-use, or discourse. However, several posts in the white nationalist online forum *Stormfront* directly cite other works by the same author. In one particularly popular post (with over nine-thousand views and seventy-four replies) OP³² (a user by the name of "Tenniel") links visitors to an interview with the author, who they describe as being, "genuinely knowledgeable and is racially awakened. On intelligence issues I've studied fairly deeply over the years, I agree with 95% or more of what he says (which is high for such interviews)."

By examining the ways in which open knowledge infrastructures entwine with the production and circulation of white nationalist research objects, I don't intend to imply that either the center or individual open science advocates are somehow "at fault." On the contrary, many of them were alarmed to find that some within the "open science community" were using the tools they'd developed in this way. When I asked what, if anything could be done differently, open science workers like Eric usually paused for several minutes contemplatively. Just like with the hypothetical scenario I'd posed to Gwen in 2016 of OSF being used to support and disseminate research designed to discredit climate change research, the hope was that, eventually, "good" open science would cancel out the bad.

³² In anonymous online forums and chatrooms, OP ("Original Poster") refers to an initiator of a thread or conversation, someone who posts OC ("Original Content").

What's most recently been rebranded and repackaged into seemingly neutral, context-independent, and value-free signifiers, like "race realism" and "race science," the "story of knowledge built on the brutal exploitation of racialized subjects," has (of course) a long history, predating by several centuries the relatively emergence of complex social movements to increase transparency in scientific research (Rusert 2017, 5)³³. Nor am I arguing that the contemporary resurgence and domination of white supremacy throughout public discourses and institutions is a *result* of open science (at least not in the way we might otherwise assume). While "open science" manifests in particular groups, institutions, organizations, and tools, I have consistently argued that open science exists and operates within a much more widely dispersed, heterogenous, and confusing set of technocultural relationships and infrastructures (Edwards 2010). As I continued to "follow" open science, it's contours and borders continued to become increasingly blurry and ill-defined. While the notion of "studying-up" works from the presumption that particular organizations and institutions exercise an outsized influence over the distribution of material resources and discursive legitimacy (Nader 1969), it never felt as though the center was steering or guiding the progression of open science. It usually felt more like a real-time unfolding, an emergent, often urgent configuration of imaginaries and realities, not unlike the ways in which Deleuze and Guattari (1987) describe a continuous, iterative and often disorienting re-assembly of the virtual and the real across

³³ While it's outside of the scope of this particular project, it is well worth mentioning that Rusert's (2017) research documents how not only well-known white anthropologists (L. D. Baker 2010; King 2019), but also African-American and black researchers in the Antebellum era worked to upend the presuppositions surrounding race science of the day.

multiple, disparate planes of immanence. Configurations and manifestations of open science imaginaries and tools at the center now feel more like a collective act of *boundary-work* (Star and Griesemer 1989), attempts to categorize and classify complex communities of practice which were *already* being reconfigured into a confusing, indeterminate, and partial assemblage (rather than what I expected to find, a group trying to standardize science to align with a nostalgic image of Science's past). As I demonstrated in my chapter on metascience, groups of metascientists appeared to be much more motivated by a collective affect of care than one of disruption and exposure.

In many ways, the conduits for circulating and deliberating scientific knowledges and for configuring alternative publics around research entities have already been rendered radically “participatory,” though the physical and digital conduits themselves remain highly centralized (Starosielski 2015). In a context in which information infrastructures are increasingly designed to maximize and accelerate the flows of more extreme content, the mantra of transcending stubborn “barriers to entry” conjures increasingly awkward and difficult questions about the nature of scientific discourse. Digital scholars and anthropologists have examined the ways in which contemporary information infrastructures often easily *accommodate* (rather than moderate) white supremacist views (Panofsky and Donovan 2019). Rather than allow for self-moderation, many of these communities develop highly successful strategies for insulating themselves from critique, maximizing the reach of extreme content, particularly when platform corporations defer to the ideal of “openness” and freely flowing ideas on their platforms (Massanari 2017). Why would we assume that this technocultural infrastructure would leave communities of

scientific practice untouched? Writing on the recent controversial publications of both, a new book by Charles Murray and a philosophy article which baselessly argues that “in a very short time, it is likely that we will identify many of the genetic variants underlying individual differences in intelligence,” philosopher Regina Rini (Rini n.d.) recently argued that the

“race science” racket is growing, and we needn’t assume that all its practitioners have such transparently bigoted motives. Rather, I suspect that some are in it for the iconoclastic thrill of prodding at *bien pensant* pieties from behind the intellectual shield of capital-S Science.

It’s unlikely that “lulz” will replace citations and impact factors as the primary currency in research economies. However, as they come to underwrite open knowledge infrastructures, imaginaries of acceleration, participation, and decentralization collide with existing configurations of race, class, sexuality, nationality, and global capitalist extraction. Partially as a consequence of its openness, open science comes to mirror and reflect, rather than *transcend* what are widely considered pathological patterns of knowledge-making and consumption. Despite an intoxicating and often *absolute* moral economy of teleological progression (Tkacz 2012), it is often unclear for which kinds of worlds openness is arguing on behalf (Haraway 2016; Puig de la Bellacasa 2017). While open science advocates often articulate complex technocultural imaginaries configured around *repairing* communities of scientific practice, open science remains disarticulated and uncoupled from imaginaries which are *reparative*—fundamentally reconfiguring

asymmetric relations of power and knowledge (Sedgwick 2003). Valuing an often fetishized image of informational infinitude (Halpern 2014), open science instead places all knowledges on an equal, accelerated plane, connecting a vast network of decentralized nodes and conduits. For many open science workers at the center, the idea of building discipline-neutral, expansive and generalized research tools was a significant part of the personal appeal to working at the center. If open science is *for* one particular world over others, it is one full of information. While replication is configured as a mechanism for exposing the “differences that make a difference” in an experiment (Bateson 2000), resource-strain in contemporary, corporate research cultures (Mirowski 2011; Harney and Moten 2013) create an environment in which it’s unlikely that independent replication can ever really “scale” to adequately meet the demands of higher data throughput. In the opened frontiers of knowledges, how do we ever sort the wheat from the chaff?

Conclusion

All sorts of mantras and buzzwords circulate through the hermetically sealed, often bloated atmospheres of tech bubbles. At the center, some buzzwords stood out more than others, weightier and more significant. The anticipatory promises of *scaling* and *surfacing*, of achieving *modularity* and of “connecting” researchers to a wider *research lifecycle* can reflect, on the one hand, what commentators immersed in the impulsively disruptive cultures of Silicon Valley describe as cynical marketing strategies (Wiener 2020), particular kinds of technosocial conjuring tricks designed to give lift to a vague and ethereal *economy of appearances* (Tsing 2005). On the other hand, they also potentially reflect the *recursive* attempt to simultaneously and in real-time comprehend, and *engineer* alternative publics and socialities (Kelty 2008). While appropriated to mystify and exploit, the semiotic economy of *tech* potentially also stands-in for an attempt to come to terms with an iteratively unfolding, indeterminate, and often dizzying imaginary of research and knowledge futures (Appadurai 2013).

Early in my 2016 fieldwork trip, when I asked him what he thought the future looked like for open science and for the center, Mitch told me how the founders often said that if “they were successful, they would eventually disappear.” Apart from this single meeting, I never heard the phrase again at the center. Later, I’d read that it had been used to describe the goal of other “open culture” movements (Kelty 2008, 256). According to Mitch, the idea that all that was now solid at the center would eventually melt into thin air, dissipate, and dissolve—on the counter-intuitive condition that everything had gone *right*—was one that had initially struck him as unnerving. This was another way of

saying that hopefully, over time, “open science would just become science,” a diffuse, collective, collaborative, and set of practices and infrastructures that weren’t able to be neatly confined to specific institutions and organizations. While open science workers were constantly busy building and iteratively maintaining (i.e. rebuilding with difference) specific tools which were designed to manage research workflows (OSF) and outputs (OSF ArXivs), the future of open science was, nonetheless contingent and indeterminate *by design*, unhemmed and detached from specific organizations. Openness is envisioned without a center, decentralized and diffuse.

‘The World Needs Open Science Now More Than Ever’

In the contemporary expressions of technoculture unfolding in the early twenty-first century in which many of us now reside, domains and events that surround the reproduction of daily life, from the spectacular to the mundane are increasingly fused through personal data-“sharing” and/or extraction platforms (Gillespie 2010; Srnicek 2017). Ambivalently, end-users simultaneously find alternative spaces of belonging and community (“platforms” for articulating meaningful connection and relationality), while increasingly finding themselves sources of surplus value, content “creators” and increasingly precarious “gig workers” in service of endless capital accumulation for the digital *nouveau riche* (Jarrett 2015; Wark 2019). From these platforms, the spirit of “disruption” extends, infusing into zones for reproducing life, as with the decimation of local affordable housing, displacing historically marginalized and racialized communities. Shouted through breathless tones, “disruption” obfuscates relations of exhaustion, invisibilizing contingent, flexible, precarious workers newly classified as

masters of their own “destiny,” “independent contractors” with the flexibility to “choose,” all in the imaginative and speculative fervor of “innovation.” Very often, these mechanisms of extraction are underwritten by fantastic and intoxicating promises of *community, belonging, and connection* articulated through a cynical repurposing of reciprocity and solidarity.

Open science emerges within the context of this cultural and political milieu, this affective and imaginative field of exhaustion and uncertainty. Open science forms a particular expression of attempting to come to terms with the hollowing-out and privatization of the public research university. To circumvent, rather than dismantle. At times, open science surfaces as an expression of neoliberal capital, a technocratic *post-politics* (Mouffe 2005; Tkacz 2016), a non-profit funded, incremental “tinkering” around the margins and symptoms of a systemic set of political and social problems that have infected and effectively eroded the reproductive foundations of research cultures (Mirowski 2018). After spending time with open science workers, befriending many of them, developing a partial and fragmentary sense of some of what they held most meaningful and significant in their working lives, understanding how labor became an extension of their desire to make a positive (if recognizably small) impact on a broken world, the stories of “fixing” science continued to grow increasingly complex.

Open science is *multiple*, variegated and variable, iterative and indeterminate. “Fixing” science, I argue signifies a social movement organized around creating a modular, scalable, and clearly articulated (i.e. fixed) imaginary centered around making research reproducible, while also creating social infrastructures designed to *repair* the

sociality of experiments. “Fixing science” is therefore ambivalent, encompassing both, the reinvigoration of a staid view of rationalized and ordered, predictable and linear knowledge production for the accelerated era of the digital platform, while also signifying emergent imaginaries of experimentation and research as practices rendered valuable for their processes and relationships, rather than for their products; I find this view of research and experimentation much more in line with valuing practices of maintenance over innovation (Jackson 2014; Russell and Vinsel 2018). Such visions of science, of valuing practices of care and scrupulousness (de la Bellacasa 2017, Fortun and Fortun 2005) align much more closely with feminist visions and attention toward the relationships that bind experiments and research together, and that compose alternative means of living, thriving, and flourishing together. Opening science is therefore simultaneously fragmentary and fragmenting. Despite the supposed, hegemonic fixity of open science discourses, I suggest that open sciences are multiple, saturated with political indeterminacy and potential.

Open sciences therefore represent more than just the disruption or implosion of the conventional social orders that demarcate legitimate mechanisms for data storage and sharing; open sciences also (once-again) re-orient and reconfigure scientific objectivity in significant ways, articulating alternative, “platformized” modes of experimental seeing and doing. The emergence of *platformized*, participatory modes of experimental seeing and doing represent deeply aspirational, techno-utopian visions of research practices and reciprocity. Open science workers often spoke of the hope that such platforms might help to lift marginalized voices in the scientific community (e.g. those most often precariously

positioned in research hierarchies according to sex, race, gender, and nationality). Open science platforms become infused with many of the same speculative political aspirations and semiotic multiplicity as “platforms” found in the contemporary digital economy; to participate in software, “social media platforms” is (ostensibly) to avail oneself of a powerful “cultural platform” (i.e. a relatively frictionless, and accessible mode of amplified speech for both, the powerful and subaltern, for the influential and for those historically pushed to the margins) (Gillespie 2010). Dreams and visions of flattened networks and dissolved hierarchies materialize through an ostensibly value-neutral, infinitely modular, *connectionist politics* (Turner 2017).

As with social media platforms, open knowledge platforms engineered to create more diffuse, participatory, and seamless research data-sharing practices act in the world with unintended, potentially toxic downstream consequences. Despite claims to neutrality, open knowledge platforms are deeply ambivalent infrastructures, powerfully configuring and reshaping the aesthetic, sensorial, and political grounds of experimentation (Larkin 2013). I suggest in particular that open knowledge infrastructures ought to be explored in the context of a contemporary, trans-local implosion of (neo)Liberal political hegemony (Boyer 2016). How is open science configured as a project of social infrastructural *repair*, involving urgent practices of cultural re-engineering? In the course of these repair practices, how might the configuration of open knowledge platforms as radically “modular” (i.e. elements of practice and design oriented around the idea of circumventing mechanisms of peer-review seen as inefficient and attenuative to the flow of data and to

the acceleration of discovery) create opportunities and entry-points for reactionary (i.e. nativist, racist, and sexist) “research” products?

While part of the allure and aspirational imaginary of open knowledge infrastructures, the disruption and flattening of social research workflows *also* potentially renders increasingly murky the discursive efficacy of the categories conventionally relied upon to delineate between legitimate and “pseudo” sciences. Open knowledge infrastructures increasingly call into doubt the naturalized, often fetishized assurance in academic social sciences that configurations of scientific “fact” and “fiction” are timeless, stable, and teleologically destined to defeat reactionary “folk” sciences (Hartigan 2008; Panofsky and Donovan 2019). Like with social media (Massanari 2017), might the hope that reactionary “junk” science will be canceled out and overshadowed by the due diligence of scientific replicators/fact-finders, seamlessly and rapidly sharing their findings in the “free marketplace of ideas” be quickly exhausted in the accelerated, high bandwidth conduits of participatory, effectively infinitely “open” knowledge production?

I haven’t tried to argue for any sort of return to a status quo, where researchers are dependent upon exploitative and extractive relationships with journal publishers, but to push back against the idea that “openness” and “(en)closure” are binary choices. Attending to the social lives of open knowledge infrastructures (Edwards 2010) means attempting to anticipate as much as possible their situation within specific contexts and histories, dense sets of relationships which enable particular and indeterminate forms of distributed political agency, forms which may even depart from their (however well) intended design. As I write these words, large crowds of mostly white protestors are once

again gathering throughout the U.S., this time to protest shelter-in-place and self-isolation pleas from state public health officials, which were issued to protect healthcare workers and vulnerable populations. For a brief moment, as social media feeds flooded with posts urging support for healthcare, grocery, delivery, and food workers, it had seemed as though this crisis might give birth to a renewed sense of solidarity, and perhaps something like class consciousness, or a mutual understanding of precarious circumstances and collective, collaborative agency and power.

Solidarity is the heart that beats throughout this work. It's my sincere belief that research and experimentation depend upon a deep and shared appreciation for collaborative webs of cause/effect. It was what felt like solidarity, not "the tech" that drew me to the center in the first place. Meeting with developers, metascientists, and marketers, I quickly became enchanted with their devotion to discovery and wonder, to each other, and to their certainty in the power of collaboration. If I strike a pessimistic tone throughout this work, it's not because I ever felt that open science workers are/were naïve. On the contrary, I hope to have shown that their conception of open science is instead very often deeply complex and attentive. My sense of pessimism instead arises two-fold: from my brief time in the professional, managerial, and entrepreneurial spaces of the contemporary university—a set of institutions that collectively work to suppress and stifle meaningful "study" (Harney and Moten 2013)—and from what only looks like a further erosion of solidarity and the commons with the proliferation of "open" channels of communication. It's worth keeping in mind that the online message boards and chat rooms where many of the "anti-quarantine" protests are being coordinated are likely to

also be flooded with deliberately and unintentionally misleading pseudo- and quasi-scientific objects and (mis/dis)information regarding Covid-19.

Throughout this work, I refer to open science without the use of capital letters, without explaining why. I tried to underscore how (open) science discourses, configurations of power and knowledge constructed around knowing, experimentation, and understanding extend *beyond* particular institutions and organizations. Anthropology draws attention the ways in which our bodies and selves extend beyond the limits of our skin, surfacing the multiple scales and relationships in which we're nested, for better or worse. Despite effervescent, optimistic, and at times explicitly "utopian" visions and imaginaries, it's worth considering the effects of more seamless, accelerated, and modular flows of scientific research and information in specific and situated political contexts.

In contemporary North American research cultures, where the externalities of late industrial capitalism continue to erode any remaining potential for social solidarity and care at precisely the moments when they're needed most, isn't it worth considering how more "seamlessness" and "acceleration" between "connections" come to reconfigure research cultures? What are the ethical and political obligations of moderation and content curation in an ostensibly increasingly decentralized and diffuse set of articulations amongst multiple knowledge infrastructures? As it becomes clearer that wild, free flows of data and information really never moderate themselves, can we envision communal strategies of maintenance, of moderation and curation built on a foundation of creative solidarity and wonder, which are simultaneously durable and

sustainable, able to root out toxic (dis/mis)information, without resorting to extraction and exploitation? I hope that I've been able to demonstrate how glossy, future-oriented narratives of hope and aspiration for increasingly innovative and disruptive platforms and tools to somehow automate the processes of research maintenance is likely to be short-lived if they continue to remain decoupled from the material and embodied conditions and circumstances under which researchers and research-support teams increasingly labor. Opening science is just as much a matter of dismantling and reconfiguring systems which have foreclosed on the lived circumstances of research cultures as it is a matter of data and information.

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